SCHEME & SYLLABUS

B.Tech, Mechanical Engineering

(For Batch 2025 ONWARDS)

Choice Based Credit System

Department of Mechanical Engineering

University Institute of Engineering and Technology

Sant Baba Bhag Singh University

ABOUT

Mechanical Engineering department at SBBSU offers a B.Tech programme in Mechanical Engineering and M.Tech programme in Production Engineering (both UGC Accredited). Right from its inception in 2015, the department has been focusing on high-quality teaching along with integrated Laboratory experience. Its strong and interactive curriculum and hands-on learning will make the students capable of taking their career to the next level, whether in the professional engineering practice or in advanced studies. The Discipline of Mechanical Engineering effectively connects teaching of engineering education to active research in different areas. The department has the most modern infrastructure to support high-end teaching, research, and developmental activities in its laboratories.

The aim of Mechanical Engineering Department is to provide the students with a perfect blend of intellectual and practical experiences that helps them to serve the society and address a variety of needs. With a solid grounding in the principles and practice of mechanical engineering, the undergraduates will be ready to engage in ethical approaches to engineering, with concern for society and the environment. The program at the postgraduate level aligns academic course work with research, to prepare students in specialized areas within the field of Production engineering.

SALIENT FEATURES

1. Provides a learning environment strongly focused on collaborative and interdisciplinary research under the guidance of experienced and qualified faculty.
2. Provides 24 hours High speed Internet facility with Wi-Fi Connectivity.
3. The department provides Digital Library with access to Journals and Video lectures of Eminent Professors.
4. The department regularly organizes Conferences, Seminars, Student Symposia, Short-Term Training Program, Value Added Courses and frequent Industrial Visits to Industry for Practical Exposure and Technical Awareness.
5. The department has signed MOU with IIT Delhi, to provide remote access to Virtual Labs and has established Student Chapter of Computer Society of India.

VISION

The Mechanical Engineering Department endeavours to be recognized globally for outstanding education and research leading to well qualified engineers, who are innovative, entrepreneurial, and successful in advanced fields of Mechanical Engineering to cater the ever-changing industrial demands and social needs.

MISSION

To impart highest quality education, to build students capability and enhance their skills to make them globally competitive Mechanical Engineers.

To provide the students with academic environment of excellence, leadership, ethical guidelines and lifelong learning needed for a long productive career.

ELIGIBILITY CRITERIA

1. 10+2 with Physics & Mathematics with Chem / Comp.Sc / Bio / Biotechnology conducted by a recognized Board/ University/Council.
2. Diploma in Engineering & Tech. from AICTE Approved Institutions or B.Sc. (N.M) from UGC approved University at least 45% marks. (For Lateral Entry)

DURATION

1. The duration of B.Tech Mechanical Engineering for Regular students (for students after 12^{th} class) is 4 Years.
2. The duration of B.Tech, Mechanical Engineering for LEET students is 3 years
3. The duration of M.Tech Regular is 2 years

MINOR DEGREE DETAILS

A Minor Degree in Artificial Intelligence and Machine Learning shall be awarded to B.Tech. Mechanical Engineering students upon successful completion of an additional 18 credits of prescribed coursework.

PROGRAMME OUTCOMES (PO)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and teamwork: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: To be well familiar with the concepts of Mechanical Engineering for leading a successful career in industry or as entrepreneur or to pursue higher education.
PEO2: To develop techno-commercial skills for providing effective solutions to complex problems using domain knowledge of Mechanical Engineering.
PEO3: To instill lifelong learning approach towards constantly evolving technologies with innovative and ethical mindset.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO1: Analyze, design, evaluate and provide solutions to the real-life mechanical engineering problems.
PSO2: Design and evaluate thermal systems including IC engines, refrigeration, air conditioning, and power generating systems.
PSO3: Engage in Planning, including methods design, process plan, process automation, and quality assurance systems to ensure optimization in manufacturing.

ABOUT THE CHOICE BASED CREDIT SYSTEM (CBCS)

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill-based courses. The courses can be evaluated following

the grading system, which is considered to be better than the conventional marks system. The basic idea is to look into the needs of the students so as to keep up to date with development of higher education in India and abroad. CBCS aims to redefine the curriculum keeping pace with the liberalization and globalization in education. CBCS allows students an easy mode of mobility to various educational institutions spread across the world along with the facility of transfer of credits earned by students.

NOMENCLATURE: Following Table shows the abbreviation (Course codes) used for different course types.

Course code	Definitions
BS	Basic Science Courses
ES	Engineering Science Courses
HS	Humanities and Social Sciences including Management courses
PC	Professional core courses
PE	Professional Elective courses
OE	Open Elective courses
MC	Mandatory courses

COURSE CURRICULUM SCHEME FORMAT

S. No.	Course Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours

SYLLABUS FORMAT

Course Code	
Course Title	
Type of Course	
L T P	
Credits	
Course Prerequisite	
Course Objective (CO)	
Course Outcomes	

SYLLABUS

REFERENCE BOOKS

COURSE SCHEME

SEMESTER I

I. Theory Subjects

S.No.	Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	BS	CHM105	Engineering Chemistry	3:1:0	3:1:0	4	4
2	BS	MAT172	Engineering Mathematics-II	4:0:0	4:0:0	4	4
3	ES	ME101	Engineering Graphics and Design	2:0:4	2:0:2	6	4
4	ES	EE102	Basic Electrical Engineering	3:0:0	3:0:0	3	3
5	MC	MDC023	*Indian Knowledge System*	3:0:0	3:0:0	3	3

II. Practical Subjects

S.No.	Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	BS	CHM107	Engineering Chemistry Practical	0:0:2	0:0:1	2	1
2	ES	*EE104	Basic Electrical Engineering Laboratory	0:0:2	0:0:1	2	1
3	EMC	EMC112	Entrepreneurship Mindset & Curriculum-II	0:0:4	0:0:2	4	2
4	PT	*PT102/PT104/ PT106	Physical Training-II (NSO/NCC/NSS)	0:0:2	NC	2	NC

+Note: Four weeks Institutional/Industrial Internship in campus/industry after 2nd semester and its evaluation in 3rd semester

TotaTotal Contact Hours= 30

Total Credits Hours= 22

SEMESTER II

I. Theory Subjects

S.No.	Type	Subject Code	Subject Name	Contact Hours(L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	ES	CSE111	Introduction to programming in C	3:0:0	3:0:0	3	3
2	BS	MAT171	Engineering Mathematics-I	4:0:0	4:0:0	4	4
3	AEC-1/ HS	AEC0010	Communication Skills-I	2:0:0	2:0:0	2	2
4	BS	*PHY115	Engineering Physics	4:0:0	4:0:0	4	4
5	MC	EVS002	Environmental Sciences	3:0:0	NC	3	NC

II. Practical Subjects

S.No.	Type	Subject Code	Subject Name	Contact Hours(L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	ES	CSE113	Programming in C Practical	0:0:2	0:0:1	2	1
2	ES/SEC- I	ME105	Workshop/Manufacturing Practices Practical	0:0:6	0:0:3	6	3
3	BS	*PHY107	Engineering Physics Practical	0:0:2	0:0:1	2	1
4	EMC	EMC111	Entrepreneurship Mindset & Curriculum-I	0:0:4	0:0:2	4	2
5	PT	*PT101/PT103 /PT105	Physical Training-I (Sports and Yoga/NCC/NSS)	0:0:2	NC	2	NC

Total Contact Hours=32

Total Credit Hours=20

SEMESTER III

I. Theory Subjects

S. No.	Course Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	PC	ME201	Kinematics of Machines -I	3:1:0	3:1:0	4	4
2	ES	EE001	Basic Electronics Engineering	3:0:0	3:0:0	3	3
3	PC	ME203	Strength of Materials -I	3:1:0	3:1:0	4	4
4	PC	ME205	Basic Thermodynamics	3:1:0	3:1:0	4	4
5	PC	ME207	Machine Drawing	3:0:0	3:0:0	3	3

II. Practical Subjects

S. No	Course Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	PC	ME209	Kinematics of Machines Laboratory	0:0:2	0:0:1	2	1
2	PC	ME211	Strength of Materials Laboratory	0:0:2	0:0:1	2	1
3	PC	ME213	Computer Aided Machine Drawing Lab	0:0:2	0:0:1	2	1
4		PT201/ PT203/ PT205	Physical Training-III (NSO/NCC/NSS)	0:0:2	NC	2	NC
5		EMC201	Entrepreneurship Mindset Curriculum-III	0:0:4	0:0:2	4	2

Total Contact Hours: 30

Total Credit Hours: 23

SEMESTER IV

I. Theory Subjects

S. No.	Course Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	PC	ME202	Kinematics of Machines - II	3:1:0	3:1:0	4	4
2	PC	ME204	Strength of Materials -II	3:1:0	3:1:0	4	4
3	ES	ME206	Manufacturing Processes	3:0:0	3:0:0	3	3
4	PC	ME208	Applied Thermodynamics	3:1:0	3:1:0	4	4
5	PC	ME210	Materials Engineering	3:0:0	3:0:0	3	3
6	HS	SSC007	Universal Human Values: Understanding Harmony	3:0:0	3:0:0	3	3
7	MC	EVS002	Environmental Sciences	3:0:0	NC	3	NC

S. No	Course Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	ES	ME212	Manufacturing Processes Laboratory	0:0:2	0:0:1	2	1
2	PC	ME214	Applied Thermodynamics Laboratory	0:0:2	0:0:1	2	1
3	PC	ME216	Materials Engineering Laboratory	0:0:2	0:0:1	2	1
4		PT202/ PT204/ PT206	Physical Training-IV (NSO/NCC/NSS)	0:0:2	NC	2	NC
5		EMC202	Entrepreneurship Mindset Curriculum-IV	0:0:4	0:0:2	4	2

After 4th semester, the student will opt for 4 week, which will be evaluated in 5th semester.

Total Contact Hours: 36

Total credit Hours: 26

SEMESTER V

I. Theory Subjects

S. No.	Course Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	PC	ME301	Heat Transfer	3:1:0	3:1:0	4	4
2	PC	ME303	Fluid Mechanics & Machines	3:1:0	3:1:0	4	4
3	OE-1	SSC006	Human Values and Professional Ethics	3:0:0	3:0:0	3	3
4	MC	LAW005	Constitution of India		NC	3	NC
5	Minor Degree	MAI301	Introduction to AI and Machine Learning	3:0:0	3:0:0	3	3
6	Minor Degree	MAI303	Introduction to Data Analytics	3:0:0	3:0:0	3	3

II. Practical Subject

S. No	Course Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	PC	ME305	Heat Transfer Lab	0:0:2	0:0:1	2	1
2	PC	ME307	Fluid Mechanics and Machines Lab	0:0:2	0:0:1	2	1
3	Training	ME309	4-Week Industrial Training				3
4	Minor Degree	MAI305	Introduction to AI and Machine Learning Lab	0:0:2	0:0:1	2	1
5	Minor Degree	MAI307	Introduction to Data Analytics Lab	0:0:2	0:0:1	2	1
6	MC	PT301/ PT303/ PT305	Physical Training—V (NSO/NCC/NSS)	0:0:2	NC	2	NC
7		EMC301	Entrepreneurship Mindset Curriculum-V	0:0:4	0:0:2	4	2

Total Contact Hours: 34

Total Credit Hours : 26

SEMESTER VI

I. Theory Subjects

S. No.	Course Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	PC	ME302	Design of Machine Elements	3:1:0	3:1:0	4	4
2	PC	ME306	Mechanical Measurements and Metrology	3:0:0	3:0:0	3	3
3	PC	ME308	Automobile Engineering	3:0:0	3:0:0	3	3
4	PE		Professional Elective I	3:0:0	3:0:0	3	3
5	OE-II	SSC008	Gender Culture and Development	3:0:0	3:0:0	3	3
6	Minor Degree	MAI302	Deep Learning and Neural Network	3:0:0	3:0:0	3	3

II. Practical Subjects

S. No	Course Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	PC	ME310	Mechanical Measurements and Metrology Lab	0:0:2	0:0:1	2	1
2	PC	ME312	Automobile Engineering Lab	0:0:2	0:0:1	2	1
3	Minor Degree	MAI304	Deep Learning and Neural Network Lab	0:0:2	0:0:1	2	1
4	MC	PT302/ PT304/ PT306	Physical Training-VI (NSO/NCC/NSS)	0:0:2	NC	2	NC
5		EMC302	Entrepreneurship Mindset Curriculum-VI	0:0:4	0:0:2	4	2

Professional Elective-I

S No.	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	ME316	Industrial Automation and Robotics	3:0:0	3:0:0	3	3
2	ME318	Composite Materials	3:0:0	3:0:0	3	3
3	ME320	Computer Aided Design	3:0:0	3:0:0	3	3

Total Contact Hours:31

Total Credit Hours: 24

SEMESTER VII

I. Theory Subjects

S. No.	Course Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	PC	ME401	Mechanical Vibrations	3:1:0	3:1:0	4	4
2	PC	ME403	Refrigeration and Air Conditioning	3:1:0	3:1:0	4	4
3	PE		Professional Elective-II	3:0:0	3:0:0	3	3
4	PE		Professional Elective-III	3:0:0	3:0:0	3	3
5	OE-III		Open Elective- III	3:0:0	3:0:0	3	3
6	Minor Degree	MAI401	Special topics in Artificial Intelligence	3:0:0	3:0:0	3	3
7	Minor Degree	MAI403	Applications of AI	3:0:0	3:0:0	3	3

II. Practical Subjects

S. No	Course Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	PC	ME405	Refrigeration and Air Conditioning Laboratory	0:0:2	0:0:1	2	1
1	Project	ME407	Major Project	0:0:8	0:0:4	8	4

Professional Elective-II

S No.	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	ME409	Additive Manufacturing	3:0:0	3:0:0	3	3
2	ME411	Finite Element Analysis	3:0:0	3:0:0	3	3
3	ME413	Industrial Safety Engineering	3:0:0	3:0:0	3	3

Professional Elective-III

S No.	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	ME415	Renewable Energy Engineering	3:0:0	3:0:0	3	3
2	ME417	Mechatronic Systems	3:0:0	3:0:0	3	3
3	ME419	Power Plant Engineering	3:0:0	3:0:0	3	3

Total Contact Hours: 33

Total credit Hours: 28

SEMESTER VIII

I. Practical Subjects

S. No	Course Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	Training	ME402	6-Month Industrial Training				20

Total credit Hours: 20

List of Open Electives offered by Mechanical Engineering

S. No	Code	Course Title	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours	Semester
1	ME371	Total Quality Management	3:0:0	3:0:0	3	3	5th
2	ME372	Environmental Pollution and	3:0:0	3:0:0	3	3	6th
3	ME373	Industrial Engineering Management	3:0:0	3:0:0	3	3	5th
4	ME374	Management Information System	3:0:0	3:0:0	3	3	6th
5	ME375	Material Management	3:0:0	3:0:0	3	3	5th
6	ME376	Maintenance and Reliability Engineering	3:0:0	3:0:0	3	3	6th
7	ME471	Operations Management	3:0:0	3:0:0	3	3	7th
8	ME472	Industrial Safety and Environment	3:0:0	3:0:0	3	3	8th
9	ME473	Production Planning and Control	3:0:0	3:0:0	3	3	7th
10	ME474	Group Technology and Flexible	3:0:0	3:0:0	3	3	8th
11	ME475	Smart Materials and Devices	3:0:0	3:0:0	3	3	7th
12	ME476	Work Study and Ergonomics Engineering	3:0:0	3:0:0	3	3	8th

COURSE SCHEME SUMMARY

Sem.	L	T	P	Contact hrs/wk	Credits	HS	BS	ES	PC	PE	OE	Project/ Training	MC	Minor Degree
1	15	1	14	30	22	0	9	8	-	-	-	-	-	
2	16	0	16	32	20	2	9	4	-	-	-	-	-	
3	15	3	12	30	23	0	0	3	18	-	-	-	-	
4	21	3	12	36	26	3	-	4	17	-	-	-	-	
5	18	2	14	34	26	-	-	-	10	0	3	3	-	8
6	18	1	12	31	24	-	-	-	12	3	3	0	-	4
7	21	0	10	31	26	-	-	-	7	6	3	4	-	6
8					20	-	-	-	-			20	-	
Total	**124**	**10**	**90**	**224**	**187**	**5**	**18**	**19**	**64**	**9**	**9**	**27**	**0**	**18**

DETAILED SYLLABUS

Course Code	**CHM105**
Course Title	Engineering Chemistry
Type of Course	BS
L T P	3 1 0
Credits	4
Course Prerequisite	NA
Course Objective (CO)	To relate the students to the basic concepts of chemistry that underpin engineering practice, and to develop, through newly introduced topics, the attitudes and analytical skills required to cope with new technological developments.
Course Outcomes	**The course will enable the student to:** 1. CO1: Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces. Rationalize bulk properties and processes using thermodynamic considerations. 2. CO2: Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques 3. CO3: Rationalize periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity. 4. CO4: List major chemical reactions that are used in the synthesis of molecules.

SYLLABUS

UNIT-I

Atomic and molecular structure Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multi center orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

UNIT-II

Spectroscopic techniques and applications: Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational

spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques. Diffraction and scattering.

Intermolecular forces and potential energy surfaces:

Ionic, dipolar and van DerWaals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H_3,H_2F and HCN and trajectories on these surfaces.

UNIT-III

Use of free energy in chemical equilibria: Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

Periodic properties: Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

UNIT-IV

Stereochemistry Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

Organic reactions and synthesis of a drug molecule: Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

REFERENCE BOOKS

S. No	Name	Author(s)	Publisher
1.	Engineering chemistry	J.C. Curiacose and J.Raja Ram	Tata Mcgraw-Hill Co. New Delhi.
2	Inorganic Chemistry,	Gary L. Miessler, Paul J. Fischer and Donald A. Tarr, (2013).	Pearson
3	Introduction to spectroscopy. (2008).	Pavia, D. L., Lampman, G. M., Kriz, G. S., and Vyvyan, J. A.	Cengage Learning.
4	Principles of Organic Synthesis	Norman and Coxon	*CRC Press*

Course Code	**MAT172**
Course Title	**Engineering Mathematics-II**
Type of Course	BS
L T P	4 0 0
Credits	4
Course Prerequisite	+2 with Non-Medical, B.Tech. Ist semester
Course Objective (CO)	The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.
Course Outcomes	**By the end of the course, students will be able to:** CO1 comprehend the mathematical tools needed in evaluating multiple integrals and their usage. CO2 use mathematical tools for the solutions of differential equations that model physical processes. CO3 practice the tools of differentiation and integration of functions of a complex variable that are used in various techniques, dealing engineering problems.

SYLLABUS

UNIT I

Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal. curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

UNIT II

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for 'p', equations solvable for 'y', equations solvable for 'x' and Clairaut's type. Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy-Euler equation.

UNIT III

Complex Variable – Differentiation**:** 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.

UNIT IV

Complex Variable – Integration: 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.

REFERENCE BOOKS

S. No.	Name	Author(s)	Publisher
1	Higher Engineering Mathematics	Grewal, B.S.	Khanna Publishers, Delhi.
2	Advanced Engineering Mathematics	Jain, R.K and Iyengar	Narosa Publishing Company
3	Advanced Engineering Mathematics (Fifth Edition)	Erwin Kreyszig	John Wiley – 1999
4	A textbook of Engineering Mathematics	N.P. Bali and Manish Goyal	Laxmi Publications (Reprint 2010)

Course Code	**ME101**
Course Title	**Engineering Graphics and Design**
Type of Course	ES
L T P	2 0 4
Credits	4
Course Prerequisite	
Course Objective (CO)	To prepare you 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 to prepare you to communicate effectively to prepare you to use the techniques, skills, and modern engineering tools necessary for engineering practice
Course Outcomes	The student will learn : 1. CO1: Introduction to engineering design and its place in society and engineering communication 2. CO2: Exposure to the visual aspects and engineering graphics of engineering design standard 3. CO3: Exposure to solid modelling 4. CO4: Exposure to computer-aided geometric design and creating working drawings

SYLLABUS

UNIT-I

Introduction to Engineering Drawing

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid, and Involute; Scales – Plain, Diagonal and Vernier Scales.

Orthographic Projections

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes.

UNIT-II

Projections of Regular Solids

Inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

Sections and Sectional Views of Right Angular Solids Covering

Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

UNIT-III

Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.

Overview of Computer Graphics: Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software, conventional and Auto-Desk Fusion 360. The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

UNIT-IV

Customisation & CAD Drawing

Consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

Annotations, layering & other Functions

Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques;dimensioning and scale multi views of dwelling. Hands-on-Practice of above Drawings in softwares such as AutoCad and AutoDesk Fusion 360.

REFERENCE BOOKS:

S. No	Name	Author(s)	Publisher
1.	Engineering Drawing	Bhatt N.D., Panchal V.M. & Ingle P.R., (2014)	Charotar Publishing House
2.	Engineering Drawing and Computer Graphics	Shah, M.B. & Rana B.C. (2008)	PearsonEducation
3.	Engineering Graphics	Agrawal B. & Agrawal C. M. (2012)	TMH Publication
4.	Textbook on Engineering Drawing	Narayana, K.L. & P Kannaiah (2008)	Scitech Publishers

Course Code	**EE102**
Course Title	**Basic Electrical Engineering**
Type of Course	ES
L T P	3 0 0
Credits	3
Course Prerequisite	
Course Objective (CO)	understand and analyse basic electric and magnetic circuits; to dy the working principles of electrical machines and power nverters; and to introduce the components of low-voltage ctrical installations.
Course Outcomes	completion of this course the student will be able to:)1: Analyse simple DC and AC electric and magnetic circuits ng network theorems and phasor methods.)2: Explain the construction, working principle and characteristics transformers, DC machines and induction motors.)3: Describe the operation of basic power electronic converters l their applications.)4: Identify the components of a low-voltage electrical installation l select appropriate protection and earthing arrangements.

SYLLABUS

UNIT I: DC Circuits

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first order RL and RC circuits.

UNIT II: AC Circuits and Transformers

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three- phase balanced circuits, voltage and current relations in star and delta connections. Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

UNIT III: Electrical Machines and Power Converters

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators. DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

UNIT IV: Electrical Installations

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

REFERENCE BOOKS

Sr. No.	Name	Author	Publisher
1	Basic Electrical Engineering	D. P. Kothari and I. J. Nagrath	Tata Mcgraw Hill.
2	Basic Electrical Engineering	D. C. Kulshreshtha	McGraw Hill, 2009.
3	Electrical and Electronics Technology	L. S. Bobrow	Pearson, 2010.
4	Electrical Engineering Fundamentals	V. D. Toro	Satya Prakashan, Delhi

Course Code	**CHM107**
Course Title	**Engineering Chemistry Practical**
Type of Course	BS
L T P	0 0 2
Credits	1
Course Prerequisite	NA
Course Objective (CO)	The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering.
Course Outcomes	**The students will learn to:** CO1: Estimate rate constants of reactions from concentration of reactants/Products as a function of time CO2: Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc. CO3: Synthesize a small drug molecule and analyse a salt sample

SYLLABUS

1. Determination of surface tension and viscosity of liquids.
2. Determination of viscosity of oil by means of Red Wood Viscometer.
3. Thin layer chromatography: Determination of Rf value of a mixture by TLC.
4. Separation of methyl orange and phenolphthalein from given mixture by paper chromatography
5. Ion exchange column for removal of hardness of water/Determination of total hardness of water by EDTA method.
6. Determination of Total Residual Chlorine in water sample.
7. Colligative properties using freezing point depression
8. Determination of the rate constant of a reaction
9. Determination of cell constant and conductance of solutions
10. Potentiometry-determination of redox potentials and emfs:
11. Determine the strength of a solution pH metrically.
12. Synthesis of a polymer/drug: Preparation of Urea Formaldehyde Resin;
13. Synthesis of paracetamol
14. To bring catalysed condensation or to prepare a pure sample of dibenzalpropane
15. Saponification/acid value of an oil
16. Chemical analysis of a salt
17. Lattice structures and packing of spheres
18. Models of potential energy surfaces
19. Chemical oscillations-Iodine clock reaction
20. Determination of the partition coefficient to of a substance between two immiscible liquids
21. Adsorption of acetic acid by charcoal
22. Use of the capillary viscosity meters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gel at in sols and/or coagulation of the white part of egg.

REFERENCE BOOKS

S. No	Name	Author(S)	Publisher
1	Vogel's Qualitative Inorganic Analysis (7th Edition).	G Svehla	Prentice Hall
2	Laboratory Manual in Organic Chemistry	R.K. Bansal,	Wiley Eastern
3	Advanced Experimental Chemistry. Vol. I	Physical, J.N. Gurtu and R. Kapoor	S. Chand & CO.
4	Vogel's Qualitative Inorganic Analysis	Svehla	Orient Longman
5	Vogel's Textbook of Quantitative Inorganic Analysis (revised),	J. Basseff, R.C. Dennery, G.H. Jeffery	ELBS

Course Code	**EE104**
Course Title	**Basic Electrical Engineering Laboratory**
Type of Course	ES
L T P	0 0 2
Credits	1
Course Prerequisite	Basics Of Electrical Engineering
Course Objective (CO)	To familiarise students with AC and DC circuits, transformers, electrical machines and electrical measuring instruments through laboratory experimentation.
Course Outcomes	On completion of this course the student will be able to: CO1: Use common electrical measuring instruments to measure voltage, current, power and power factor. CO2: Verify network theorems and circuit laws experimentally on DC and AC circuits. CO3: Determine the performance characteristics of transformers and electrical machines from test data. CO4: Record observations systematically and interpret experimental results in a laboratory report.

SYLLABUS

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter,ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuitsto a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
3. Transformers: Observation of the no-load current waveform on an oscilloscope (non- sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
4. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
5. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement),

induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.

6. Torque Speed Characteristic of separately excited dc motor.
7. Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super- synchronous speed.
8. Synchronous Machine operating as a generator: stand-alone operation with a load.Control of voltage through field excitation.
9. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) theuse of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

Course Code	**CSE111**
Course Title	**Introduction to Programming in C**
Type of Course	ES
L T P	3 0 0
Credits	3
Course Prerequisite	Basics of computer and knowledge of any high-level language
Course Objective (CO)	To familiarize the students of all branches in engineering with computer organization, operating systems, problem solving and programming in C++.
Course Outcomes	The student will learn to- CO1: To formulate simple algorithms for arithmetic and logical problems. CO2: To translate the algorithms to programs (in C language). CO3: To test and execute the programs and correct syntax and logical errors. CO4: To implement conditional branching, iteration and recursion. CO5: To decompose a problem into functions and synthesize a complete program using divide andconquer approach. CO6: To use arrays, pointers and structures to formulate algorithms and programs. CO7: To apply programming to solve matrix addition and multiplication problems and searchingand sorting problems. CO8: To apply programming to solve simple numerical method problems, namely rot finding offunction, differentiation of function and simple integration.

SYLLABUS

UNIT-I: 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

UNIT-II : Arithmetic expressions and precedence

Conditional Branching and Loops: Writing and evaluation of conditionals and consequent branching

Iteration and loops, Arrays: Arrays (1-D, 2-D), Character arrays and Strings

Basic Algorithms: Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding

roots of equations,notion of order of complexity through example programs (no formal definition required)

UNIT-III: Function and Recursion

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference

Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

UNIT-IV: Structure and Pointers

Structures, Defining structures and Array of Structures

Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

File handling (can be done in lab)

REFERENCE BOOKS:

S. No	Name	Author(s)	Publisher
1.	Schaum's Outline of Programming with C	Byron Gottfried	McGraw-Hill
2.	Programming in ANSI C	E. Balaguruswamy	Tata McGraw-Hill

Course Code	**MAT171**
Course Title	**Engineering Mathematics-I**
Type of Course	BS
L T P	4 0 0
Credits	4
Course Prerequisite	Maths Grade 12
Course Objective	The course aims to equip the students with standard concepts and tools of mathematics at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they
Course Outcomes	**By the end of the course, students will be able to:** CO1 understand the essential tool of matrices and linear algebra in a comprehensive manner. CO2 to deal with functions of several variables that are essential in most branches of engineering. CO3 comprehend tool of power series and Fourier series for learning advanced Engineering Mathematics. CO4 appreciate the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems. CO5 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.

SYLLABUS

UNIT-I

Algebra of matrices, inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms.

UNIT-II

Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.UNIT-III

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

UNIT-IV

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. Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L' Hospital's rule; Maxima and minima.

REFERENCE BOOKS:

S. No	Name	Author(S)	Publisher
1	Higher Engineering Mathematics	Dr. B.S. Grewal	Khanna Publishers
2	Fourier Series and Boundary Values Problems	Churchill	McGraw Hill.
3	Complex Variables & Applications	Churchill	McGraw Hill.
4	Advanced Engineering Mathematics (6th edition,1995)	Wylie and Barren	Mcgrawhill,
5	Advanced Engineering Mathematics (10th Edition)	Erwin Kreyszig	Wiley,

Course Code	**AEC0010**
Course Title	**Communication Skills-I**
Type of Course	AEC-1 / HS
L T P	2 0 0
Credits	2
Course Prerequisite	NA
Course Objective (CO)	The objective of this course is to: 1. Assist the students to acquire proficiency, both in spoken and written language. 2. To develop comprehension, improve writing skills, and enhance skills in spoken English.
Course Outcomes	On completion of this course the student will be able to: CO1: Read and comprehend passages and summarise, paraphrase and interpret written content. CO2: Write grammatically correct paragraphs, précis, letters and reports in a professional register. CO3: Speak fluently in presentations, group discussions and interviews using appropriate pronunciation and body language. CO4: Listen actively and respond appropriately in academic and workplace situations.

SYLLABUS

UNIT I

1. *Vocabulary Building:*

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

UNIT II

2. Basic Writing Skills

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

3. Identifying Common Errors in Writing

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

UNIT III

4. Nature and Style of sensible Writing

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion

5. Writing Practices

5.1 Comprehension
5.2 Précis Writing
5.3 Essay Writing

UNIT IV

6. Oral Communication

(This unit involves interactive practice sessions in Language Lab)

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

REFERENCE BOOKS

Author(s)	Title	Publisher
Bhupender Kour	Effectual CommunicationSkills	S.K. Kataria andSons
R. Datta Roy and K.K.Dheer	Communications Skills	Vishal PublishingCompany
The Essence of Effective Communication	Ludlow and Panthon	Prentice Hall ofIndia
Essentials of Business Communication	Pal and Rorualling	S. Chand and Sons.New Delhi

Course Code	**PHY115**
Course Title	**Engineering Physics**
Type of Course	BS
L T P	4 0 0
Credits	4
Course Objective (CO)	To build a strong foundation in the physical principles underlying engineering practice — mechanics and oscillations, wave and quantum optics, and solid-state physics — and to relate these principles to the working of practical optical and electronic devices.
Course Outcomes	**Students will able:** CO1: To get to know about fundamentals of physics. CO2: To gain basic knowledge of optics, mechanics, optics, wave optics, quantum mechanics; solid state physics and its applications. CO3: To understand the basics of optical devices. CO4: To gain knowledge in basic concepts of physics relevant to Engineering applications.

SYLLABUS

UNIT I

Forces in Nature: Newton's laws of motions and its completeness in describing particle motion; Potential energy function; F = - Grad V, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Kepler problem; Application: Satellite manoeuvres; Non-inertial frames of reference, Rotating coordinate system: Five-term acceleration formula- Centripetal and Coriolis accelerations; Applications: Weather systems, Foucault pendulum.

UNIT II

Simple harmonic motion: damped and forced simple harmonic oscillator 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, electrical and mechanical impedance, steady state motion of forced damped harmonic oscillator, power absorbed by oscillator.

UNIT III

Optics: Light as an electromagnetic wave; Reflectance of light; total internal reflection, and evanescent wave; Mirrors and lenses and optical instruments based; Interference of light; Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach-Zehnder interferometer. Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power;

LASER: He-Ne LASER, ruby LASER, CO_2 LASER, Properties of laser beams,

applications of lasers in science, engineering and medicine.

UNIT IV

Wave nature of particles and the Schrodinger equation: Introduction to Quantum mechanics, Wave nature of Particles, Time-dependent and time- independent Schrodinger equation for wave function, Born interpretation, probability current, Expectation values, Free- particle wave function and wave-packets, Uncertainty principle; Free electron theory of metals, Fermi level, density of states, Bloch's theorem for particles in a periodic potential, Kronig- Penney model and origin of energy bands.

REFERENCE BOOKS

S. No	Name	Author(S)	Publisher
1	Engineering Mechanics	M K Harbola	2nd ed. CENGAGE 2012
2	Theory of Vibrations with Applications	W T Thomson	GEORGE ALLEN & UNWIN LTD 2008
3	Optics	A.Ghatak	Tata McGraw-Hill Education, 2005
4.	Quantum mechanics	D. J. Griffiths	2Nd Edn, Cambridge India, 2016

Course Code	**EVS002**
Course Title	**Environmental Sciences**
Type of Course	MC
L T P	3 0 0
Credits	NC
Course Prerequisite	Nil
Course Objective (CO)	To make students aware about environment and need of maintaining it with best possible knowledge.
Course Outcomes	CO1: Measure environmental variables and interpret results. CO2: Evaluate local, regional, and global environmental topics related to resource use and management. CO3: Propose solutions to environmental problems related to resource use and management.

SYLLABUS

UNIT-I

Introduction to Environment and Ecosystem: Definition and scope and importance of multidisciplinary nature of environment. Need for public awareness, Concept of Ecosystem, Structure, interrelationship, producers, Consumers and decomposers, ecological pyramids-biodiversity, and importance. Hot spots of biodiversity.

UNIT-II

Environmental Pollution & Natural Resources: Definition, Causes, effects and control measures of air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, nuclear hazards. Solid waste Management: Causes, effects, and control measure of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster Management: Floods, earthquake, cyclone and landslides, Natural Resources, and associated problems, use and over exploitation, case studies of forest resources and water resources.

UNIT-III

Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of pollution) Act. Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation

UNIT-IV

Human Population and the Environment & Field Work: Population growth, variation among nations. Population explosion –Family Welfare Programme. Environment and human health, Human Rights, Value Education, HIV/AIDS. Women and child Welfare. Role of Information Technology in Environment and human health. Case studies

Visit to a local area to document environmental assets river/forest/grassland/hill/mountain; Visit to a local polluted site-Urban/Rural/Industrial/Agricultural; Study of common plants, insects, birds; Study of simple ecosystems-pond, river, hill slopes, etc.

REFERENCE BOOKS:

S. No	Name	Author(S)	Publisher
1	A Textbook for Environmental Studies	Erach Bharucha	Orient BlackSwan
2	Environmental Biology,	Agarwal, K.C. 2001	Nidi Publ. Ltd. Bikaner.
3	Environmental Sciences,	Miller T.G. Jr.	Wadsworth

Course Code	**CSE113**
Course Title	**Programming in C Practical**
Type of Course	ES
L T P	0 0 2
Credits	1
Course Prerequisite	Basics of computer and knowledge of any high level language
Course Objective (CO)	To familiarize the students of all branches in engineering with computer organization, operating systems, problem solving and programming in C++.
Course Outcomes	The learner will be able to- CO1: Understand the basic building blocks of general purpose digital computer system like computer hardware/software, memory and peripheral devices, internet applications and services. CO2: Understand the program development life cycle using various tools likeflowcharts and algorithms and pseudo-code. CO3: Classify operators, expressions, character set, data types and control structures. CO4: Design and develop modular programming and code reusability using library functions.

SYLLABUS

Familiarization with the Computer System:

1) To explain the part of the computer system such as system unit, input devices, output devicesconnected to the computer.
2) To explore the outside view of the system unit that includes the panels on front and ports atthe rear.
3) To explore the inside view of the system unit that includes the motherboard, processor, expansion slots, various add-on cards, storage devices, power supply, fans.
4) To understand the booting process that includes switching on the system, execution of POSTroutine, then bootstrap loader, and loading of the operating system, and getting it ready for use.
5) To introduce the graphical user interface (desktop) of Windows operating System to explainthe various elements of the desktop such as taskbar, icons (My Computer, Recycle Bin, etc.), short cuts, notification area.
6) To configure the desktop that includes selecting the wallpaper, selecting the screen saver with or without password protection, selecting the screen resolution and color quality.

Explore Office automation

1) Creating, Formatting documents with Word, explore the various toolbar options, MailMerge, Spell Check, Word –Art.
2) Creating PowerPoint presentations with Power Point, Explore various views of PPT,Charts, Graphs, animation, multimedia.
   Creating Sheets in Excel using formulas, chart and graphs

Programming using C++

1) Implement programs using various operators in C++
2) Implement various Branch statements: if, if-else, nested if, switch
3) Implement various loop statements: for, while, do-while
4) Implement other control statements: go-to, exit function, continue
5) Implement various programs using arrays and string
6) Implement various programs classes and objects
7) Implement various programs using Pointers and structures
8) Implement various programs using File operations

Computer Aided Tools and Internet

1) Exercise with CAD
2) Internet surfing and E-mail

Course Code	**ME105**
Course Title	**Workshop/Manufacturing Practices Practical**
Type of Course	ES / SEC-I
L T P	0 0 6
Credits	3
Course Prerequisite	
Course Objective (CO)	Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

Course Code	ME105
Course Outcomes	CO1: Understanding different manufacturing techniques and their relative advantages/ disadvantages with respect to different applications with selection of a suitable technique for meeting a specific fabrication need. CO2:Acquire a minimum practical skill with respect to the different manufacturing methods and develop the confidence to design & fabricate small components for their project work. CO3: Introduction to different manufacturing methods in different fields of engineering. CO4: Practical exposure to different fabrication techniques and Creation of simple components using different materials.

SYLLABUS

LECTURES

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. Fitting operations & power tools
3. Electrical &Electronics
4. Carpentry
5. Metal casting
6. Welding (arc welding & gas welding), brazing

WORKSHOP PRACTICE

1. Machine shop
2. Fitting shop
3. Carpentry
4. Electrical & Electronics
5. Welding shop
6. Casting
7. Smithy

Examinations could involve the actual fabrication of simple components, utilizing one or more of thetechniques covered above.

REFERNCE BOOKS

S. No	Name	Author(S)	Publisher
1.	Workshop Technology	HS Bawa	McGraw-Hill Publishing Company Limited
2.	Workshop Technology I,II,III	S K Hajra, Choudhary and A K Choudhary	Media Promoters and Pu blishers Pvt. Ltd., Bombay
3.	Manual on Workshop Practice	K Venkata Reddy	MacMillan India Ltd. New Delhi
4.	Basic Workshop Practice Manual	T Jeyapoovan	VikasPublishing House (P) Ltd., New Delhi

Course Code	**PHY107**
Course Title	**Engineering Physics Practical**
Type of Course	BS
L T P	0 0 2
Credits	1
Course Prerequisite	10+2 with physics as core subject.
Course Objective (CO)	The aim of the subject is to enhance the Practical knowledge of students about various aspects of fundamental of physics including mechanics, optics, wave optics, quantum mechanics;
Course Outcomes	**Students will able:** CO1: Measure the Magnetic effects along axis of circular coil, magnetic dipole moment of a bar magnet. CO2: Infer the characteristics, wavelength & diffraction of laser beam using Michelson interferometer, grating elements. CO3: determine numerical aperture, attenuation and propagation losses in optical fiber, various crystal structures, polarizability of a dielectric substance. CO4: Determine the resistivity, band gap of semiconductor materials. .

SYLLABUS

1. To study the variation of magnetic field with distance along the axis of a circular coil carrying current.
2. To determine the magnetic dipole moment of a bar magnet and horizontal intensity of earth's magnetic field using a deflection galvanometer.
3. To study B-H curve using CRO.
4. To study the laser beam characteristics like divergence using diffraction grating aperture.
5. To determine the wavelength of a laser using Michelson interferometer.
6. To study diffraction using laser beam and thus to determine the grating element.
7. To find the refractive index of a material using spectrometer.
8. To find the refractive index of a liquid using a hollow prism and spectrometer.
9. To determine numerical aperture of an optical fiber.
10. To determine attenuation and propagation losses in optical fibers.
11. To study various crystal structures.
12. To find out polarizability of a dielectric substance.
13. To set up and observe Newton's rings.
14. To Determine Energy Band Gap of Semiconductor.
15. To determine the number of lines per millimeter of the grating using the green line of the mercury spectrum.
16. To calculate the wavelength of the other prominent lines of mercury by normal incidence method.
17. To find the acceleration of the cart in the simulator(Newton 2^{nd} law)
18. To determine the resistivity of semiconductors by four probe Method.

REFERENCE BOOKS

S. No	Name	Author(S)	Publisher
1	Advanced Practical Physics for students	B.L. Flint & H.T.	Asia Publishing House.
2	Advanced level Physics Practicals	Michael Nelson and Jon	Heinemann Educational
3	A Text Book of Practical Physics	Indu Prakash and	Kitab Mahal, New Delhi

Course Code	**ME201**
Course Title	Kinematics of Machines-I
Type of Course	PC
L T P	3 1 0
Credits	4
Course Prerequisite	Engineering Physics, Engineering Mechanics
Course Objective (CO)	To understand the kinematics and rigid-body dynamics of kinematically driven machine components To understand the motion of linked mechanisms in terms of the displacement, velocity, and acceleration at any point in a rigid link To be able to design some linkage mechanisms and cam systems to generate specified output motion To understand the kinematics of gear trains
Course Outcomes	On completion of this course the student will be able to: CO1: Analyse the displacement, velocity and acceleration of links in planar mechanisms using graphical and analytical methods. CO2: Design linkage mechanisms, cams and gear trains to obtain a specified motion. CO3: Evaluate the performance of mechanisms, including friction, brakes and dynamometers, for optimal functioning.

SYLLABUS

UNIT-I

Motion transmission devices: Belts Ropes and Chains: Material & Types of belt, Flat and V-belts, Type of Pulleys, Crowning of Pulley, Velocity Ratio, Numerical based on Length of belt, Power transmitted by belts including consideration of Creep and Slip, Centrifugal Tensions and its effect on power transmission, Rope & Chain Drives. Toothed Gears: Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, Gear Train Ratio, Epicyclic and regular Gear train kinematics.

UNIT-II

Flywheel and Governors: Turning moment and crank effort diagrams for reciprocating machines' Fluctuations of speed, coefficient of fluctuation of speed and energy Governors: Function, types and characteristics of governors. Watt, Porter and Proell governors. Hartnell and Willson-Hartnell

Course Code	ME201

spring loaded governors. Numerical problems related to these governors. Sensitivity, stability, isochronisms and hunting of governors.

UNIT-III

Gyroscopes: Gyroscopic action in automobiles, gyroscopes and their role in stabilization in ships, and airplanes.

Cams and Follower: Classification of cams and followers-Terminology and definitions-Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions-derivatives of follower motions-specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers.

UNIT-IV

Balancing: Necessity of balancing, static and dynamic balancing, balancing of single and multiple rotating masses, partial unbalanced primary force in an engine, balancing of reciprocating masses, and condition of balance in multi cylinder in line V-engines , concept of direct and reverse crank, balancing of machines, rotors, reversible rotors.

REFERENCE BOOKS

S.No.	Name	Author(s)	Publisher
1	Theory of Machines	S. S. Rattan	Tata McGraw Hill
2	Theory of Machines	V.P. Singh	Dhanpat Rai
3	Theory of Machines	Shigley	McGraw Hill.

Course Code	EE001
Course Title	**Basic Electronics Engineering**
Type of Course	ES
L T P	3 0 0
Credits	3
Course Prerequisite	Basics of Electrical Engineering
Course Objective (CO)	develop a broad understanding of the concepts and ıctionality of electronic devices, tools and instruments, luding their uses, general specifications and deployment engineering systems.
Course Outcomes	completion of this course the student will be able to:)1: Explain the construction, characteristics and olications of semiconductor diodes and transistors.)2: Analyse rectifier, amplifier and oscillator circuits and aluate their performance.)3: Describe the operation of digital logic gates, mbinational circuits and basic electronic instruments.)4: Select electronic devices and instruments for a given asurement or control application.

SYLLABUS

UNIT1: **Diodes and Applications**

Semiconductor Diode - Ideal versus Practical, Resistance Levels, Diode Equivalent Circuits, Load Line Analysis; Diode as a Switch, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener Diode – Operation and Applications; Opto-Electronic Devices – LEDs, Photo Diode and Applications; Silicon Controlled Rectifier (SCR) – Operation, Construction, Characteristics, Ratings, Applications;

UNIT 2: Transistor Characteristics

Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Operating Point, Voltage Divider Bias Configuration; Field Effect Transistor (FET) – Construction, Characteristics of Junction FET, Depletion and Enhancement type Metal Oxide Semiconductor (MOS) FETs, Introduction to CMOS circuits;

UNIT 3: Transistor Amplifiers and Oscillators

Classification, Small Signal Amplifiers – Basic Features, Common Emitter Amplifier, Coupling and Bypass Capacitors, Distortion, AC Equivalent Circuit; Feedback Amplifiers – Principle, Advantages of Negative Feedback, Topologies, Current Series and Voltage Series Feedback Amplifiers; Oscillators – Classification, RC Phase Shift, Wien Bridge, High Frequency LC and Non-Sinusoidal type Oscillators;

UNIT 4: Operational Amplifiers and Applications

Introduction to Op-Amp,Differential Amplifier Configurations, CMRR, PSRR, Slew Rate; Block Diagram, Pin Configuration of 741 Op-Amp, Characteristics of Ideal OpAmp, Concept of Virtual Ground

REFERENCE BOOKS

Sr.No.	Name	Author	Publisher
1	Basic Electronics- Devices, Circuits and IT Fundamentals	Santiram Kal (2002)	PrenticeHall, India
2	Digital Fundamentals	Thomas L. Floyd and R. P. Jain (2009),	Pearson Education,
4	Basic Electronics	Paul B. Zbar, A.P. Malvino and M.A. Miller (2009),	A Text-Lab.Manual, TMH
5	Introductory Electronic Devices & Circuits, Conventional FlowVersion	R. T. Paynter (2009),	Pearson

Course Code	**ME203**
Course Title	**Strength of Materials-I**
Type of Course	PC
L T P	3 1 0
Credits	4
Course Prerequisite	Engineering Mechanics
Course Objective (CO)	To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders, and spheres for various types of simple loads To calculate the elastic deformation occurring in various simple geometries for different types of loading
Course Outcomes	On completion of this course the student will be able to: CO1: Recognise the various types of loads applied to machine components of simple geometry. CO2: Explain the nature of the internal stresses developed within loaded components. CO3: Evaluate the strains and deformations resulting from the elastic stresses developed in bars, beams, shafts, cylinders and spheres.

SYLLABUS

UNIT-I

Stress and Strain: Types of stresses and strains, Volumetric, linear and shear strains, Analysis of Thermal Stresses, Analysis of stresses on tapered rectangular bar and circular rod, Analysis of stresses considering lateral deformation, Analysis of stresses on force applied on composite sections. Variation of temperature in compound bars.

Principal Stresses and Strains: Two-dimensional stress system, stress at a point on a plane, principal stresses and principal planes, Mohr's circle of stress ellipse of stress and their applications. Generalized Hook's law, principal stresses related to principal strains.

UNIT-II

Bending and shear stresses in Beams: Assumptions in the simple bending theory; derivation of formula and its application to beams of rectangular, circular and channel, I and T- sections. Combined direct and bending stresses. Sections, composite / fletched beams, Shear stress distribution in rectangular, circular, I, T and channel section; built up beams. Shear centre and its importance.

UNIT-III

Torsion: Derivation of torsion equation and its assumptions and its application to the hollow and solid circular shafts. Torsional rigidity, combined torsion and bending of circular shafts; principal stress and maximum shear stresses under combined loading of bending and torsion.

UNIT-IV

Course Code	ME203

Columns and struts: Introduction, failure of columns, Euler's formula, Rankine-Gordon's formula, Johnson's empirical formula for axially loaded columns and their applications.

Slope and deflection: Relationship between moment, slope and deflection; method of integration, Macaulay's method, moment area method and use of these methods to calculate slope and deflection for the following:

a) Cantilevers
b) Simply supported beams with or without overhang
c) Under concentrated loads, uniformly distributed loads or combination of concentrated & uniformly distributed loads

REFERENCE BOOKS:

S. No	Name	Author(S)	Publisher
1	Strength of Materials	*R.K.Rajput*	S.Chand *Publications.*
2	Strength of Materials	*Dr. Sadhu Singh*	*Khanna publications.*
3	Strength of Materials	D.S. Bedi	Khanna Book Publishing Company.
4	Mechanics of Materials	E.P. Popov	Prentice Hall India

Course Code	ME205
Course Title	**Basic Thermodynamics**
Type of Course	PC
L T P	3 1 0
Credits	4
Course Prerequisite	Physics, Chemistry.
Course Objective (CO)	To learn about work and heat interactions, and balance of energy between system and its surroundings To learn about application of I law to various energy conversion devices To evaluate the changes in properties of substances in various processes To understand the difference between high grade and low-grade energies and II law limitations on energy conversion
Course Outcomes	**On completion of this course the student will be able to:** **CO1: Apply energy balances to systems and control volumes involving heat and work interactions.**

Course Code	ME205
	CO2: Evaluate changes in the thermodynamic properties of pure substances and ideal gases. **CO3: Evaluate the performance of energy conversion devices using the first and second laws.** **CO4: Apply entropy concepts to determine the feasibility and efficiency of thermodynamic processes.**

SYLLABUS

UNIT-I

Basic Concepts: Definition of thermodynamics, Concept of Thermodynamic System and of thermodynamic equilibrium, Boundary and Surroundings; Open, Closed and Isolated Systems. Property, state, path, process and cycle; dot/point functions and path functions, Phase and pure substances, Equation of State, reversible, Quasi-static and irreversible processes; Energy and its forms, Energy transfer across the System boundaries. Types of work transfer, heat and work; sign conventions for heat and work interaction, Concept of temperature and heat, microscopic and macroscopic approach, Concept of continuum, Zeroth law of thermodynamics. Concept of thermal equilibrium and principles of thermometry. Ideal gas and characteristic gas equation.

UNIT-II

First Law of Thermodynamics and its applications: Concept of First law of thermodynamics, specific heat and heat capacity, thermal diffusivity, essence and corollaries of First law; internal energy and enthalpy, analysis of non-flow and flow processes, Changes in various thermodynamic properties, work done and heat exchange during these processes, free expansion and throttling process and its applications in Engineering processes; Steady Flow Energy Equation (SFEE) and its application to Nozzles, Turbines, Boilers, Compressors, Condensers and Pumps.

UNIT-III

Second Law of Thermodynamics: Drawbacks of First law of thermodynamics, *equivalence OF* Kelvin Plank and Clausius statements and Their application *to Refrigerator, Heat Pump and Heat Engine*. Analysis of Carnot cycle, Carnot Engine and Carnot theorem; Clausius theorem; Clausius inequality. Concept of entropy, principle of increase in entropy, representation of various processes on T-S coordinates and change in entropy for different thermodynamic processes, concept of entropy generation in Closed and Open systems. Efficiency and energy analysis of Thermodynamic Systems, Introduction to Third law of Thermodynamics.

UNIT-IV

Gas Power Cycles: Air-standard efficiency, Nomenclature of Piston-Cylinder arrangement w.r.t. swept volume; clearance volume, compression ratio and mean effective pressure; Analysis and philosophy of Air-Standard Cycles i.e. Otto Cycle, Diesel Cycle and Dual Cycle; their compression ratio, mean effective pressure, power output and Efficiency; Comparison between the three Cycles.

REFERENCE BOOKS

S.No.	Name	Author(s)	Publisher
1	Engineering Thermodynamics	G. Rogers and Y. Mayhew	Pearson
2	Applied Thermodynamics	R. Yadav, Sanjay and Rajay	Central Publishing House
3	Advanced thermodynamics for engineers	Wark	McGraw-Hill
4	*Engineering Thermodynamics*	P.K Nag,	Tata McGraw-Hill Publishing Co. Ltd

Course Code	ME205		
5	Thermodynamics and Thermal Engineering	J.S. Rajadurai	New Age International (P) Ltd. Publishers

Course Code	ME207
Course Title	**Machine Drawing**
Type of Course	PC
L T P	3 0 0
Credits	3
Course Prerequisite	Engineering Drawing
Course Objective (CO)	The objective of this course is to make students understand the principles and requirements of production drawings and learning how to assemble and disassemble important parts used in major mechanical engineering applications. After going through this course, the student shall be able to understand the drawings of mechanical components and their assemblies along with their utility for design of components.
Course Outcomes	The student will be able to CO1: Draw the machine elements including keys, couplings, cotters, riveted, bolted, and welded joints CO2: Understand the representation of materials used in machine drawing. CO3: Construct an assembly drawing using part drawings of machine components

SYLLABUS

UNIT-I

Introduction: Principles of Drawing, Requirements of production drawing, Sectioning and

Conventional representation, Dimensioning, symbols of standard tolerances, Machining Symbols, Introduction and Familiarization of Code IS: 296

UNIT-II

Fasteners: Various types of screw threads, types of nuts and bolts, screwed fasteners, welding joints and riveted joints

UNIT-III

Assembly and Disassembly:

a) Couplings: Solid or Rigid Coupling, Protected Type Flange coupling, Pin type flexible coupling, muff coupling, Oldham, universal coupling, claw coupling, cone friction clutch, free hand sketch of single plate friction clutch.

b) Knuckle and cotter joints

c) Pipe and Pipe Fittings: flanged joints, spigot an socket joint, union joint, hydraulic an expansion joint

UNIT-IV

Assembly and Disassembly:

d) IC Engine Parts: Piston, connecting rod

e) Boiler Mountings: Steam stop valve, feed check valve, safety valve, blow off cock.

f) Bearings: Swivel bearing, thrust bearing, Plummer block, angular plumber block

g) Miscellaneous: Screw Jack, Drill Press Vice, Crane hook, Tool Post, Drilling Jigs

h) Hand-on-Practice of above Drawings in software such as AutoDesk Fusion 360.

REFERENCE BOOKS

S.No.	Name	Author(s)	Publisher
1	Machine Drawing	N.D. Bhatt	Charotar publications.
2	Machine Drawing	P.S. Gill, Machine Drawing,	BD Kataria and Sons.
3	Machine Drawing	V Lakshmi , N. Sidheshwar	Tata McGraw Hill.
4	Machine Drawing	Narayanan and Mathur	

Course Code	**ME209**
Course Title	Kinematics of Machines Laboratory
Type of Course	PC
L T P	0 0 2
Credits	1
Course Prerequi	Physics
Course Objective (CO)	To understand the various links and mechanisms of machines by performing experiments.
Course Outcomes	Students will be able to: **CO1** Analyze and construct various mechanisms—such as four-bar chains, slider-crank mechanisms, cam profiles, and gear trains—by drawing their inversions, velocity diagrams, and motion curves using standard graphical methods. **CO2** Conduct experiments on governors, gyroscopic systems, journal bearings, and rotating masses to measure key performance parameters (e.g., equilibrium speed, pressure distribution, gyroscopic couple) and interpret the resulting graphs and data. **CO3** Apply graphical techniques such as Klein's construction, balancing diagrams, and gear-train value determination to solve real-world kinematics and dynamics problems, demonstrating the ability to design, evaluate, and optimize mechanical motion systems.

LIST OF EXPERIMENTS

1. Study of various links and mechanisms.
2. Study and draw various inversions of 4- bar chain and single slider crank chain.
3. Draw velocity and diagram of engine mechanism using graphical methods including Klien's construction.
4. Conduct experiments on various types of governors and draw graphs between height and equilibrium speed of a governor.
5. Determination of gyroscopic couple (graphical method).
6. Balancing of rotating masses (graphical method)

7.Cam profile analysis (graphical method).

8.Determination of gear- train value of compound gear trains and Epicyclic gear trains.

9. Study pressure distribution in a full journal bearing.

Course Code	**ME211**
Course Title	Strength of Materials Laboratory
Type of Course	PC
L T P	0 0 2
Credits	1
Course Prerequisit	Physics
Course Objective (CO)	The objective of the strength of materials lab is to demonstrate the basic principles in the area of strength and mechanics of materials and structural analysis to the undergraduate students through a series of experiments. In this lab the experiments are performed to measure the properties of the materials such as impact strength, tensile strength, compressive strength, hardness, ductility etc.
Course Outcomes	**CO1:** To perform standard mechanical tests—including tensile, compression, hardness, impact, torsion, fatigue, and bending tests—on various engineering materials and interpret stress–strain behavior to determine key mechanical properties. **CO2:** To analyze the failure modes of materials under different loading conditions (tension, compression, impact, torsion, fatigue, and buckling) and evaluate factors affecting material strength and stability. **CO3:** To determine mechanical constants such as Young's modulus, modulus of rupture, modulus of rigidity, stiffness of springs, and critical buckling loads, and compare experimentally obtained results with theoretical predictions.

- **LIST OF EXPERIMENTS**

1. To perform tensile test in ductile and brittle materials and to draw stress-strain curve and to determine various mechanical properties.

2. To perform compression test on Cast Iron.

3. To perform any one hardness tests (Rockwell, Brinell & Vicker's test)

4. To perform impact test to determine impact strength.

5. To perform torsion test and to determine various mechanical properties.

6. To perform Fatigue test on circular test piece.

7. To perform bending test on beam and to determine the Young's modulus and modulus of rupture.

8. Determination of Buckling loads of long columns with different end conditions.

9. To evaluate the stiffness and modulus of rigidity of helical coil spring.

Course Code	**ME202**
Course Title	Kinematics of Machines-II
Type of Course	PC
L T P	3 1 0
Credits	4
Course Prerequisite	Mechanics of Machines-II
Course Objective (CO)	The students will understand the basic concepts of inertia forces & couples applied to reciprocating parts of a machine. Students should be able to understand balancing of masses and design of gears & gear trains. They will also gain knowledge of kinematic synthesis and different applications of gyroscopic effect.
Course Outcomes	**CO1:** Analyze the geometry, kinematics, and performance characteristics of various types of gears and gear trains, including conditions for correct gearing, interference prevention, velocity ratio estimation, center distance calculations, and efficiency evaluation of spur, helical, bevel, worm, and epicyclic gear systems. **CO2:** Evaluate gyroscopic effects and balancing requirements in mechanical systems by determining static and dynamic balancing conditions for rotating and reciprocating masses, including multi-cylinder engines and rotor systems. **CO3:** Apply principles of dynamic force analysis to determine inertia forces, couples, and torque requirements in crank and four-bar mechanisms using analytical and graphical methods, including dynamically equivalent systems.

SYLLABUS

UNIT-I

Gears: Toothed gears, types of toothed gears and its terminology. Path of contact, arc of contact, conditions for correct gearing, forms of teeth, involutes and its variants, interference and methods of its removal.

Calculation of minimum number of teeth on pinion/wheel for involute rack, helical, spiral, bevel and worm gears. Center distance for spiral gears and efficiency of spiral gears

UNIT-II

Gear Trains: Types of gear trains, simple, compound and epicyclic gear trains, problems involving their applications, estimation of velocity ratio of worm and worm wheel.

Gyroscopic motion and couples: Effect on supporting and holding structures of machines. Stabilization of ships and planes, Gyroscopic effect on two and four wheeled vehicles

UNIT-III

Balancing: Necessity of balancing, static and dynamic balancing, balancing of single and multiple rotating masses.

Partial unbalanced primary force in an engine, balancing of reciprocating masses, and condition of balance in multi cylinder in line V-engines.

Concept of direct and reverse crank, balancing of machines, rotors, reversible rotors

UNIT-IV

Dynamic force analysis Determination of forces and couples for a crank, inertia of reciprocating parts, dynamically equivalent system, analytical and graphical method, inertia force analysis of basic engine mechanism, torque required to overcome inertia and gravitational force of a four bar linkage.

Course Code	**ME204**
Course Title	Strength of Materials-II
Type of Course	PC
L T P	3 1 0
Credits	4
Course Prerequisite	Strength of Materials
Course Objective (CO)	The objective is to present the mathematical and physical principles in understanding the linear continuum behaviour of solids.
Course Outcomes	CO1. On completion of this course the student will be able to: CO2. CO1: Explain the deformation behaviour of solids under different loading conditions. CO3. CO2: Derive and apply the governing equations for axisymmetric problems. CO4. CO3: Apply failure theories and the fundamentals of strain energy to component analysis. CO5. CO4: Carry out stress analysis of cylinders, springs and curved beams. CO6.
SYLLABUS	

Course Code	ME204

UNIT I

Introduction to Cartesian tensors, Strains: Concept of strain, derivation of small strain tensor and compatibility, Stress: Derivation of Cauchy relations and equilibrium and symmetry equations, principal stresses and directions.
Plane stress and plane strain problems, introduction to governing equations in cylindrical and spherical coordinates, axisymmetric problems.
Generalized Hooke's law, Linear elasticity, Material symmetry; Boundary Value Problems: concepts of uniqueness and superposition

UNIT II

Thin cylinders and spheres: Calculation of Hoop stress, longitudinal stress in a cylinder, effects of joints, change in diameter, length and internal volume. Principal stresses in sphere, change in diameter and internal volume.
Thick cylinders: Derivation of Lame's equations, calculation of radial, longitudinal and hoop stresses and strains due to internal pressure in thick cylinders, compound cylinders, hub shrunk on solid shafts, shrinkage allowance and shrinkage stress.

UNIT III

Strain energy: Introduction to strain energy, energy of dilation and distortion. Resilience, stress due to suddenly applied loads. Castigliano's and Maxwell's theorem of reciprocal deflection.
Theories of failure: Maximum principal stress theory, maximum shear stress theory, maximum principal strain theory, total strain energy theory, shear strain energy theory. Graphical representation and derivation of equation for these theories and their application to problems related to two-dimensional stress systems.

UNIT IV

Springs: Open and closed coiled helical springs under the action of axial load and/or couple. Leaf spring-deflection and bending stresses.
Bending of curved beams: Calculation of stresses in cranes or chain hooks, rings of circular and trapezoidal section.

REFERENCE BOOKS

S.No.	Name	Author(s)	Publisher
1	Strength of Materials	R.K.Rajput	S.Chand Publications.
2	Strength of materials	Dr. Sadhu Singh	Khanna publications.
3	Strength of Materials	D.S. Bedi	Khanna Book Publishing Company.
4	Mechanics of Materials	E.P. Popov	Prentice Hall India.
5	Strength of Materials	R.S Lehri and A.S. Lehri	Kataria and Sons.
6	Strength of Materials	S.S.Rattan	Tata McGraw Hill.

Course Code	**ME206**
Course Title	**Manufacturing Processes**
Type of Course	ES
L T P	3 0 0
Credits	3
Course Prerequisite	Engineering Workshop, Materials Engineering
Course Objective (CO)	To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size, and form of the raw materials into the desirable product by conventional or unconventional manufacturing method.
Course Outcomes	CO1. On completion of this course the student will be able to: CO2. CO1: Explain the conventional manufacturing methods used to produce engineering products. CO3. CO2: Describe unconventional manufacturing methods and their fields of application. CO4. CO3: Analyse manufacturing processes and select a suitable process for a given product and material. CO5.

SYLLABUS

UNIT-I

Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses.

Introduction to bulk and sheet metal forming, plastic deformation, and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.

UNIT-II

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, cutting tool materials, cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.

UNIT-III

Additive manufacturing: Rapid prototyping and rapid tooling.

Joining/fastening processes: Physics of welding, brazing, and soldering; design considerations in welding, Solid and liquid state joining processes; Adhesive bonding.

Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles, and process parameters.

UNIT-IV

Electrical Discharge Machining, principle, and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant

& Maskant, process parameters, MRR and surface finish.Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining.

S.No.	**Name**	**Author(s)**	**Publisher**
1	Manufacturing Technology, Metal cutting Volume-II	P. N. Rao	Tata McGraw Hill.
3	Manufacturing Processes, Vol. I&II	H.S. Shan	Pearson Publishers
4	Fundamentals of Modern manufacturing	M. P. Groover.	Wiley

Course Code	**ME208**
Course Title	**Applied Thermodynamics**
Type of Course	PC
L T P	3 1 0
Credits	4
Course Prerequisite	Physics & Chemistry
Course Objective (CO)	(1) To learn about of the law for reacting systems and heating value of fuels (2)To learn about gas and vapor cycles and their first law and second law efficiencies (3) To understand about the properties of dry and wet air and the principles of psychrometry (4) To learn about gas dynamics of air flow and steam through nozzles (5) To learn the about reciprocating compressors with and without intercooling (6) To analyse the performance of steam turbines
Course Outcomes	CO1. On completion of this course the student will be able to: CO2. CO1: Analyse practical power, refrigeration and heat pump cycles and evaluate their efficiencies. CO3. CO2: Analyse energy conversion in thermal devices such as combustors, nozzles, diffusers, steam turbines and reciprocating compressors. CO4. CO3: Determine the properties of fuels and reacting mixtures and calculate heating values and combustion products. CO5. CO4: Evaluate gas and vapour power cycles using first- and second-law efficiencies. CO6.

SYLLABUS

UNIT-I

Compressors: Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, isothermal, overall thermal, isentropic, polytropic and mechanical efficiency, Clearance volumetric efficiency, Overall volumetric efficiency, effect of various parameters on volumetric efficiency, free air delivery; Multistage compressors: purpose and advantages, construction and operation, work input, heat rejected in intercoolers, minimum work input, optimum pressure ratio; isothermal, overall thermal, isentropic, polytropic and mechanical efficiencies; Performance curves.

UNIT-II

I.C.Engines and Boilers: Introduction, classification and application, Combustion in S.I. engine: Flame propagation, pre-ignition, detonation, engine variables effects, mixture requirements, fuel rating; Fuel supply system, Combustion in C.I.Engine, delay period, knocking, engine variables effects, fuel requirements, rating, combustion chambers; Fuel supply system, Engine cooling and lubrication, Performance of engines: Variable and constant speed tests as per ISI standards. Performance curves, heat balance, Exhaust and emission control. Introduction to Boilers, classifications, mountings and accessories, Overview of steam power plant.

UNIT-III

Vapour Power Cycle: Carnot Cycle and its limitations; Introduction to Rankine cycle, Rankine steam power cycle, Ideal and actual; Mean temperature of heat addition; Effect of pressure, temperature and vacuum on Rankine Efficiency; Rankine Cycle Efficiency and methods of improving Rankine efficiency: Reheat cycle, Bleeding(*feed-water-heating*), Regenerative Cycle, combined reheat-regenerative cycle; Ideal working fluid; Binary vapour cycle, Combined power and heating cycles.

UNIT-IV

Steam Nozzles: Definition, types and utility of nozzles; Flow of steam through nozzles; Condition for maximum discharge through nozzle; Critical pressure ratio, its significance and its effect on discharge; Areas of throat and at exit for maximum discharge; Effect of friction; Nozzle efficiency; Convergent and Convergent-divergent nozzles. Calculation of Nozzle dimensions (length and diameters of throat and exit); Supersaturated (or metastable) flow through nozzle.

REFERENCE BOOKS

S.No	Name	Author(s)	Publisher
1	Gas Turbine Theory	H. Cohen, G.F.C. Rogers and M. Sarvan	Longmans
2	Applied Thermodynamics	R. Yadav, Sanjay and Rajay	Central Publishing House
3	Advanced thermodynamics for engineers	Wark	McGraw-Hill

Course Code	**ME210**
Course Title	**Materials Engineering**
Type of Course	PC
L T P	3 0 0
Credits	3
Course Prerequisite	Engineering Physics, Engineering Chemistry, Strength of Materials
Course Objective (CO)	Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria. To provide a detailed interpretation of equilibrium phase diagrams Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.
Course Outcomes	On completion of this course the student will be able to: CO1: Identify the crystal structures of engineering materials and explain the defects present in them. CO2: Relate the internal structure of ferrous and non-ferrous alloys to their mechanical properties and tailor properties by heat treatment. CO3: Quantify mechanical integrity and failure in materials using standard tests and failure criteria.

SYLLABUS

UNIT I

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness, and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.

UNIT II

Diffusion: Diffusion mechanisms, steady-state and non-steady- state diffusion, factors affecting diffusion. Theories of plastic deformation, nucleation, recovery, re-crystallization and grain growth, Nucleation. Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions.

UNIT III

Iron Iron-carbide phase diagram Construction and interpretation Fe-Fe_3C diagrams. Transformation of Austenite to Pearlite, Bainite and Martensite.

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening,

Course Code	ME210

vacuum and plasma hardening.

UNIT IV

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable, and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys.

REFERENCE BOOKS

S.No.	Name	Author(s)	Publisher
1	The Science and Engineering of Materials	D.K. Bhattacharya	Cengage Learning.
2	Engineering Physical Metallurgy	Y. Lakhin	Mir Publishers.
3	The Science and Engineering of Materials	D.K. Bhattacharya	Cengage Learning.
4	Heat Treatment of Metals,	B. Zakharov	University Press
5	Physical Metallurgy	Vijendra Singh	Tata Mcgraw Hill

Course Code	SSC007
Course Title	Universal Human Values: Understanding Harmony
Type of Course	HS
L T P	3 0 0
Credits	3
Course Objective (CO)	1. Develop a universal perspective based on self- exploration about themselves (human being), family, society and nature. 2. Understand the harmony in human relations. 3. Strengthen the Self-Reflection. 4. Develop commitment and courage.
Course Outcomes	**CO1:** To become more aware of themselves, and their surroundings (family, society, nature). **CO2:** To become more responsible in life and in handling problems with sustainable solutions. **CO3:** To develop a sense of commitment and courage to act.

SYLLABUS

UNIT-I

Need, Basic Guidelines, Content and Process for Value Education

1. Concept of Value Education including its needs, basic guidelines, content & process.
2. Concept of Self-Exploration, Natural Acceptance & Experiential Validation as the

process for Self-Exploration.
3. Happiness & Prosperity.

UNIT-II

Understanding Harmony in Human Beings

1. Understanding Human Being as a Co-existence of Self (I) & Body.
2. Understanding the needs of Self (I) & Body.
3. Understanding harmony of Self (I) with Body: Sanyam &Swasthya.

UNIT-III

Understanding Harmony in Human Relationships

1. Need for and Importance of Values in Human Relationships.
2. Human Values to be practiced in a family.
3. Visualizing a Universal Human Order in Society.

UNIT-IV

Understanding Harmony in Nature & Existence

1. Need & Importance of Harmony in Nature.
2. Understanding the Interconnectedness among Four Orders of Nature.
    1. Holistic Perception of Harmony at all levels of Existence.

Sessional work:

- Organize a group discussion regarding the ways and measures to inculcate values among individuals.

Sr. No.	Name	Author(s)	Publisher
1.	Human Values and Professional Ethics	Varinder Kumar	Kalyani Publishers
2.	A Foundation Course in Value Education	R.R. Gaur & R. Sangal	Excel Books Publishers
3.	Human Values and Professional Ethics	RishabhAnand	Satya Prakashan, New Delhi

Course Code	**ME212**
Course Title	Manufacturing Processes Laboratory
Type of Course	ES
L T P	0 0 2
Credits	1
Course Prerequi	Manufacturing Practice Lab
Course Objective (CO)	The students become aware of different manufacturing processes in industry.
Course Outcomes	**Students will be able to:** **CO1** *Analyze* **the properties of molding and core sands by determining parameters such as clay content, moisture content, hardness, permeability, grain fineness number, and mechanical strengths.** **CO2** *Perform* **various casting and welding operations—such as core making, arc welding, gas welding, and MIG/TIG welding—to** *create* **standard joints (lap, butt, T-joint) and cast components.** **CO3** *Evaluate* **the working principles and industrial applications of casting and welding equipment, including cupola furnaces and welding setups, through laboratory study and industrial visits.**

LIST OF EXPERIMENTS

UNIT-1

Casting:

1. To study ingredients of molding sand and core sand.
2. Core making, core baking process and produced hollow cylindrical jobs with the help of cores.
3. To determine clay content, moisture content, hardness of a moulding sand sample.
4. To determine shatter index of a moulding sand sample.
5. To test tensile, compressive, transverse strength of moulding sand in green condition.
6. To determine permeability and grain fineness number of a moulding sand sample.
7. To study the feature of cupola furnance.

UNIT-II

Welding:

1. To make lap joint, butt joint and T- joints with manual arc welding processes
2. To make lap joint, butt joint and T- joints with the help of oxy-acetylene gas welding
3. To study MIG/TIG welding and make weld joints by these processes.
4. To study the different types of gas welding
5. To make the joints by using spot welding.

Note: At least one industrial visit must be arranged for the students for the live demonstration of Casting, Welding, Forming and Machining processes.

Course Code	**ME214**
Course Title	Applied Thermodynamics Laboratory
Type of Course	PC
L T P	0 0 2
Credits	1
Course Prerequi	Thermodynamics
Course Objective (CO)	This course is designed for providing comprehensive understanding of four stroke petrol and diesel engines and to understand the working of timing of valves in IC engines and to calculate the mechanical efficiency of engines.
Course Outcomes	**Students will be able to:** **CO1:** Explain the construction and working principles of 2-stroke and 4-stroke petrol/diesel engines, boilers, condensers, and cooling towers, and analyze valve timing diagrams and their effects on engine performance. **CO2:** Conduct performance tests on petrol and diesel engines (single and multi-cylinder) under varying load conditions to determine brake power, indicated power, friction power, mechanical efficiency, fuel consumption, and exhaust emissions, and interpret the resulting performance and emission curves. **CO3:** Perform boiler trials to calculate equivalent evaporation and overall boiler efficiency and evaluate the influence of operating parameters on thermal performance.

LIST OF EXPERIMENTS

1. Study of construction and operation of 2 stroke and 4 stroke Petrol and Diesel engines using actual engines or models.
2. To plot actual valve timing diagram of a 4 stroke petrol and diesel engines and study its impact on the performance of engine.
3. To perform a boiler trial to estimate equivalent evaporation and efficiency of a boiler.
4. Performance testing of a diesel engine from no load to full load (at constant speed) for a

single cylinder/ multi- cylinder engine in terms of brake power, indicated power, mechanical efficiency and specific fuel consumption and to measure the smoke density. Draw/obtain power consumption and exhaust emission curves.

5. Performance testing of a petrol engine from no load to full load (at constant speed) for a single cylinder/ multi- cylinder engine in terms of brake power, indicated power, mechanical efficiency and specific fuel consumption and to measure the exhaust emissions. Also draw/obtain power consumption and exhaust emission curves.

6. Study of construction and operation of various types of steam condensers and cooling towers.

Course Code	**ME216**
Course Title	Materials Engineering Laboratory
Type of Course	PC
L T P	0 0 2
Credits	1
Course Prerequi	Concepts of heat treatment processes and fundamentals of mechanical properties
Course Objective (CO)	To provide students with hands-on experience in heat treatment processes, metallographic specimen preparation, microstructure analysis, and mechanical property evaluation of ferrous and non-ferrous metals, enabling them to understand the relationship between processing, structure, and properties of engineering materials.
Course Outcomes	**After studying this course, the students will be able to:** **CO1:** Apply heat-treatment processes such as annealing, hardening, and quenching to steel specimens and demonstrate the influence of process parameters (time, temperature, and medium) on hardness. **CO2:** Analyze the microstructures of mild steel, aluminium, and hardened steel by preparing metallographic specimens and **i**nterpreting the presence of phases such as ferrite and pearlite. **CO3:** Evaluate the hardenability of steel using the Jominy End Quench Test and **assess** the relationship between cooling rate, microstructure, and resulting mechanical properties.

LIST OF EXPERIMENTS

1) Preparation of models/charts related to atomic/crystal structure of metals.

2) Annealing the steel specimen and study the effect of annealing time and temperature on hardness of steel.

3) Hardening the steel specimen and study the effect of quenching medium on hardness of steel.

4) Practice of specimen preparation (cutting, mounting, polishing, etching) of mild steel, Aluminium and hardened steel specimens.

5) Study of the microstructure of prepared specimens of Mild Steel, Aluminium and hardened steel.

6) Identification of ferrite and pearlite constituents in given specimen of milsteel.

7) Determination of hardenability of steel by Jominy End Quench Test.

Course Code	**ME301**
Course Title	**Heat Transfer**
Type of Course	PC
L T P	3 1 0
Credits	4
Course Prerequisite	Thermodynamics
Course Objective (CO)	The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection, and radiation. Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations. The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers
Course Outcomes	On completion of this course the student will be able to: CO1: Formulate and analyse heat transfer problems involving conduction, convection and radiation. CO2: Obtain temperature distributions using analytical methods, approximate methods or empirical correlations. CO3: Evaluate the rate of heat transfer in engineering systems and design heat exchangers using the LMTD and NTU methods.
SYLLABUS	
UNIT-I **Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer-approximate solution to unsteady conduction heat transfer by the use of Heissler charts.** **UNIT-II**	

Heat convection, basic equations, boundary layers- Forced convection, external and internal flows- Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer-Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow-Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.

UNIT-III

Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method

UNIT-IV

Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and ε-NTU methods. Boiling and Condensation heat transfer, Pool boiling curve. Introduction mass transfer, Similarity between heat and mass transfer.

REFERENCE BOOKS

S.No.	Name	Author(s)	Publisher
1.	Fundamentals of Heat and Mass transfer	DS Kumar	SK Kataria and Sons, Delh
2.	A Course in Heat and Mass Transfer	S Domkundwar	Dhanpat rai & Sons,Delhi
3.	Heat transfer	J P Holmans	Mcgraw hill London
4.	Heat Transfer	AJ Chapman	Macmillan Publishing Company, New York

Course Code	**ME303**
Course Title	**Fluid Mechanics & Machines**
Type of Course	PC
L T P	3 1 0
Credits	4
Course Prerequisite	Thermodynamics
Course Objective (CO)	1. To learn about the application of mass and momentum conservation laws for fluid flows 2. To understand the importance of dimensional analysis 3. To obtain the velocity and pressure variations in various types of simple flows 4. To analyse the flow in water pumps and turbines.
Course Outcomes	CO1: Formulate and analyze a heat transfer problem involving any of the three modes of heat transfer

	CO2: Obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer. CO3: Design heat exchangers and estimate the insulation needed to reduce heat losses where necessary

SYLLABUS

UNIT-I

Properties of Fluid: Definition of fluid; Newton's law of viscosity; Units and dimensions; Physical properties of fluids; Control volume; Continuity equation and momentum equation; Incompressible flow; Bernoulli's equation and its applications.

Dimensional Analysis: Dimensionally homogeneous equations; Buckingham Pi Theorem; Calculation of dimensionless parameters. Similitude and complete similarity; Model scales; Basic boundary layer theory and analysis.

UNIT-II

Fluid Kinematics: Different approaches; Reynolds transport theorem; Flow visualization; Types of flow; Strain rate, stream line, streak line, path lines and stream tubes; Continuity equation in Cartesian coordinates in 3D forms; Velocity and acceleration of fluid particles; Velocity potential function and stream function.

Momentum Equation: Momentum equation; Nervier Stoke equation; Development of Euler's equation; Bernoulli's equation and application; Steady and unsteady flow through orifice; Orifice placed in pipe; Venturimeter; Flow over triangular and rectangular notches; Pitot tube.

UNIT-III

Laminar and Turbulent Flow: Viscous/Laminar flow – Plane Poiseuille flow and Coutte flow; Laminar flow through circular pipes; Loss of head and power absorbed in viscous flow; Turbulent flow – Reynolds experiment; Frictional losses in pipe flow; Shear stress in turbulent flow; Major and minor losses (Darcy's and Chezy's equation); Flow through siphon pipes; Branching pipes and equivalent pipe.

UNIT-IV

Rotodynamic Machines: Euler's equation; Theory of Rotodynamic machines; Various efficiencies; Velocity components at entry and exit of the rotor; Velocity triangles; Centrifugal pumps – working principle, work done by the impeller and performance curves; Cavitation in pumps; Reciprocating pump – working principle.

Hydraulic Turbines: Classification of water turbines; Heads and efficiencies; Velocity triangles; Axial, radial and mixed flow turbines; Pelton wheel, Francis turbine and Kaplan turbines – working and design principles.

REFERENCE BOOKS

S.No.	Name	Author(s)	Publisher
1.	Fluid Mechanics & Hydraulic Machines	S.S. Rattan	Khanna Book Publishing, 2019

2.	Introduction to Fluid Mechanics	P.J. Pritchard, A.T. McDonald and R.W. Fox	Wiley India, 2012
3.	Fluid Mechanics	F.M. White	Tata McGraw Hill, 2011
4.	A Textbook of Fluid Mechanics and Hydraulic Machines	R. K. Bansal	Laxmi Publication, 2005

Course Code	SSC006
Course Title	Human Values and Professional Ethics
Type of Course	OE-I
L T P	3 0 0
Credits	3
Course Prerequisite	None
Course Objective (CO)	To help the students to discriminate between valuable and superficial in the life. To help students develop sensitivity and awareness; leading to commitment and courage to act on their own belief. This Course will encourage the students to discover what they consider valuable. Accordingly, they should be able to discriminate between valuable and the superficial in real situations in their life. This course is an effort to 77ulfil our responsibility to provide our students significant input about understanding
Course Outcomes	The students will able to: CO1: Learn the moral issues and problems in engineering; find the solution to those problems. CO2: Learn the need for professional ethics, codes of ethics and roles, concept of safety,risk assessment. CO3: Gain exposure to Environment Ethics & computer ethics; know their responsibilities and rights

SYLLABUS

UNIT-I

Course Introduction-Need, Basic Guidelines, Content and Process for Value Education: Understanding the need, basic guidelines, content and process for Value Education, Understanding Happiness and Prosperity correctly.

Understanding Harmony in the Human Being : Understanding the harmony with self and the Body: Sanyam and Swasthya.

UNIT II

Harmony in Human Relationship: Understanding harmony in the Family- the basic unit of human interaction, visualizing a universal harmonious order in society **Understanding Harmony in the Nature and Existence:** Understanding the harmony in the Nature, Holistic perception of harmony at all levels of existence

UNIT III

Understanding of Harmony on Professional Ethics: Ability to utilize the professional competence for augmenting universal human order, Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems

UNIT IV

Strategy for transition from the present state to Universal Human Order: At the level of individual, at the level of society. **Case studies**: typical holistic technologies, management models and production systems

REFERENCE BOOKS

NAME	AUTHOR	PUBLISHER
A Foundation Course in Value Education	R R Gaur, R Sangal	Excel Books Publishers
Energy & Equity	Ivan Illich	The Trinity Press, Worcester, and HarperCollins, USA
Human Values and Professional Ethics	RishabhAnand	Satya Prakashan, New Delhi

Course Code	**LAW005**
Course Title	**Constitution of India**
Type of Course	MC
L T P	3 0 0
Credits	NC
Course Prerequisite	None
Course Objective (CO)	(i) To provide students with knowledge of the basic features of the Indian Constitution and of the various rights and duties provided under it. (ii)
Course Outcomes	CO1. On completion of this course the student will be able to: CO2. CO1: Explain the basic features and fundamental concepts of constitutional law in India. CO3. CO2: Identify and discuss the sources of the Constitution and the rights and duties it confers. CO4. CO3: Describe the working of the governance system, including Centre–State legislative, administrative and financial relations. CO5.

SYLLABUS

UNIT–I

Constitution of India: - Basic features of the Indian Constitution: Sovereign, Socialist, Secular and Democratic Republic, Preamble of the Constitution of India: Text and features of Indian Federation and its importance, Nature of Indian Federalism and Centre-State Relations

UNIT-II

Fundamental Duties: Fundamental Duties included in the Constitution, Importance of Fundamental Duties, Directive Principles of the State Policy: Nature and Classification of Directive Principles, Criticism & Importance of Directive Principles, Parliament: Characteristics, Powers & Actual role of Parliament, Decline in the position of Parliament.

UNIT-III

President: Method & Stages of President Election, Powers and Position of the President, Prime Minister: Appointment of the Prime Minister, Powers, Changing role of Prime Minister, Supreme Court: Its Composition, Powers and Functions of Supreme Court, Position and Independence of judiciary.

UNIT-IV

Governor: Appointment, Powers and position of the Governor, Chief Minister: Powers and Position of the State Council Minister & Chief Minister, High Court: Its Composition, Powers and Functions of Supreme Court

S.No.	**Name**	**Author(s)**	**Publisher**
1	Indian Constitutional Law	M.P.Jain	Lexis Nexis, 2014
2	Introduction to Constitution	D.D. Basu	Lexis Nexis, 2014
3	Constitutional Law of India.	H.M Seervai	Universal Law Publishing, 2015

Course Code	MAI301
Course Title	Introduction to AI and Machine Learning
Type of Course	Minor Degree
L T P	3 0 0
Credits	3
Course Prerequisite	NA
Course Objective (CO)	To introduce the foundations of artificial intelligence, knowledge representation and logic programming, and to build the mathematical and programming basis required for supervised and unsupervised machine learning.
Course Outcomes	On completion of the course the student will be able to: CO1: Explain the scope of artificial intelligence and represent simple facts and rules using predicate logic. CO2: Apply matrix theory and statistics to formulate regression and classification problems. CO3: Implement and evaluate linear and logistic regression models, including remedies for overfitting. CO4: Distinguish supervised, unsupervised and clustering techniques and select an appropriate approach for a given dataset.

SYLLABUS

UNIT I

Defining Artificial Intelligence, Defining AI techniques, Using Predicate Logic and Representing Knowledge as Rules, Representing simple facts in logic, Computable functions and predicates, Procedural vs Declarative knowledge, Logic Programming, Mathematical foundations: Matrix Theory and Statistics for Machine Learning.

UNIT II

Idea of Machines learning from data, Classification of problem –Regression and Classification, supervised and Unsupervised learning.

UNIT III

Linear Regression: Model representation for single variable, Single variable Cost Function, Gradient Decent for Linear Regression, Gradient Decent in practice.

UNIT IV

Logistic Regression: Classification, Hypothesis Representation, Decision Boundary, Cost function, Advanced Optimization, Multi-classification (One vs All), Problem of Overfitting.

Discussion on clustering algorithms and use-cases cantered around clustering and classification.

Text Books/References:

1. Saroj Kaushik, Artificial Intelligence, Cengage Learning, 1st Edition 2011.
2. Anindita Das Bhattacharjee, "Practical Workbook Artificial Intelligence and Soft Computing for beginners, Shroff Publisher-X team Publisher.
3. Yuxi (Hayden) Liu, "Python Machine Learning by Example", Packet Publishing Limited, 2017.
4. Tom Mitchell, Machine Learning, McGraw Hill, 2017.
5. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2011.
6. T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e, 2011.

Course Code	MAI303
Course Title	Introduction to Data Analytics
Type of Course	Minor Degree
L T P	3 0 0
Credits	3
Course Prerequisite	NA
Course Objective (CO)	To familiarise students with the data analytics life cycle — exploratory data analysis, feature engineering, prediction and visualisation — using Python as the working environment.
Course Outcomes	On completion of the course the student will be able to: CO1: Explain the data science life cycle and the role of Python within it. CO2: Perform exploratory data analysis using quantitative and graphical techniques. CO3: Generate and select features to build predictive models. CO4: Design effective visualisations and discuss privacy, security and ethical issues in data science.

SYLLABUS

UNIT I

Introduction to Data Science, Different Sectors using Data science, Purpose and Components of Python in Data Science.

UNIT II

Data Analytics Process, Knowledge Check, Exploratory Data Analysis (EDA), EDA- Quantitative

technique, EDA- Graphical Technique, Data Analytics Conclusion and Predictions.

UNIT III

Feature Generation and Feature Selection (Extracting Meaning from Data)- Motivating application: user (customer) retention- Feature Generation (brainstorming, role of domain expertise, and place for imagination)- Feature Selection algorithms.

UNIT IV

Data Visualization- Basic principles, ideas and tools for data visualization, Examples of inspiring (industry) projects- Exercise: create your own visualization of a complex dataset.

Applications of Data Science, Data Science and Ethical Issues- Discussions on privacy, security, ethics- A look back at Data Science- Next-generation data scientists.

Text Books/References:

1. Joel Grus, Data Science from Scratch, Shroff Publisher Publisher /O'Reilly Publisher Media
2. Annalyn Ng, Kenneth Soo, Numsense! Data Science for the Layman, Shroff Publisher Publisher
3. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline. O'Reilly Publisher Media.
4. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.
5. Jake VanderPlas, Python Data Science Handbook, Shroff Publisher Publisher /O'Reilly Publisher Media
6. Philipp Janert, Data Analysis with Open Source Tools, Shroff Publisher Publisher

Course Code	ME305
Course Title	Heat Transfer Laboratory
Type of Course	PC
L T P	0 0 2
Credits	1
Course Prerequi	Applied Thermodynamics and Fluid Mechanics
Course Objective (CO)	This Lab gives insight to study of conduction, convection and radiation processes and their applications along with insight on the coefficient of heat transfer associated with it and knowledge of flow of heat in fins.

Course Outcomes	Students will be able to: CO1: Apply the principles of conduction, convection, boiling, and condensation to experimentally determine thermal conductivity, heat-transfer coefficients, and shape factors for various materials and geometries used in heat-transfer applications. CO2: Analyze the temperature distribution patterns in finned surfaces and boiling curves to evaluate fin efficiency, fin effectiveness, and the critical heat flux associated with phase-change heat transfer. CO3: Evaluate and compare experimentally measured heat-transfer parameters under different operating conditions such as free vs. forced convection or film vs. dropwise condensation to assess performance and interpret deviations from theoretical

LIST OF EXPERIMENTS

1. Determination of thermal conductivity of insulating powder material by concentric spheres method.
2. Determination of thermal conductivity of a metal rod.
3. Determination of coefficient of heat transfer for free/forced convection from the surface of a cylinder / plate when kept:
a) along the direction of flow
4. To plot the pool boiling curves for water and to determine its critical point
5. Determination of heat transfer coefficient for
i) film condensation ii) drop-wise condensation
6. Determination of shape factor of a complex body.
7. To plot the temperature profile and to determine fin effectiveness and fin efficiency for pin fin open to atmosphere.

Course Code	MAI305
Course Title	Introduction to AI and Machine Learning Laboratory
Type of Course	Minor Degree
L T P	0 0 2
Credits	1
Course Prerequisite	NA
Course Objective (CO)	To provide hands-on practice in implementing logical rules and core machine-learning algorithms in Python, and in evaluating model performance on real datasets.

Course Outcomes	On completion of the course the student will be able to: CO1: Implement logical rules and predicates in Python. CO2: Build and evaluate linear regression, gradient descent and logistic regression models. CO3: Handle missing data and diagnose underfitting and overfitting in a dataset. CO4: Implement clustering and classification algorithms and interpret their results.

Syllabus

1. Implementation of logical rules in Python.
2. Using any data apply the concept of:
    a. Liner regression
    b. Gradient decent
    c. Logistic regression
3. To add the missing value in any data set.
4. Perform and plot under fitting and overfitting in a data set.
5. Implementation of clustering and classification algorithms.

Course Code	MAI307
Course Title	Introduction to Data Analytics Laboratory
Type of Course	Minor Degree
L T P	0 0 2
Credits	1
Course Prerequisite	NA
Course Objective (CO)	To develop practical proficiency in the Python scientific stack — NumPy, SciPy, Pandas, Scikit-Learn and Matplotlib — for data manipulation, prediction and visualisation.
Course Outcomes	On completion of the course the student will be able to: CO1: Set up a Python environment and use core language constructs for data work. CO2: Perform numerical and scientific computation using NumPy and SciPy. CO3: Manipulate and clean datasets using Pandas. CO4: Build predictions using Scikit-Learn and present results using Matplotlib.

Lab Work:

1. Python Environment setup and Essentials.
2. Mathematical computing with Python (NumPy).
3. Scientific Computing with Python (SciPy).
4. Data Manipulation with Pandas.
5. Prediction using Scikit-Learn
6. Data Visualization in python using matplotlib

Course Code	**ME302**
Course Title	**Design of Machine Elements**
Type of Course	PC
L T P	3 1 0
Credits	4
Course Prerequisite	Strength of Materials, Solid Mechanics, Machine Drawing
Course Objective (CO)	This course seeks to introduce the design of machine elements commonly encountered in mechanical engineering practice, through 1. A strong background in mechanics of materials-based failure criteria underpinning the safety-critical design of machine components 2. An understanding of the origins, nature, and applicability of empirical design principles, based on safety considerations 3. An overview of codes, standards, and design guidelines for different elements 4. An appreciation of parameter optimization and design iteration 5. An appreciation of the relationships between component level design and overall machine system design and performance
Course Outcomes	CO1. On completion of this course the student will be able to: CO2. CO1: Apply mechanics-of-materials based failure theories to the design of machine components. CO3. CO2: Design and select common machine elements such as shafts, fasteners, springs, bearings and gears. CO4. CO3: Carry out failure analysis of designed components and justify the design methodology adopted. CO5.

SYLLABUS

UNIT-I

Design considerations - limits, fits and standardization, Review of failure theories for static and dynamic loading (including fatigue failure).

UNIT-II

Design of shafts under static and fatigue loadings, Analysis, and design of sliding and rolling contact bearings.

UNIT-III

Design of transmission elements: spur, helical, bevel and worm gears; belt and chain drives, Design of springs: helical compression, tension, torsional and leaf springs.

UNIT-IV

Design of joints: threaded fasteners, pre-loaded bolts and welded joints, Analysis and applications of power screws and couplings, Analysis of clutces and brakes.

REFERENCE BOOKS

S.No.	Name	Author(s)	Publisher
1.	Mechanical Engineering Design	Shigley, J.E. and Mischke, C.R	h Edition, McGraw-Hill international; 1989.
2.	Machine Design Theory and Practice	Deutschman, D., Michels, W.J. and Wilson, C.E	cmillan, 1992.
3.	Fundamentals of Machine Component Design	Juvinal, R.C	John Wiley, 1994
4.	Design of Machine elements	Spottes, M.F.	Prentice-Hall India, 1994
5.	Mechanical Design – An Integrated Approach	R. L. Norton	Prentice Hall, 1998

Course Code	**ME306**
Course Title	**Industrial Automation and Robotics**
Type of Course	PC
L T P	3 0 0
Credits	3
Course Prerequisite	Engineering Physics
Course Objective (CO)	The course aims at providing the knowledge of fluid power and methods to control the fluid power in a hydraulic or pneumatic circuit, application of fluid power to logic gate circuits, basic knowledge of robotics.
Course Outcomes	The students will able to: CO1: Enumerate principles, strategies and advantages of industrial automation CO2: Differentiate types of robots and robot grippers. CO3: Understand the basic components of robots.

SYLLABUS

UNIT-I

Introduction: Concept and scope of automation, Socio economic impacts of automation, Types of Automation, Low-Cost Automation.

Fluid Power: Fluid power control elements, Standard graphical symbols, Fluid power generators; Hydraulic and pneumatic Cylinders - construction, design and mounting; Hydraulic and pneumatic Valves for pressure, flow, and direction control.

UNIT-II

Basic hydraulic and pneumatic circuits: Direct and Indirect Control of Single/Double Acting Cylinders; Designing of logic circuits for a given time displacement diagram & sequence of operations, Hydraulic & Pneumatic Circuits using Time Delay Valve & Quick Exhaust Valve; Memory Circuit & Speed Control of a Cylinder, Troubleshooting and "Causes & Effects of Malfunctions", Basics of Control Chain, Circuit Layouts, Designation of specific Elements in a Circuit.

UNIT-III

Fluidics: Boolean algebra, Truth Tables, Logic Gates, Conda effect.

Electrical and Electronic Controls: Basics of Programmable logic controllers (PLC), Architecture & Components of PLC, Ladder Logic Diagrams.

UNIT-IV

Transfer Devices and feeders: Classification, Constructional details and Applications of Transfer devices, Vibratory bowl feeders, Reciprocating tube, Centrifugal hopper feeders.

Robotics: Introduction, Classification based on geometry, control and path movement, Robot Specifications, Robot Performance Parameters, Robot Programming, Machine Vision, Teach pendants, Industrial Applications of Robots.

REFERENCE BOOKS

S.No.	Name	Author(s)	Publisher
1	Fluid Power with applications	Anthony Esposito	Pearson
2	Robotic Technology and Flexible Automation	S. R Deb	Tata Mc Hill
3	Pneumatic Control	S. R Majumdar	McGraw Hill
4	Introduction to Robotics	Saeed B. Niku	Wiley India
5	Robotics	Ashitava Ghosal	Oxford

Course Code	**ME308**
Course Title	Mechanical Measurements and Metrology
Type of Course	PC
L T P	3 0 0
Credits	3
Course Prerequisite	Engineering mechanics

Course Objective (CO)	1. To provide a basic knowledge about measurement systems and their components 2. To learn about various sensors used for measurement of mechanical quantities 3. To learn about system stability and control 4. To integrate the measurement systems with the process for process monitoring and control
Course Outcomes	CO1.On completion of this course the student will be able to: CO2.CO1: Explain the components of a measurement system and evaluate accuracy, precision, range and error. CO3.CO2: Select and use sensors and instruments for the measurement of mechanical quantities. CO4.CO3: Apply metrological techniques to the measurement of linear, angular and surface-finish parameters. CO5.CO4: Explain the principles of system stability and the automatic control of devices. CO6.

SYLLABUS

UNIT-I

Basic Concepts of Measurements & Metrology: Measurement systems and performance, Types of measurement system, Standards of Measurement, Standardizing organizations; Limits, fits & tolerances; accuracy, range, resolution, error sources, Error sources

Linear and Angular Measurements: Working principle and applications of Linear Measuring Instruments: Vernier Calliper, Vernier Height Gauge, Vernier Depth Gauge, Micrometers of different types, Dial indicators and Comparators. Calibration of various linear measuring instruments. Working principle and applications of Angular Measuring instruments like Protractors, Sine bars, Sine centre, Angle gauges, Spirit level, Clinometers.

Screw Thread and Gear Measurements: Elements, Specification & forms of Screw Threads; Various Methods for measuring elements of External & Internal Screw Thread; Screw Thread Gauges; Errors in Threads. Forms of gear teeth, Measurement of tooth thickness, tooth profile & pitch. Errors in Gears.

UNIT-II

Measurement of Surface Finish, Straightness, Flatness: Surface Texture; Methods of Measuring Surface finish- Comparison Methods & Direct Instrument Measurement, Talysurf method; Measurement of Straightness, Flatness by Interferometry, Tool Makers microscope.

Functional Elements: Introduction of electromechanical sensors & transducers; Resistance strain gauge; Gauge Factor; Bonded & Unbounded strain gauges; Temperature Compensation.

Temperature Measurement: Thermal expansion methods- Bimetallic thermometers, Liquid in glass and filled-in-system thermometers; Metal resistance thermometers and Thermistors; Pyrometers; Calibration of temperature measuring instruments.

UNIT-III

Pressure and Flow Measurement: Bourdon tube, Mcleod gauge, Thermal conductivity gauge, Ionisation gauge; Dead weight gauge tester; Ultrasonic flow meter, Hot wire anemometer, Flow visualization techniques

Measuring instruments for Speed, Force, Torque and Shaft Power: Mechanical tachometers, Vibration reed tachometer and Stroboscope; Proving ring, Hydraulic and Pneumatic load cells, Torque on rotating shafts; Absorption, Transmission and driving dynamometers.

UNIT-IV

Control Systems: Signal processing and conditioning sensors; correction elements- actuators: pneumatic, hydraulic, electric; Control systems – basic elements, open/closed loop, design of block diagram; control method – P, PI, PID, when to choose what, tuning of controllers; System models, transfer function and system response, frequency response; Nyquist diagrams and their use.

REFERENCE BOOKS

S.No.	Name	Author(s)	Publisher
1.	Measurement System: Application and Design	E.O Doebelin	Tata McGraw Hill Publishing Company Limited, New Delhi
2.	Experimental Methods for Engineers	J.P Holman	McGraw Hill
3.	Mechanical Measurement and Control,	D.S Kumar	Metropolitan Book Co
4.	Engineering Metrology	R.K Jain	Khanna Publishers
5.	Mechanical Measurements and Instrumentation	R.K. Rajput	S. K. Kataria & Sons

Course Code	**ME316**
Course Title	**Automobile Engineering**
Type of Course	PE
L T P	3 0 0
Credits	3
Course Prerequisite	Thermodynamics
Course Objective (CO)	To understand the construction and working principles of the major systems of an automobile and to evaluate overall vehicle performance.
Course Outcomes	On completion of this course the student will be able to: CO1: Explain the function and construction of each major automobile component and system. CO2: Evaluate overall vehicle performance, including transmission, steering, braking and suspension behaviour.

	CO3: Describe modern developments in automobile technology, including emission control and electric and hybrid vehicles.

SYLLABUS

UNIT-I

Types of automobiles, vehicle construction and layouts, chassis, frame and body, vehicle aerodynamics, IC engines-components, function and materials, variable valve timing (VVT).

Engine auxiliary systems, electronic injection for SI and CI engines, unit injector system, rotary distributor type and common rail direct injection system, transistor based coil ignition & capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS).

UNIT-II

Transmission systems, clutch types & construction, gear boxes- manual and automatic gear shift mechanisms, Over drive, transfer box, flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle, Hotchkiss drive and Torque tube drive.

UNIT-III

Steering geometry and types of steering gear box, power steering, types of front axle, types of suspension systems, pneumatic and hydraulic braking systems, antilock braking system (ABS), electronic brake force distribution (EBD) and traction control.

UNIT-IV

Alternative energy sources, natural gas, LPG, biodiesel, bioethanol, gasohol and hydrogen fuels in automobiles, modifications needed, performance, combustion & emission characteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles, application of Fuel Cells

S.No.	**Name**	**Author(s)**	**Publisher**
1.	Automobile Engineering	Kirpal Singh	7th ed., Standard Publishers, New Delhi, 1997.
2.	Automobile Engineering	Jain K.K. and Asthana R.B.	Tata McGraw Hill, New Delhi, 2002.
3.	Automotive Mechanics	Heitner J.	2nd ed., East-West Press, 1999.
4.	Advanced Engine Technology	Heisler H	SAE International Publ., USA, 1998

Course Code	**ME318**
Course Title	Composite Materials
Type of Course	PE
L T P	3 0 0
Credits	3
Course Prerequisite	Materials Engineering
Course Objective (CO)	To understand the mechanical behaviour of composite materials and to gain an overview of the methods of manufacturing them.
Course Outcomes	On completion of this course the student will be able to: CO1: Explain the mechanical behaviour of composite materials and of their constituents. CO2: Describe the methods of manufacturing polymer, metal and ceramic matrix composites. CO3: Select composite materials for a given engineering application and analyse a laminate for stiffness and strength.

SYLLABUS

UNIT-I

Definition and applications of composite materials, Fibres-glass, carbon, ceramic and aramid fibres; Matrices-polymer, graphite, ceramic and metal matrices; characteristics of fibres and matrices. Lamina-assumptions, macroscopic viewpoint, generalized Hookes law, reduction of homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix, commercial material properties, rule of mixtures, transformation matrix, transformed stiffness.

UNIT-II

Manufacturing of composite materials, bag moulding, compression moulding, pultrusion, filament welding, other manufacturing processes.

UNIT-III

Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses, maximum stress and strain criteria, von Mises Yield criterion for isotropic materials, generalized Hill's criterion for anisotropic materials, Tsai-Hill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates.

UNIT-IV

Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies

REFERENCE BOOKS

S. No	Name	Author(S)	Publisher
1.	Principles of Composite Material Mechanics	Gibson R.F.	McGraw Hill.
2.	Stress Analysis of Fiber- Reinforced Composite Materials,	Hyer M.W.	McGraw Hill

S. No	Name	Author(S)	Publisher

Course Code	**ME320**
Course Title	**Computer Aided Design**
Type of Course	PE
L T P	3 0 0
Credits	3
Course Prerequisite	None
Course Objective (CO)	To introduce the fundamentals of computer-aided design — geometric modelling, transformations and CAD standards — and to develop the ability to model and document mechanical components using CAD software.
Course Outcomes	Upon completion of this course, the students can CO1: Effectively use computer and CAD software for modelling mechanical components CO2: construct the drawings and give proper dimensioning CO3: understand the CAD standards

SYLLABUS

UNIT-I

Fundamentals of Computer Graphics- Product cycle, sequential and concurrent engineering, Computer Aided Design, CAD system architecture, computer graphics, coordinate systems, 2D and 3D transformations, viewing transformation

UNIT-II

Geometric Modelling- representation of curves, Hermite curves, Bezier curves, B-spline curves, rational curves, Techniques of surface modelling, surface patch, Coons and bicubic patches, Bezier and B-spline surfaces, Solid modelling techniques, CSG and B-rep.

UNIT-III

Visual r e a l i s m - hidden line-surface-solid removal algorithms, shading, colouring, computer animation

UNIT-IV

Assembly of parts- assembly modelling, interferences of positions and orientation, tolerance analysis, mass property calculations, mechanism simulation and interefence checking

CAD standards- Graphical Kernel System (GKS), standards for vexchange images, Open Graphics Library (OpenGL), Data exchange standards- IGES, STEP, CALS etc., Communication standards

REFERENCE BOOKS

S. No	Name	Author(S)	Publisher
1.	Mastering CAD CAM	Ibrahim Zeid	Tata McGraw Hill Publishing Co.
2.	CAD/CAM Principles	C. McMohan and J. Browne	Pearson Education

S. No	Name	Author(S)	Publisher
3.	Principles of Computer Graphics	W. M. Neumann and R.F. Sproul	McGraw Hill
4.	Computer Graphics	D. Hearn and M.P Baker	Prentice Hall Inc

Course Code	**SSC008**
Course Title	**Gender, Culture and Development**
Type of Course	OE-II
L T P	3 0 0
Credits	3
Course Prerequisite	None
Course Objective (CO)	**To build an understanding of gender, culture and development, and to initiate and strengthen programmes combating gender-based violence and discrimination.**
Course Outcomes	On completion of this course the student will be able to: CO1: Explain the key concepts of gender, culture and development and their interrelationship. CO2: Identify forms of gender-based violence and discrimination and the mechanisms that address them. CO3: Discuss the role of gender equality and multiculturalism in national progress and in the professional workplace.

SYLLABUS

UNIT-I

Introduction to Gender

1. Definition of Gender
2. Basic Gender Concepts and Terminology
3. Exploring Attitudes towards Gender
4. Social Construction of Gender

UNIT-II

Gender Roles and Relations

1. Types of Gender Roles
2. Gender Roles and Relationships Matrix
3. Gender-based Division and Valuation of Labour

UNIT-III

Gender Development Issues

1. Identifying Gender Issues
2. Gender Sensitive Language
3. Gender, Governance and Sustainable Development
4. Gender and Human Rights

Gender-based Violence

1. The concept of violence
2. Types of Gender-based violence
3. The relationship between gender, development and violence
4. Gender-based violence from a human rights perspective

UNIT-IV

Gender and Culture

1. Gender and Film
2. Gender and Electronic Media

3. Gender and Advertisement
4. Gender and Popular Literature

Course Code	MAI302
Course Title	Deep Learning and Neural Network
Type of Course	Minor Degree
L T P	3 0 0
Credits	3
Course Prerequisite	NA
Course Objective (CO)	To develop an understanding of artificial neural network architectures and training methods, and to apply convolutional and recurrent networks to image and sequence problems using modern frameworks.
Course Outcomes	On completion of the course the student will be able to: CO1: Explain information flow and the basic structure of an artificial neural network. CO2: Train a neural network and determine an appropriate number of hidden layers. CO3: Apply convolutional neural networks to image classification problems. CO4: Build and deploy RNN and LSTM models using TensorFlow and Keras.

SYLLABUS

UNIT I

Information flow in a neural network, understanding basic structure and ANN.

UNIT II

Training a Neural network, how to determine hidden layers, recurrent neural network.

UNIT III

Convolutional neural networks, image classification and CNN.

UNIT IV

RNN and LSTMs. Applications of RNN in real world. Creating and deploying networks using tensor flow and keras.

Text Books/References:

1. John Paul Mueller, Luca Massaron, Deep Learning for Dummies, John Wiley & Sons.
2. Adam Gibson, Josh Patterson, Deep Learning, A Practitioner's Approach, Shroff Publisher /O'Reilly Publisher Media.
3. Christopher M. Bishop, Neural Networks for Pattern Recognition, Oxford.

Course Code	ME312
Course Title	Mechanical Measurements and Metrology Laboratory
Type of Course	PC
L T P	0 0 2

Credits	1
Course Prerequi	Manufacturing Practice and Materials Engineering
Course Objective (CO)	The objective of this course is to enable students to understand and apply the principles, operation, and applications of various precision measuring instruments including linear, angular, pressure, speed, and thermal measurement tools in order to accurately inspect, analyze, and evaluate engineering components and systems.
Course Outcomes	**After studying this course, the students will be able to:** **CO1:** Demonstrate the use of instruments for measuring linear (internal and external), angular dimensions and surface roughness. **CO2:** Identify proper measuring instrument and know requirement of calibration, errors in measurement etc. **CO3:** Apply analytical and experimental methods to make measurements and to find and correct defects in measurement systems.

LIST OF EXPERIMENTS

1. Vernier Calliper/ vernier height gauge: Principle of vernier scale to measure internal and external dimensions including depth

2. Micrometer and vernier micrometer: concept, principle and use

3. Sine bar, slip gauges and angle gauge: principle and applications

4. Surface texture: Roughness of machined and un-machined plane and spherical surfaces

5. Profile projector: to measure screw and gear elements

6. Three wire method: Diameter of external V-threads

7. Dead weight gauge: calibration of pressure gauges

8. Stroboscope: measure speed of rotating elements

9. Thermocouple: principle, applications and preparation

Course Code	MAI304
Course Title	Deep Learning and Neural Network Laboratory
Type of Course	Minor Degree
L T P	0 0 2
Credits	1
Course Prerequisite	NA
Course Objective (CO)	To provide hands-on experience in building, training and deploying deep neural networks for text and image tasks using open-source frameworks and public datasets.

Course Outcomes	On completion of the course the student will be able to: CO1: Use public datasets and notebook platforms to develop and share models. CO2: Engineer features and build a model for text analytics. CO3: Build and train a deep neural network using TensorFlow. CO4: Deploy a trained network as a web-accessible application.

Lab Work:

1. Introduction to Kaggle and how it can be used to enhance visibility.
2. Build general features to build a model for text analytics.
3. Build and deploy your own deep neural network on a website using tensor flow.
4. Russell Reed, Robert J MarksII, Neural Smithing: Supervised Learning in Feedforward Artificial Neural Networks, Bradford Book Publishers.

Course Code	**ME401**
Course Title	**Mechanical Vibrations**
Type of Course	PC
L T P	3 0 0
Credits	3
Course Prerequisite	Engineering Physics, Kinematics and Theory of Machines
Course Objective (CO)	1. Explain the concepts and dynamic modelling methods of multi-rigid body systems and flexible body systems through theoretical derivation, explanation, demonstrations and the setting of tasks that exemplify what has been taught Demonstrate proficiency in obtaining analytical and numerical solutions 3. Apply skills in instrumentation, measurement and signal processing - through vibration testing for several physical, mechanical and structural systems 4. Apply the learned vibration theory to solve engineering problems.
Course Outcomes	The students will able to: CO1: Understand the causes and effects of vibration in mechanical systems. CO2: Develop schematic models for physical systems and formulate governing equations of motion. CO3: Understand the role of damping, stiffness and inertia in mechanical systems
SYLLABUS	
UNIT-I **Introduction:** **Basic concepts, Types of vibration, Periodic & Harmonic vibrations, Methods of vibration analysis, Beats** **UNIT-II** **Vibration of Single Degree of Freedom System:** **Undamped free vibrations, damped free vibrations and damped force vibration system, Equilibrium and energy methods for determining natural Frequency, Rayleigh's method, free vibrations of system with viscous damping, over damped, critically and under damped systems, Equivalent stiffness of spring combination, Estimation of damping by decay plots, logarithmic decrement**	

Forced vibration
Sources of Excitation, Response of an undamped, damped, unbalance rotating-reciprocating systems, base and support excitation under Harmonic force, vibration isolators, transmissibility, whirling of shaft, Vibration exciters and pickups.

UNIT-III
Two degrees of Freedom systems: a) Principal modes of vibrations, natural frequencies, amplitude ratio, undamped free, damped free, forced harmonic vibration, semi-definite systems, combined rectilinear & angular modes; Lagrange's equation.
b) Application to un-damped and damped absorbers: Vibration absorber – principle; centrifugal pendulum vibration absorber, torsional vibration damper, Torsionally equivalent shaft and Langrange's Equations to form equation of motion of vibrating body.
Multi-degree of freedom systems:
Undamped free vibrations, stiffness and flexibility influence coefficients, Generalised coordinates, orthogonality
principal, matrix iteration method, Rayleigh and Dunkerley, Eigen values and eigen vectors

UNIT-IV
Continuous systems:
Lateral vibrations of a string, longitudinal vibrations of bars, transverse vibrations of beams,Euler's equation of motion for beam vibration, natural frequencies for various end conditions,torsional vibration of circular shafts

REFERENCE BOOKS

S.No.	Name	Author(s)	Publisher
1	The Science and Engineering of Materials	D.K. Bhattacharya,	Cengage Learning
2	Physical Metallurgy	Vijendra Singh	Y. Lakhin , Engineering Physical Metallurgy, Mir Publishers.
3	Heat Treatment of Metals	B. Zakharov	University Press.
4	Physical Metallurgy: Principles and Practice	V. Raghavan	PHI Learning.
5	Engineering Physical Metallurgy	Y. Lakhin	Mir Publishers.

Course Code	**ME403**
Course Title	**Refrigeration and Air Conditioning**
Type of Course	PC
L T P	3 0 0
Credits	3
Course Prerequisite	Applied Thermodynamics & Heat Transfer

Course Objective (CO)	Provide broad study of refrigeration process in different systems. Its applications in Aircraft system and study of human comfort and Load Estimation.
Course Outcomes	The students will be able to: CO1: Understand the principles and applications of refrigeration systems. CO2: Understand vapour compression refrigeration system and identify methods for performance improvement. CO3: Analyze air-conditioning processes using the principles of psychometric.

SYLLABUS

UNIT I

Introduction And Basic Cycles of Refrigeration: Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect & C.O.P. Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART).

UNIT II

Vapour Compression Refrigeration System: Single stage system, Analysis of vapour compression cycle, Use of TS and PH charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, Intercooling, Different configuration of multistage system, Cascade system.

UNIT III

Vapour Absorption Refrigeration System: Working Principle of vapour absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy – concentration diagram, Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium-Bromide water vapour absorption system, Comparison. Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary Refrigerants and CFC free refrigerants

UNIT IV

Air Conditioning and Load Estimation: Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart, Different Psychometric processes, Thermal analysis of human body, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration & ventilation, Internal heat gain, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP). Elementary knowledge of refrigeration & air conditioning equipment's compressors, condensers, evaporators & expansion devices, Air washers, Cooling, towers & humidifying efficiency, Food preservation, Cold storage, Refrigerates Freezers, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, Basic difference between comfort and industrial air conditioning.

REFERENCE BOOKS

S.No.	Name	Author(s)	Publisher
1	Refrigeration and Air-Conditioning	CP Arora	Tata McGraw Hill

2	Refrigeration and Air-Conditioning	S C Arora & S Domkundwar	Dhanpat Rai Publication
3	Refrigeration and Air-Conditioning	R.K. Rajput	Katson Books.
4	Refrigeration and Air-Conditioning	Jordan and Priester	Prentice Hall of India
5	Refrigeration and Air-Conditioning	W.F.Stocker and J.W.Jones	McGraw-Hill
6	Refrigeration and Air-Conditioning	Ramesh Arora	Prentice Hall of India

Course Code	**ME409**
Course Title	**Additive Manufacturing**
Type of Course	PE
L T P	3 0 0
Credits	3
Course Prerequisite	Manufacturing Technology
Course Objective (CO)	To provide an overview of Additive Manufacturing processes, systems and applications.
Course Outcomes	The students will be able to CO1: Acquire, apply and share in depth knowledge in the area of Energy Engineering and Management. CO2: Ability to evaluate the relationship between materials, processes, structure, and properties in AM-produced components. CO3: An ability to apply engineering and scientific principles for the effective management of energy systems.

SYLLABUS

UNIT-I

Introduction to Additive Manufacturing (AM): Evolution of AM/3D printing; Comparison with subtractive and forming processes; Advantages of AM; Classification of AM processes; Key steps in AM.

Liquid State-based AM Processes: Stereo lithography – Process and working principle; Photopolymers; Photo polymerization, layering technology, Laser and Laser scanning; Microstereolithography; Equipment and specifications; Applications, advantages, disadvantages, examples; Solid ground curing: Process, Working principle; Equipment and specifications; Applications, advantages, disadvantages, examples.

UNIT-II

Solid State-based AM Processes: Fused Deposition Modeling – Process, working principle and materials; Equipment and specifications; Laminated object manufacturing – Process and working principle; Equipment and specifications; Applications, advantages, disadvantages, examples; Other solid-state processes – Ultrasonic consolidation, Gluing, Thermal bonding; Demonstration of equipment.

UNIT-III

Powder Based AM Processes: Powder Bed Fusion Processes – Working principle and materials; Powder fusion mechanism and powder handling; Various LBF processes (principle, materials, applications and examples) – Selective laser Sintering, Electron Beam Melting, Laser Engineered Net Shaping, Binder Jetting and Direct Metal Deposition; Comparison between LBF processes; Materials-process-structure-property relationships; relative advantages and limitations.

UNIT-IV

Applications of AM: Product development lifecycle applications – Rapid prototyping, concept models, visualization aids, replacement parts, tooling, jigs and fixtures, moulds and casting; Application sectors – aerospace, automobile, medical, jewelry, sports, electronics, food, architecture, construction and others.

REFERENCE BOOKS

S No.	Name	Author(s)	Publisher
1	Modern Machining Processes	Shan and Pandey	Tata Mc Hill N. Delhi
2	G.F Benedict	Non Traditional manufacturing,	Marcel Dekker
3	P.K Mishra	Non-Conventional Machining	Narosa Publishing House N. Delhi
4	ASTME	High Velocity Forming	pf Metals PHI N. Delhi

Course Code	ME411
Course Title	**Finite Element Analysis**
Type of Course	PE
L T P	3 0 0
Credits	3
Course Prerequisite	Solid Mechanics, Design of Machine Elements
Course Objective (CO)	To illustrate the principles of mathematical modelling of engineering problems and to introduce the basics and applications of the finite element method.
Course Outcomes	On completion of this course the student will be able to: CO1: Explain the mathematical basis of the finite element method and formulate element equations. CO2: Apply the finite element method to simple structural problems, including bars, trusses and beams. CO3: Apply the finite element method to one- and two-dimensional thermal problems and interpret the results.

SYLLABUS

UNIT-I

Historical Background, Mathematical modelling of field problems in engineering, governing equations, discrete and continuous models, boundary and initial value problems, Weighted Residual Methods, Variational formulation of boundary value problems, Ritz technique, Basic concept of Finite Element Method.

UNIT-II

One dimensional second order equation, discretization, linear and higher order elements, derivation of shape functions, Stiffness matrix and force vectors, assembly of elemental matrices, solution of problems from solid mechanics and heat transfer, longitudinal vibration and mode shapes, fourth order beam equation, transverse deflections and natural frequencies.

UNIT-III

Two dimensional equations, variational formulation, finite element formulation, triangular elements- shape functions, elemental matrices and RHS vectors; application to thermal problems, torsion of non-circular shafts, quadrilateral, and higher order elements. Plane stresses and plane strain problems, body forces and thermal loads, plate, and shell elements.

UNIT-IV

Natural coordinate systems, isoparametric elements and shape functions, numerical integration, and application to plane stress problems, matrix solution techniques, solution of dynamic problems, introduction to FE software.

REFERENCE BOOKS

S.No.	Name	Author(s)	Publisher
1.	An Introduction to Finite Element Method	Reddy J.N.,	Tata McGraw Hill
2.	Textbook of Finite Element Analysis	Seshu P.	Prentice Hall, New Delhi
3.	The Finite Element Method in Engineering	Rao S. S	Butterworth Heinemann

Course Code	**ME373**
Course Title	**Industrial Engineering Management**
Type of Course	OE
L T P	3 0 0

Credits	3
Course pre-requisite	None
Course Objectives	To familiarize the students with management of industrial resources and production operations
Course outcomes	1)Student shall be able to describe basic concepts and theories within the area of industrial management 2)Student shall be able to present organization analysis. 3)Student shall also be able to use simple project planning technique

SYLLABUS

UNIT-1

Introduction: Definition and scope of industrial engineering Role of an industrial engineering Role of an industrial engineer in industry, Functions of industrial engineering department and its organization, Qualities of an industrial engineer. Plant Layout and Material Handling: Different types of layouts viz. Product, process and combination layouts, Introduction to layouts based on the GT, JIT and cellular manufacturing systems, Development of plant layout. Types of material handling equipment, relationship of material handling with plant layouts.

UNIT -2

Work-study: Areas of application of work study in industry; Method study and work measurements and their inter-relationship. Reaction of management and labour to work study; Role of work study in improving plant productivity and safety. Method Study: Objectives and procedure for methods analysis: Select, Record, Examine, Develop, Define, Install and Maintain. Recording techniques, Micromotion and macro-motion study: Principles of motion economy, Normal work areas and workplace design.

UNIT-3

Work Measurement: Objectives, Work measurement techniques - time study, work sampling, pre-determined motion time standards (PMTS) Determination of time standards. Observed time, basic time, normal time, rating factors, allowances, standard time. Value Engineering: Types of values, concept of value engineering, phases of value engineering studies, application of value engineering.

UNIT-4

Work Design: Concepts of job enlargement, job enrichment and job rotation. Effective job design considering technological and behaviour factors. Ergonomics: Introduction to ergonomic considerations in designing man-machine systems with special reference to design of displays and controls.

REFERENCE BOOKS

S. No	Author	Title	Publisher
1	Gayler Shotbolt	Introduction to Work study	Tata McGraw Hill

2	H.S. Shan	Work Study and Ergonomics	Dhanpat Rai and Co. Ltd
3	R. Bernes	Motion and time study by	John-Wiley
4	D.J. Oborne	Ergonomics at work	John Wiley
5	D. Miles	Techniques of Value Analysis and Engineering	McGraw Hill

Course Code	**ME415**
Course Title	**Renewable Energy Engineering**
Type of Course	PE
L T P	3 0 0
Credits	3
Course Prerequisite	
Course Objective (CO)	Upon completion of the course, the students can understand the principles of operation for different power plants and their economics.
Course Outcomes	**CO1:** Explain the principles, potential, and environmental impact of various renewable energy sources, with detailed understanding of solar radiation physics, measurement techniques, and solar energy collection systems including flat plate and concentrating collectors. **CO2:** Analyze the working principles, performance characteristics, and energy conversion mechanisms of solar, wind, and biomass energy systems, including energy storage methods and practical applications such as photovoltaic systems, biogas production, and wind turbines. **CO3:** Evaluate the technical feasibility, conversion methods, and economic considerations of emerging renewable energy technologies including geothermal, ocean (OTEC), tidal, wave, mini-hydel systems, and direct energy conversion processes.

SYLLABUS

UNIT-I

Introduction: Basic concepts of energy; Introduction to Renewable Energy Technologies; Energy and Environment – global warming, acid rains, depletion of ozone layer; Global and Indian Scenario of renewable energy sources; Energy storage - necessity and energy storage methods.

Solar Energy: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Measurement of solar radiation data.

UNIT-II

Solar Thermal Systems: Introduction; Basics of thermodynamics and heat transfer; Flat plate collector; Evacuated Tubular Collector; Solar air collector; Solar concentrator; Solar distillation; Solar cooker; Solar refrigeration and air conditioning; Thermal energy storage systems.

Solar Photovoltaic Systems: Introduction; Solar cell Fundamentals; Characteristics and classification; Solar cell: Module, panel and Array construction; Photovoltaic thermal systems.

UNIT-III

Wind Energy: Introduction; Origin and nature of winds; Wind turbine siting; Basics of fluid mechanics; Wind turbine aerodynamics; wind turbine types and their construction; Wind energy conversion systems.

Fuel cells: Overview; Classification of fuel cells; Operating principles; Fuel cell thermodynamics.

UNIT-IV

Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies; Urban waste to energy conversion; Biomass gasification.

Other forms of Energy: Introduction: Nuclear, ocean and geothermal energy applications; Origin and their types; Working principles.

S.No.	Name	Author(s)	Publisher
1	Non-Conventional Energy Sources	G.D. Rai	Khanna Publishers
2	Renewable Energy Resources	Twidell&Wier	CRC Press(Taylor & Francis)
3	Renewable Energy Resources	Tiwari and Ghosal	Narosa.
4	Renewable Energy Technologies	K Mittal	Wheeler

Course Code	ME417
Course Title	**Mechatronic Systems**
Type of Course	PE
L T P	3 0 0
Credits	3
Course Prerequisite	None
Course Objective (CO)	To understand the structure of microprocessors and their applications in mechanical devices To understand the principle of automatic control and real time motion control systems, with the help of electrical drives and actuators To understand the use of micro-sensors and their applications in various fields
Course Outcomes	On completion of this course the student will be able to: CO1: Explain the architecture of microprocessor- and microcontroller-based mechatronic systems. CO2: Select micro-sensors, actuators and signal-conditioning elements for a mechatronic application. CO3: Design and analyse real-time motion control systems using the principles of automatic control.

SYLLABUS

UNIT-I

Introduction: Definition of Mechanical Systems, Philosophy, and approach; Systems and Design: Mechatronic approach, Integrated Product Design, Modelling, Analysis and Simulation, Man- Machine Interface; Sensors and transducers: classification, Development in Transducer technology, Opto-electronics- Shaft encoders, CD Sensors, Vision System, etc.

UNIT-II

Drives and Actuators: Hydraulic and Pneumatic drives, Electrical Actuators such as servo motor and Stepper motor, Drive circuits, open and closed loop control; Embedded Systems: Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems.

UNIT-III

Smart materials: Shape Memory Alloy, Piezoelectric and Magnetostrictive Actuators: Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation, etc.

UNIT-IV

Micro-mechatronic systems: Microsensors, Micro-actuators; Micro-fabrication techniques LIGA Process: Lithography, etching, Micro-joining etc. Application examples; Case studies Examples of Mechatronic Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and

Medical Technology.

REFERENCE BOOKS

S.No.	Name	Author(s)	Publisher
1.	Mechatronics System Design	Devdas Shetty & Richard A. Kolk,	PWS Publishing Company
2.	Mechatronics: A multidisciplinary Approach	William Bolton,	Pearson Education
3.	A Textbook of Mechatronics	R.K.Rajput	S. Chand & Company Private Limited

Course Code	ME419
Course Title	**Power Plant Engineering**
Type of Course	PE
L T P	3 0 0
Credits	3
Course Prerequisite	Applied Thermodynamics, Heat Transfer, Fluid Mechanics and Fluid Machinery
Course Objective (CO)	To provide an overview of power plants and of the associated energy conversion and economic issues.
Course Outcomes	On completion of this course the student will be able to: CO1: Explain the principles of operation of thermal, hydro, nuclear, diesel and gas turbine power plants. CO2: Analyse the economics of thermal power plant operation, including load factors and tariffs. CO3: Discuss power plant instrumentation, pollution control and safety requirements.

SYLLABUS

UNIT-I

Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems.

UNIT-II

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

UNIT-III

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

UNIT-IV

Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.

Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

REFERENCE BOOKS

S.No.	Name	Author(s)	Publisher
1.	Power Plant Engineering	Nag P. K	Tata McGraw Hill
2.	Power Plant Technology	El Wakil M.M	Tata McGraw Hill
3.	Power Plant Engineering,	Elliot T.C., Chen K and Swanekamp R.C	McGraw Hill

Course Code	MAI401
Course Title	Special Topics in Artificial Intelligence
Type of Course	Minor Degree
L T P	3 0 0
Credits	3
Course Prerequisite	NA
Course Objective (CO)	To expose students to advanced and emerging areas of artificial intelligence, including Bayesian filtering, deep and reinforcement learning, generative models and learning from evolving data streams.
Course Outcomes	On completion of the course the student will be able to: CO1: Explain Bayesian filtering and its use in state estimation. CO2: Describe deep neural network and deep reinforcement learning architectures. CO3: Compare self-play and generative adversarial networks and their applications.

	CO4: Apply techniques for learning from concept-drifting data streams.

SYLLABUS

UNIT I

Bayesian Filtering; Recurrent Neural Networks, Deep Neural Networks, Deep Reinforcement Learning.

UNIT IISelf-Play Networks, Generative Adversarial Networks, Learning from Concept-Drifting Data Streams.UNIT IIIUNIT IVText Books/References:

1. Dr. Nilakshi Jain, Artificial Intelligence: Making a System Intelligent, John Wiley & Sons.
2. Artificial Intelligence & Soft Computing for Beginners, 3rd Edition-2018, by Anindita Das, Shroff Publisher Publisher.
3. Artificial Intelligence: A Modern Approach, 3rd Edition, by Stuart Russell and Peter Norvig, Pearson Publisher.
4. New Artificial Intelligence (Advanced), Takashi Maeda and Fumio Aoki, Ohmsha Publisher.

Course Code	MAI403
Course Title	Applications of AI
Type of Course	Minor Degree
L T P	3 0 0
Credits	3
Course Prerequisite	NA
Course Objective (CO)	To survey the application of artificial intelligence across business, healthcare, manufacturing and security domains, and to examine emerging AI-enabled technologies.
Course Outcomes	On completion of the course the student will be able to: CO1: Explain the linguistic aspects of natural language processing and the role of quantum computing in AI. CO2: Describe applications of AI in business, sales and customer support. CO3: Apply AI techniques to emotion recognition, early disease prediction and investment analysis. CO4: Discuss AI-optimised hardware, digital twins and the use of AI in information security.

SYLLABUS

UNIT I

Linguistic aspects of natural language processing, A.I. And Quantum Computing, Applications of Artificial Intelligence (AI) in business.

UNIT II

Emotion Recognition using human face and body language, AI based system to predict the diseases early, Smart Investment analysis, AI in Sales and Customer Support.

UNIT III

Robotic Processes Automation for supply chain management.

UNIT IV

AI-Optimized Hardware, Digital Twin i.e. AI Modelling, Information Technology & Security using AI.

Recent Topics in AI/ML: AI/ML in Smart solutions, AI/ML in Social Problems handling, Block chain and AI.

Text Books/References:

1. Sameer Dhanrajani, AI and Analytics, Accelerating Business Decisions, John Wiley & Sons.
2. Life 3.0: Being Human in the Age of Artificial Intelligence by Max Tegmark, published July 2018.
3. Homo Deus: A Brief History of Tomorrow by Yuval Noah Harari, published March 2017.
4. Artificial Intelligence in Practice: How 50 Successful Companies Used AI and Machine Learning to Solve Problems, Bernard Marr, Matt Ward, Wiley.

Course Code	ME405
Course Title	Refrigeration and Air Conditioning Laboratory
Type of Course	PC
L T P	0 0 2
Credits	1
Course Prerequi	Applied Thermodynamics and Heat Transfer
Course Objective (CO)	Provide broad study of refrigeration process in different systems. Its applications in Aircraft system and study of human comfort and Load Estimation.
Course Outcomes	**Students will be able to:** **CO1 :** Explain the construction and working principles of various refrigeration and air-conditioning systems—including VCR systems, Electrolux refrigerator, domestic refrigerator, window AC, and water cooler—using cut-section models and actual equipment. **CO2: Conduct** performance tests on refrigeration and air-conditioning equipment and **analyze** key parameters such as COP, cooling capacity, power consumption, and system efficiency. **CO3: Estimate** cooling load requirements for large buildings and **evaluate** real-world HVAC installations (central AC plant, ice plant, cold storage) during industrial visits to assess system operation and suitability for different applications.

LIST OF EXPERIMENTS

1. Study of various elements of a vapour compression refrigeration system through cut sections models / actual apparatus.

2. Study and performance testing of domestic refrigerator.

3. Study the performance testing of Electrolux refrigerator.

4. Calculation/ Estimation of cooling load for a large building.

5. Visit to a central Air conditioning plant for study of processes for winter and summer air-conditioning

6. Visit to a cold storage site to study of its working.

7. Study and performance testing of window-type room air conditioner.

8. Study and performance testing of water cooler.