ME - COURSE STRUCTURE

I Year I Semester

S. No.	Course Code	Name of Course / Laboratory	No. of Periods per week			No. of Credits
			L	T	P	
1	PH4501	Engineering Physics	3	0	0	3
2	MA4501	Linear Algebra & Calculus	3	0	0	3
3	EE4501	Basic Electrical & Electronics Engineering	3	0	0	3
4	ME4501	Engineering Graphics	1	0	4	3
5	CT4501	Introduction to Programming	3	0	0	3
6	PH4502	Engineering Physics Lab	0	0	2	1
7	EE4502	Electrical & Electronics Engineering Workshop	0	0	3	1.5
8	CT4502	Computer Programming Lab	0	0	3	1.5
9	CT4503	IT Workshop	0	0	2	1
10	NS4501	NSS/NCC/Scouts & Guides/Community Service	-	-	1	0.5
Total			**13**	**0**	**15**	**20.5**

I Year II Semester

S. No.	Course Code	Name of Course / Laboratory	No. of Periods per week			No. of Credits
			L	T	P	
1	EG4501	Communicative English	2	0	0	2
2	CH4503	Engineering Chemistry	3	0	0	3
3	MA4502	Differential Equations & Vector Calculus	3	0	0	3
4	CM4501	Basic Civil & Mechanical Engineering	3	0	0	3
5	CE4501	Engineering Mechanics	3	0	0	3
6	EG4502	Communicative English Lab	0	0	2	1
7	CH4504	Engineering Chemistry Lab	0	0	2	1
8	CE4502	Engineering Mechanics Lab	0	0	3	1.5
9	ME4502	Engineering Workshop	0	0	3	1.5
10	HW4501	Health and Wellness, Yoga and Sports	-	-	1	0.5
Total			**14**	**0**	**11**	**19.5**

II B.Tech - I Semester

Sl. No.	Course Code	Name of Course / Laboratory	No. of Periods per week			No. of Credits
			L	T	P	
1	MA4504	Numerical Methods and Transform Techniques	3	0	0	3
2	ME4503	Thermodynamics	2	0	0	2
3	ME4504	Mechanics of Solids	3	0	0	3
4	ME4505	Material Science and Metallurgy	3	0	0	3
5	ME4506	Mechanics of Solids and Materials Science Lab	0	0	3	1.5
6	ME4507	Computer- Aided Machine Drawing	0	0	3	1.5
7	CT4507	Python programming Lab	0	0	2	1.0
8	EC4501	Embedded Systems and IoT	0	1	2	2
9	DT4501	Design Thinking & Innovation	1	0	2	2
10	EN4501	Environmental Science	2	0	0	-
Total			**14**	**1**	**12**	**19**

II Year II Semester

Sl. No.	Course Code	Name of Course / Laboratory	No. of Periods per week			No. of Credits
			L	T	P	
1	UH4501	Universal Human Values– Understanding Harmony & Ethical Human Conduct	2	1	0	3
2	MA4509	Complex Variables, Probability and Statistics	3	0	0	3
3	ME4508	Industrial Management	2	0	0	2
4	ME4509	Manufacturing Processes	3	0	0	3
5	ME4510	Fluid Mechanics & Hydraulic Machines	3	0	0	3
6	ME4511	Theory of Machines	3	0	0	3
7	ME4512	Fluid Mechanics & Hydraulic Machines Lab	0	0	3	1.5
8	ME4513	Manufacturing Processes Lab	0	0	3	1.5
9	EG4503	Soft Skills	0	1	2	2
Total :			**16**	**2**	**08**	**22**

III B.Tech - I Semester

Sl. No.	Course Code	Name of Course / Laboratory	No. of Periods per week			No. of Credits
			L	T	P	
1	ME4514	Machine Tools and Metrology	3	-	-	3
2	ME4515	Thermal Engineering	3	-	-	3
3	ME4516	Design of Machine Elements	3	-	-	3
4		**Professional Elective – I**	3	-	-	3
5		**Open Elective – I**	3	-	-	3
6	ME4523	Machine tools and Metrology Lab	-	-	4	2
7	ME4524	Thermal Engineering Lab	-	-	3	1.5
8	ME4525	Theory of Machines Lab	-	-	3	1.5
9	EE4518	Tinkering Lab	-	-	2	1
10	ME4526	Community Service Internship	-	-	4	2
Total			**15**	**-**	**14**	**23**

III Year II Semester

Sl. No.	Course Code	Name of Course / Laboratory	No. of Periods per week			No. of Credits
			L	T	P	
1	ME4527	Heat Transfer	3	-	-	3
2	DM4503	Artificial Intelligence and Machine Learning	3	-	-	3
3	ME4528	Finite Element Methods	3	-	-	3
4	-	**Professional Elective – II**	3	-	-	3
5	-	**Professional Elective – III**	3	-	-	3
6	-	**Open Elective – II**	3	-	-	3
7	ME4539	Heat Transfer Lab	-	-	3	1.5
8	DM4507	Artificial Intelligence and Machine Learning Lab	-	-	3	1.5
9	ME4540	Robotics and Drone Technologies Lab	-	-	4	2
10	EG4504	Technical Paper Writing and IPR	2	-	-	-
Total :			**20**	**-**	**10**	**23**

Electives

Professional Elective – I

ME4517 Design for Manufacturing
ME4518 Conventional and Futuristic Vehicle Technology
ME4519 Renewable Energy Technologies
ME4520 Industrial Hydraulics and Pneumatics
MOOCs

Professional Elective – II

ME4529 Advanced Manufacturing Processes
ME4530 Non-Destructive Testing
ME4531 Micro Electro Mechanical Systems
ME4532 Sensors and Instrumentation
MOOCs

Professional Elective – III

ME4533 Energy Storage Technologies
ME4534 Industrial Robotics
ME4535 Mechatronics
ME4536 Advanced Material Science
MOOCs

Open Elective – I

ME4521 Principles of Sustainable Energy Technologies
ME4522 Additive Manufacturing

Open Elective – II

ME4537 Green Engineering
ME4538 Non-Destructive Evaluation
MOOCs

Honors Degree Course Structure

Sl. No.	Course Code	Year & Sem.	Name of Course / Laboratory	No. of Periods per week			No. of Credits
				L	T	P	
1	HME4501	III-I	Analysis and Synthesis of Mechanisms	3	-	-	3
2	HME4502	III-I	Machine Dynamics Lab	-	-	3	1.5
3	-		MOOCs	-	-	-	3
4	HME4503	III-II	Advanced Mechanisms and Robotics	3	-	-	3
5	HME4504	III-II	Mechanisms and Robotics Lab	-	-	3	1.5
6	-		MOOCs	-	-	-	3
7		IV-I					
8		IV-I					
Total							

ENGINEERING PHYSICS

(Common to All Branches)

I Year – I Semester

Lecture :3	Internal Marks : 30
Credits :3	External Marks : 70

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Course Objectives

- To apply principles of wave optics for Engineering Applications
- To Analyze crystal parameters to investigate crystal Structures
- To Impart the knowledge of solid state materials with characteristic utility in various engineering applications

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyze the intensity variation of light due to polarization, interference and diffraction.
- familiarize with the basics of crystals and their structures.
- summarize various types of polarization of dielectrics and classify the magnetic materials.
- explore the basic concepts of Quantum Mechanics and the Free electron theory of solids.
- identify conductivity mechanism in semiconductors

Course Content

UNIT – I: Wave Optics

Interference: Introduction - Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Colours in thin films- Newton's Rings, Determination of wavelength and refractive index.

Diffraction: Introduction - Fresnel and Fraunhofer diffractions - Fraunhofer diffraction due to single slit, double slit & N-slits (Qualitative) – Diffraction Grating - Dispersive power and resolving power of Grating (Qualitative). Polarization: Introduction -Types of polarization - Polarization by reflection, refraction and Double refraction - Nicol's Prism -Half wave and Quarter wave plates.

UNIT – II: Crystallography and X-ray diffraction

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes.

X-ray diffraction: Bragg's law - X-ray Diffractometer – crystal structure determination by Laue's and powder methods

UNIT – III: Dielectric and Magnetic Materials

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector – Relation between the electric vectors - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation

polarizations (Qualitative) - Lorentz internal field - Clausius- Mossotti equation - complex dielectric constant – Frequency dependence of polarization – dielectric loss

Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic materials: Dia, para, Ferro, anti-ferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials.

UNIT – IV: Quantum Mechanics and Free electron Theory

Quantum Mechanics: Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well.

Free Electron Theory: Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory – electrical conductivity based on quantum free electron theory - Fermi-Dirac distribution - Density of states - Fermi energy

UNIT – V: Semiconductors

Semiconductors: Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors: Density of charge carriers – Electrical conductivity – Fermi level – Extrinsic semiconductors: density of charge carriers – dependence of Fermi energy on carrier concentration and temperature - Drift and diffusion currents – Einstein's equation – Hall effect and its applications.

Text Books:

1. A Text book of Engineering Physics, M. N. Avadhanulu, P. G. Kshirsagar & TVS Arun Murthy, S. Chand Publications, 11th Edition 2019.
2. Engineering Physics - D. K. Bhattacharya and Poonam Tandon, Oxford press (2015)

Reference Books:

1. Engineering Physics - B.K. Pandey and S. Chaturvedi, Cengage Learning 2021.
2. Engineering Physics - Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018.
3. Engineering Physics" - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press. 2010
4. Engineering Physics - M.R. Srinivasan, New Age international publishers (2009).

e-Learning Resources:

1. https://www.loc.gov/rr/scitech/selected-internet/physics.html

LINEAR ALGEBRA AND CALCULUS

(Common to All Branches)

I Year – I Semester

Lecture :3	Internal Marks : 30
Credits :3	External Marks : 70

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Course Objectives

- To equip the students with standard concepts and tools at an intermediate to advanced level of mathematics to develop the confidence and ability among the students to handle various real-world problems and their applications.

Course Outcomes

Upon successful completion of the course, the students will be able to

- develop and use of matrix algebra techniques that are needed by engineers for practical applications.
- compute eigen values and eigenvectors of real matrices.
- utilize mean value theorems to real life problems.
- familiarize with functions of several variables, which are useful in optimization.
- measure areas and volumes using double and triple integrals.

Course Content

UNIT – I: Matrices

Rank of a matrix by Echelon form, Normal form. Cauchy–Binet formula (without proof). Inverse of non- singular matrices by Gauss-Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Jacobi and Gauss Seidel Iteration Methods.

UNIT – II: Eigenvalues, Eigenvectors and Orthogonal Transformation

Eigenvalues, Eigenvectors and their properties, Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton Theorem, Quadratic forms and Nature of the Quadratic Forms, Reduction of Quadratic form to canonical form by Orthogonal Transformation.

UNIT – III: Calculus

Mean Value Theorems: Rolle's Theorem, Lagrange's mean value theorem with their geometrical interpretation, Cauchy's mean value theorem, Taylor's and Maclaurin's theorems with remainders (without proof), Problems and applications on the above theorems.

UNIT – IV: Partial differentiation and Applications (Multi variable calculus)

Functions of several variables: Continuity and Differentiability, Partial derivatives, total derivatives, chain rule, Taylor's and Maclaurin's series expansion of functions of two variables. Jacobians, Functional dependence, maxima and minima of functions of two variables, method of Lagrange multipliers.

UNIT – V: Multiple Integrals (Multi variable Calculus)

Double integrals, triple integrals, change of order of integration, change of variables to polar, cylindrical and spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition
2. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10th Edition.

Reference Books:

1. Thomas Calculus, George B.Thomas, Maurice D.Weir and Joel Hass, Pearson Publishers, 2018, 14th Edition.
2. Advanced Engineering Mathematics, R. K. Jain and S.R.K.Iyengar, Alpha Science International Ltd., 2021, 5th Edition(9th reprint)
3. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5thEdition.
4. Advanced Engineering Mathematics, Micheael Greenberg, , Pearson publishers, 9thEdition
5. Higher Engineering Mathematics, H. K Das, Er.Rajnish Verma, S.Chand Publications, 2014, 3rd Edition (Reprint 2021)

BASIC ELECTRICAL & ELECTRONICS ENGINEERING

(Common to All Branches)

I Year – I Semester

Lecture :3	Internal Marks : 30
Credits :3	External Marks : 70

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PART A: BASIC ELECTRICAL ENGINEERING

Course Objectives

To expose the students to the fundamentals of dc and ac circuits, electrical machines, measuring instruments, operation of various power generation systems, electricity bill and electrical safety measures.

Course Outcomes

Upon successful completion of the course, the students will be able to

- apply fundamental laws / concepts to derive various equations related to impedance, voltage, current and power in electrical circuits.
- describe the construction and working principles of electrical machines, measuring instruments and power generation stations.
- calculate the electrical load / electrical bill for domestic premises and explain the electrical safety measures.

Course Content

UNIT – I: DC & AC Circuits

DC Circuits: Electrical circuit elements (R, L and C), Ohm's Law and its limitations, KCL & KVL, series, parallel, series-parallel circuits, Super Position theorem, Simple numerical problems.

AC Circuits: A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor, Voltage and current relationship with phasor diagrams in R, L, and C circuits, Concept of Impedance, Active power, reactive power and apparent power, Concept of power factor (Simple Numerical problems).

UNIT – II: Machines and Measuring Instruments

Machines: Construction, principle and operation of (i) DC Motor, (ii) DC Generator, (iii) Single Phase Transformer, (iv) Three Phase Induction Motor and (v) Alternator, Applications of electrical machines.

Measuring Instruments: Construction and working principle of Permanent Magnet Moving Coil (PMMC), Moving Iron (MI) Instruments and Wheat Stone bridge.

UNIT – III: Energy Resources, Electricity Bill & Safety Measures

Energy Resources: Conventional and non-conventional energy resources; Layout and operation of various Power Generation systems: Hydel, Nuclear, Solar & Wind power generation.

Electricity bill: Power rating of household appliances including air conditioners, PCs, Laptops,Printers, etc. Definition of "unit" used for consumption of electrical energy, two-part electricitytariff, calculation of electricity bill for domestic consumers.

Equipment Safety Measures: Working principle of Fuse and Miniature circuit breaker(MCB), merits and demerits. Personal safety measures: Electric Shock, Earthing and its types, Safety Precautions to avoid shock.

Text Books:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition

2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition

Reference Books:

1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019,Fourth Edition
2. Principles of Power Systems, V.K. Mehtha, S.Chand Technical Publishers, 2020
3. Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford UniversityPress, 2017
4. Basic Electrical and Electronics Engineering, S. K. Bhatacharya, Person Publications,2018, Second Edition.

e-Learning Resources:

1. https://nptel.ac.in/courses/108105053
2. https://nptel.ac.in/courses/108108076

PART B: BASIC ELECTRONICS ENGINEERING

Course Objectives

To teach the fundamentals of semiconductor devices, basic electronic circuits and instrumentation and principles of digital electronics.

Course Outcomes

Upon successful completion of the course, the students will be able to

- expound the operation and characteristics of various diodes, transistors and amplifiers.
- describe the working of rectifiers, regulators, amplifiers with its frequency response, and electronic instrumentation system.
- explicate the various number systems, logic gates, simple combinational circuits and sequential circuits

Course Content

UNIT – I: Semiconductor Devices

Introduction - Evolution of electronics – Vacuum tubes to nano electronics - Characteristics ofPN Junction Diode — Zener Effect — Zener Diode and its Characteristics. Bipolar Junction Transistor — CB, CE, CC Configurations and Characteristics — Elementary Treatment of Small Signal CE Amplifier.

UNIT – II: Basic Electronic Circuits And Instrumenttaion

Rectifiers and power supplies: Block diagram description of a dc power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response. Electronic Instrumentation: Block diagram of an electronic instrumentation system.

UNIT – III: Digital Electronics

Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Boolean Algebra, Basic Theorems and properties of BooleanAlgebra, Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. Simple combinational circuits–Half and Full Adders. Introduction to sequential circuits, Flip flops, Registers and counters (Elementary Treatment only)

Text Books:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009

Reference Books:

1. R. S. Sedha, A Textbook of Electronic Devices and Circuits, S. Chand & Co, 2010.
2. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India, 2002.
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version,Pearson Education, 2009.

End Examination Pattern:

i) Question paper shall be in two parts viz., Part A and Part B with equal Weightage of 35 marks each.

ii) In each part, question 1 shall contain 5 compulsory short answer questions for a total of 5 marks such that each question carries 1 mark.

iii) In each part, questions from 2 to 4, there shall be either/or type questions of 10 marks each. Student shall answer any one of them.

iv) The questions from 2 to 4 shall be set by covering one unit of the syllabus for eachquestion.

ENGINEERING GRAPHICS

(Common to All Branches)

I Year – I Semester

Lecture :1	Practice :4	Internal Marks	: 30
Credits :3		External Marks	: 70

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Course Objectives

- To impart basic knowledge and skills required to prepare engineering drawings

Course Outcomes

Upon successful completion of the course, the students will be able to

- demonstrate the ability to construct regular polygons and curves.
- develop various scales to accurately represent measurements on engineering drawings.
- prepare orthographic projections for points, lines and planes.
- create projections for solids.
- demonstrate the ability to section and develop surfaces for simple geometric shapes.
- construct orthographic views from isometric views and vice versa
- utilize computer graphics tools to create 2D and 3D drawings of objects.

Course Content

UNIT – I:

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing regular polygons by general methods.

Curves: construction of ellipse, parabolaand hyperbola by general, Cycloids, Involutes, Normal and tangent to Curves.

Scales: Plain scales, diagonal scales and vernier scales.

UNIT – II:

Orthographic Projections: Reference plane, importance of reference lines or Plane, Projections of a point situated in any one of the four quadrants.

Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes

Projections of Planes: regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

UNIT – III:

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to another plane.

UNIT – IV:

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids in simple position only.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

UNIT – V:

Conversion of Views: Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

Computer graphics: Creating 2D & 3D drawings of objects including PCB and Transformations using Auto CAD (Not for end examination).

Text Book:

1. N.D. Bhatt, Engineering Drawing, Charotar Publishing House, 2016.

Reference Books:

1. Engineering Drawing, K. L. Narayana and P. Kannaiah,Tata Mc Graw Hill, 2013.
2. Engineering Drawing, M. B. Shahand B.C.Rana, Pearson Education Inc, 2009.
3. Engineering Drawing with an Introduction to Auto CAD, Dhananjay Jolhe, Tata Mc Graw Hill, 2017.

INTRODUCTION TO PROGRAMMING

(Common to All Branches)

I Year – I Semester

Lecture :3	Internal Marks : 30
Credits :3	External Marks : 70

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Course Objectives

- To foster logical thinking and problem – solving skills using programming.
- To familiarize students with programming concepts such as data types, control structures, functions, arrays and files.

Course Outcomes

Upon successful completion of the course, the students will be able to

- solve problems using the concepts of algorithm and algorithmic thinking.
- use control structures in programming for solving the problems
- apply the concepts of arrays and strings in problem solving.
- use pointers and user-defined data types in developing the programs
- write functions to increase the reusability of code and use various file handling functions for efficient handling of data.

Course Content

UNIT – I: Introduction to Programming and Problem Solving

History of Computers, Basic organization of a computer: ALU, input-output units, memory, program counter, Introduction to Programming Languages, Basics of a Computer Program Algorithms, flowcharts (Using Dia Tool), pseudo code. Introduction to Compilation and Execution, Primitive Data Types, Variables, and Constants, Basic Input and Output, Operations, Type Conversion, and Casting.

Problem solving techniques: Algorithmic approach, characteristics of algorithm,
Problem solving strategies: Top-down approach, Bottom-up approach, Time and space complexities of algorithms.

UNIT – II: Control Structures

Simple sequential programs Conditional Statements (if, if-else, switch), Loops (for, while, dowhile) Break and Continue.

UNIT – III: Arrays and Strings

Arrays indexing, memory model, programs with array of integers, two dimensional arrays, Introduction to Strings.

UNIT – IV: Pointers & User Defined Data types

Pointers, dereferencing and address operators, pointer and address arithmetic, array manipulation using pointers, User-defined data types-Structures and Unions.

UNIT – V: Functions & File Handling

Introduction to Functions, Function Declaration and Definition, Function call Return Types and Arguments, modifying parameters inside functions using pointers, arrays as parameters. Scope and Lifetime of Variables, Basics of File Handling.

Text Books:

1. "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice-Hall, 1988
2. Schaum's Outline of Programming with C, Byron S Gottfried, McGraw-Hill Education, 1996

Reference Books:

1. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education, 2008.
2. Programming in C, Rema Theraja, Oxford, 2016, 2nd edition
3. C Programming, A Problem Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE, 3rd edition

ENGINEERING PHYSICS LAB

(Common to All Branches)

I Year – I Semester

Practice :2	Internal Marks : 30
Credits :1	External Marks : 70

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Course Objectives

To study the concepts of optical phenomenon like interference, diffraction etc., recognize the importance of energy gap in the study of conductivity and Hall effect in semiconductors and study the parameters and applications of dielectric and magnetic materials by conducting experiments.

Course Outcomes

Upon successful completion of the course, the students will be able to

- Operate optical instruments like travelling microscope and spectrometer.
- Estimate the wavelengths of different colours using diffraction grating.
- Plot the intensity of the magnetic field of circular coil carrying current with distance.
- Evaluate dielectric constant and magnetic susceptibility for dielectric and magnetic materials respectively.
- Calculate the band gap of a given semiconductor, Identify the type of semiconductor using Hall effect.
- Identify unknown frequency and verify laws of vibrations

List of Experiments:

1. Determination of radius of curvature of a given Plano-convex lens by Newton's rings.
2. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
3. Verification of Brewster's law
4. Determination of dielectric constant using charging and discharging method.
5. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
6. Determination of wavelength of Laser light using diffraction grating.
7. Estimation of Planck's constant using photoelectric effect.
8. Determination of the resistivity of semiconductors by four probe methods.
9. Determination of energy gap of a semiconductor using p-n junction diode.
10. Magnetic field along the axis of a current carrying circular coil by Stewart Gee's Method.
11. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect.
12. Determination of temperature coefficients of a thermistor.
13. Determination of acceleration due to gravity and radius of Gyration by using a compound pendulum.
14. Determination of magnetic susceptibility by Kundt's tube method.
15. Determination of rigidity modulus of the material of the given wire using Torsional pendulum.
16. Sonometer: Verification of laws of stretched string.
17. Determination of young's modulus for the given material of wooden scale by non- uniform bending (or double cantilever) method.
18. Determination of Frequency of electrically maintained tuning fork by Melde's experiment.

Note

- Any TEN of the listed experiments are to be conducted. Out of which any TWO experiments may be conducted in virtual mode.

Reference Book:

1. A Textbook of Practical Physics - S. Balasubramanian, M.N. Srinivasan, S. Chand Publishers, 2017

e-Learning Resources:

1. www.vlab.co.in
2. https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype

ELECTRICAL AND ELECTRONICS ENGINEERING WORKSHOP

(Common to All Branches)

I Year – I Semester

Practice :3	Internal Marks : 30
Credits :1.5	External Marks : 70

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PART A: ELECTRICAL ENGINEERING LAB

Course Objectives

To impart knowledge on the fundamental laws & theorems of electrical circuits, characteristics of dc generator, measurement of resistance, earth resistance, power and power factor, and energy calculations.

Course Outcomes

Upon successful completion of the course, the students will be able to

- measure voltage, current, power and power factor in an electrical circuit.
- verify the superposition theorem.
- measure resistance and earth resistance using wheat stone bridge and megger respectively.
- determine critical field resistance and critical speed of dc shunt generator and compute the electrical energy for domestic premises.

Activities

1. Familiarization of commonly used Electrical & Electronic Workshop Tools: Bread board, Solder, cables, relays, switches, connectors, fuses, Cutter, plier, screwdriver set, wire stripper, flux, knife/blade, soldering iron, de-soldering pump etc.
   a. Provide some exercises so that hardware tools and instruments are learned to be used by the students.
2. Familiarization of Measuring Instruments like Voltmeters, Ammeters, multimeter, LCR-Q meter, Power Supplies, CRO, DSO, Function Generator, Frequency counter.
   a. Provide some exercises so that measuring instruments are learned to be used by thestudents.
3. Components:
   a. Familiarization/Identification of components (Resistors, Capacitors, Inductors, Diodes, transistors, IC's etc.) – Functionality, type, size, colour coding package, symbol, cost etc.
   b. Testing of components like Resistor, Capacitor, Diode, Transistor, ICs etc. - Compare values of components like resistors, inductors, capacitors etc with the measured values by using instruments

List of Experiments:

1. Verification of KCL and KVL
2. Verification of Superposition theorem
3. Measurement of Resistance using Wheat stone bridge
4. Magnetization Characteristics of DC shunt Generator
5. Measurement of Power and Power factor using Single-phase wattmeter
6. Measurement of Earth Resistance using Megger
7. Calculation of Electrical Energy for Domestic Premises

Reference Books:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, ThirdEdition

Note: Minimum Six Experiments to be performed.

PART – B ELECTRONICS ENGINEERING LAB

Course Objectives

- To impart knowledge on the principles of digital electronics and fundamentals of Electronic devices & their applications.

Course Outcomes

Upon successful completion of the course, the students will be able to

- identify and test various electronic components and demonstrate the usage of electronic measuring instruments.
- analyse the electrical behaviour of various electronic devices and digital logic circuits.
- design and implementation of various electronic circuits for the given specifications.
- test and verify the operation of electronic circuits using modern simulation tools.

List of Experiments

1. Plot V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias.
2. Plot V – I characteristics of Zener Diode and its application as voltage Regulator.
3. Implementation of half wave and full wave rectifiers
4. Plot Input & Output characteristics of BJT in CE and CB configurations
5. Frequency response of CE amplifier.
6. Simulation of RC coupled amplifier with the design supplied
7. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs.
8. Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs.

Tools / Equipment Required

- DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters, AC Voltmeters, CROs, all the required active devices.

Reference Books:

1. R. L. Boylestad& Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education, 2009.

Note: Minimum Six Experiments to be performed. All the experiments shall be implemented using both Hardware and Software.

COMPUTER PROGRAMMING LAB

(Common to All Branches)

I Year – I Semester

Practice :3	Internal Marks : 15
Credits :1.5	External Marks : 35

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Course Objectives

- To give students hands-on experience in problem solving and train them on the concepts of C – programming language.

Course Outcomes

Upon successful completion of the course, the students will be able to

- develop and trace the execution of programs written in C language.
- select the right control structure for solving the problem.
- develop C programs using structures and unions.
- develop, debug and execute programs to demonstrate the applications of arrays, functions and basic concepts of pointers in C.
- create and access files using file handling functions.

Course Content

UNIT – I:

WEEK 1

Objective: Getting familiar with the programming environment on the computer and writing the first program.

Suggested Experiments /Activities:

Tutorial 1: Problem-solving using Computers.

Lab1: Familiarization with programming environment

i) Basic Linux environment and its editors like Vi, Vim & Emacs etc.
ii) Exposure to Turbo C, gcc
iii) Writing simple programs using printf(), scanf()

WEEK 2

Objective: Getting familiar with how to formally describe a solution to a problem in a series of finite steps both using textual notation and graphic notation.

Suggested Experiments /Activities:

Tutorial 2: Problem-solving using Algorithms and Flow charts.

Lab 1: Converting algorithms/flow charts into C Source code.

Developing the algorithms/flowcharts for the following sample programs

i) Sum and average of 3 numbers
ii) Conversion of Fahrenheit to Celsius and vice versa
iii) Simple interest calculation

WEEK 3

Objective: Learn how to define variables with the desired data-type, initialize them with appropriate values and how arithmetic operators can be used with variables and constants.

Suggested Experiments /Activities:

Tutorial 3: Variable types and type conversions:

Lab 3: Simple computational problems using arithmetic expressions.

i) Finding the square root of a given number
ii) Finding compound interest

iii) Area of a triangle using heron's formulae
iv) Distance travelled by an object

UNIT – II:
WEEK 4
Objective: Explore the full scope of expressions, type-compatibility of variables & constants and operators used in the expression and how operator precedence works.

Suggested Experiments /Activities:

Tutorial4: Operators and the precedence and as associativity:

Lab4: Simple computational problems using the operator' precedence and associativity

i) Evaluate the following expressions.
   a. A+B*C+(D*E) + F*G
   b. A/B*C-B+A*D/3
   c. A+++B---A
   d. J= (i++) + (++i)
ii) Find the maximum of three numbers using conditional operator
iii) Take marks of 5 subjects in integers, and find the total, average in float

WEEK 5
Objective: Explore the full scope of different variants of "if construct" namely if-else, nullelse, if-else if*-else, switch and nested-if including in what scenario each one of them can be used and how to use them. Explore all relational and logical operators while writing conditionals for "if construct".

Suggested Experiments /Activities:

Tutorial 5: Branching and logical expressions:

Lab 5: Problems involving if-then-else structures.

i) Write a C program to find the max and min of four numbers using if-else.
ii) Write a C program to generate electricity bill.
iii) Find the roots of the quadratic equation.
iv) Write a C program to simulate a calculator using switch case.
v) Write a C program to find the given year is a leap year or not.

WEEK 6
Objective: Explore the full scope of iterative constructs namely while loop, do-while loop and for loop in addition to structured jump constructs like break and continue including when each of these statements is more appropriate to use.

Suggested Experiments /Activities:

Tutorial 6: Loops, while and for loops

Lab 6: Iterative problems e.g., the sum of series

i) Find the factorial of given number using any loop.
ii) Find the given number is a prime or not.
iii) Compute sine and cos series
iv) Checking a number palindrome
v) Construct a pyramid of numbers.

UNIT – III:
WEEK 7
Objective: Explore the full scope of Arrays construct namely defining and initializing 1-D and 2-D and more generically n-D arrays and referencing individual array elements from the defined array. Using integer 1-D arrays, explore search solution linear search.

Suggested Experiments /Activities:

Tutorial 7: 1 D Arrays: searching.

Lab 7:1D Array manipulation, linear search

i) Find the min and max of a 1-D integer array.
ii) Perform linear search on1D array.

iii) The reverse of a 1D integer array
iv) Find 2's complement of the given binary number.
v) Eliminate duplicate elements in an array.

WEEK 8

Objective: Explore the difference between other arrays and character arrays that can be used as Strings by using null character and get comfortable with string by doing experiments that will reverse a string and concatenate two strings. Explore sorting solution bubble sort using integer arrays.

Suggested Experiments /Activities:

Tutorial 8: 2 D arrays, sorting and Strings.

Lab 8: Matrix problems, String operations, Bubble sort

i) Addition of two matrices
ii) Multiplication two matrices
iii) Sort array elements using bubble sort
iv) Concatenate two strings without built-in functions
v) Reverse a string using built-in and without built-in string functions

UNIT – IV:

WEEK 9

Objective: Explore pointers to manage a dynamic array of integers, including memory allocation & value initialization, resizing changing and reordering the contents of an array and memory de-allocation using malloc (), calloc (), realloc () and free () functions. Gain experience processing command-line arguments received by C Suggested Experiments/Activities:

Tutorial 9: Pointers, structures and dynamic memory allocation

Lab 9: Pointers and structures, memory dereference.

i) Write a C program to find the sum of a 1D array using malloc()
ii) Write a C program to find the total, average of n students using structures
iii) Enter n students data using calloc() and display failed students list
iv) Read student name and marks from the command line and display the student details along with the total.
v) Write a C program to implement realloc()

WEEK 10

Objective: Experiment with C Structures, Unions, bit fields and self-referential structures (Singly linked lists) and nested structures

Suggested Experiments/Activities:

Tutorial 10: Bitfields, Self-Referential Structures, Linked lists

Lab10 : Bitfields, linked lists Read and print a date using dd/mm/yyyy format using bit-fields and differentiate the same without using bit- fields

i) Create and display a singly linked list using self-referential structure.
ii) Demonstrate the differences between structures and unions using a C program.
iii) Write a C program to shift/rotate using bitfields.
iv) Write a C program to copy one structure variable to another structure of the same type.

UNIT – V:

WEEK 11

Objective: Explore the Functions, sub-routines, scope and extent of variables, doing some experiments by parameter passing using call by value. Basic methods of numerical integration

Suggested Experiments/Activities:

Tutorial 11: Functions, call by value, scope and extent,

Lab 11: Simple functions using call by value, solving differential equations using Eulers theorem.

i) Write a C function to calculate NCR value.
ii) Write a C function to find the length of a string.
iii) Write a C function to transpose of a matrix.
iv) Write a C function to demonstrate numerical integration of differential equations using

Euler's method

WEEK 12

Objective: Explore how recursive solutions can be programmed by writing recursive functions that can be invoked from the main by programming at-least five distinct problems that have naturally recursive solutions.

Suggested Experiments/Activities:

Tutorial 12: Recursion, the structure of recursive calls

Lab 12: Recursive functions

i) Write a recursive function to generate Fibonacci series.
ii) Write a recursive function to find the lcm of two numbers.
iii) Write a recursive function to find the factorial of a number.
iv) Write a C Program to implement Ackermann function using recursion.
v) Write a recursive function to find the sum of series.

WEEK 13

Objective: Explore the basic difference between normal and pointer variables, Arithmetic operations using pointers and passing variables to functions using pointers Suggested Experiments/Activities:

Tutorial 13: Call by reference, dangling pointers

Lab 13: Simple functions using Call by reference, Dangling pointers.
Write a C program to swap two numbers using call by reference.

i) Demonstrate Dangling pointer problem using a C program.
ii) Write a C program to copy one string into another using pointer.
iii) Write a C program to find no of lowercase, uppercase, digits and other characters using pointers.

WEEK 14

Objective: To understand data files and file handling with various file I/O functions. Explore the differences between text and binary files.

Suggested Experiments/Activities:

Tutorial 14: File handling

Lab 14: File Operations

i) Write a C program to write and read text into a file.
ii) Write a C program to write and read text into a binary file using fread() and fwrite()
iii) Copy the contents of one file to another file.
iv) Write a C program to merge two files into the third file using command-line arguments.
v) Find no. of lines, words and characters in a file
vi) Write a C program to print last n characters of a given file.

Text Books:

1. Ajay Mittal, Programming in C: A practical approach, Pearson.
2. Byron Gottfried, Schaums Outline of Programming with C, McGraw Hill

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, PrenticeHall of India.
2. C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE.

IT WORKSHOP

(Common to All Branches)

I Year – I Semester

Practice :2	Internal Marks : 30
Credits :1	External Marks : 70

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Course Objectives

- To introduce the internal parts of a computer, peripherals, I/O ports, connecting cables
- To demonstrate configuring the system as Dual boot both Windows and other Operating Systems Viz. Linux, BOSS.
- To teach basic command line interface commands on Linux.
- To teach the usage of Internet for productivity and self-paced life-long learning.
- To introduce Compression, Multimedia and Antivirus tools and Office Tools such as Word processors, Spread sheets and Presentation tools.

Course Outcomes

Upon successful completion of the course, the students will be able to

- perform Hardware troubleshooting.
- safeguard computer systems from viruses/worms.
- prepare document/ Presentation on a given topic.
- perform calculations using spreadsheets.
- apply AI tools/Chat GPT to do search, creative writing and language translation.

PC Hardware & Software Installation:

Task 1: Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.

Task 2: Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also students need to go through the video which shows the process of assembling a PC. A video would be given as part of the course content.

Task 3: Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.

Task 4: Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot (VMWare) with both Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva

Task 5: Every student should install BOSS on the computer. The system should be configured as dual boot (VMWare) with both Windows and BOSS. Lab instructors should verify the installation and follow it up with a Viva

Internet & World Wide Web:

Task1: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally students should demonstrate, to the instructor, how to access the websites and email. If there is no internet connectivity preparations need to be made by the instructors to simulate the WWW on the LAN.

Task 2: Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.

Task 3: Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student.

Task 4: Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

LaTeX and WORD:

Task 1 Word Orientation: The mentor needs to give an overview of LaTeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of LaTeX and MS office or equivalent (FOSS) tool Word as word Processors, Details of the four tasks and features that would be covered in each, Using LaTeX and word Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter in word.

Task 2: Using LaTeX and Word to create a project certificate. Features to be covered:- Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both LaTeX and Word.

Task 3: Creating project abstract Features to be covered:-Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

Task 4: Creating a Newsletter: Features to be covered:- Table of Content, Newspaper columns, Images from files and clip-art, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.

EXCEL:

Excel Orientation: The mentor needs to tell the importance of MS office or equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel Accessing, overview of toolbars, saving excel files, Using help and resources.

Task 1: Creating a Scheduler - Features to be covered: Grid-lines, Format Cells, Summation, auto fill, Formatting Text

Task 2: Calculating GPA -. Features to be covered:- Cell Referencing, Formulae in excel average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function, LOOKUP/VLOOKUP.

Task 3: Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting

POWER POINT:

Task 1: Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint.

Task 2: Interactive presentations - Hyperlinks, Inserting Images, Clip Art, Audio, Video, Objects, Tables and Charts.

Task 3: Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting Background, textures, Design Templates, Hidden slides.

AI TOOLS Chat GPT:

Task 1: Prompt Engineering: Experiment with different types of prompts to see how the model responds. Try asking questions, starting conversations, or even providing incomplete sentences to see how the model completes them.

Ex: Prompt: "You are a knowledgeable AI. Please answer the following question: What is the capital of France?"

Task 2: Creative Writing: Use the model as a writing assistant. Provide the beginning of a story or a description of a scene, and let the model generate the rest of the content. This can be a fun way to brainstorm creative ideas

Ex: Prompt: "In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality."

Task 3: Language Translation: Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output to see how accurate and fluent the translations are.
Ex: Prompt: "Translate the following English sentence to French: 'Hello, how are you doing today?'"

Reference Books:

1. Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream tech, 2003
2. The Complete Computer upgrade and repair book, Cheryl A Schmidt, WILEY Dream tech, 2013, 3rd edition
3. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education, 2012, 2nd edition
4. PC Hardware - A Handbook, Kate J. Chase, PHI (Microsoft)
5. LaTeX Companion, Leslie Lamport, PHI/Pearson.
6. IT Essentials PC Hardware and Software Companion Guide, David Anfins on and Ken Quamme. CISCO Press, Pearson Education, 3rd edition
7. IT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan CISCO Press, Pearson Education, 3rd edition

NSS/NCC/SCOUTS & GUIDES /COMMUNITY SERVICE

(Common to All branches)

I Year – I Semester

Practical :1 Internal Marks : 100

Credits :0.5

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Course Objectives

- The objective of introducing this course is to impart discipline, character, fraternity, teamwork, social consciousness among the students and engaging them in selfless service.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand the importance of discipline, character and service motto.
- solve some societal issues by applying acquired knowledge, facts, and techniques.
- **e**xplore human relationships by analyzing social problems.
- determine to extend their help for the fellow beings and downtrodden people.
- develop leadership skills and civic responsibilities.

Course Content

UNIT – I: Orientation

General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, career guidance.

Activities

i) Conducting –ice breaking sessions-expectations from the course-knowing personal talents and skills.

ii) Conducting orientations programs for the students –future plans-activities-releasing road map etc.

iii) Displaying success stories-motivational biopics- award winning movies on societal issues etc.

iv) Conducting talent show in singing patriotic songs-paintings- any other contribution.

UNIT – II: Nature & Care

Activities

i) Best out of waste competition.

ii) Poster and signs making competition to spread environmental awareness.

iii) Recycling and environmental pollution article writing competition.

iv) Organising Zero-waste day.

v) Digital Environmental awareness activity via various social media platforms.

vi) Virtual demonstration of different eco-friendly approaches for sustainable living.

vii) Write a summary on any book related to environmental issues.

UNIT – III: Community Service

Activities

i) Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authorities- experts-etc.

ii) Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS.

iii) Conducting consumer Awareness. Explaining various legal provisions etc.

iv) Women Empowerment Programmes - Sexual Abuse, Adolescent Health and Population Education.

v) Any other programmes in collaboration with local charities, NGOs etc.

Reference Books:

1. Nirmalya Kumar Sinha & Surajit Majumder, A Text Book of National Service Scheme Vol;.I, Vidya Kutir Publication, 2021 (ISBN 978-81-952368-8-6)
2. Red Book - National Cadet Corps – Standing Instructions Vol I & II, Directorate General of NCC, Ministry of Defence, New Delhi
3. Davis M. L. and Cornwell D. A., "Introduction to Environmental Engineering", McGraw Hill, New York 4/e 2008
4. Masters G. M., Joseph K. and Nagendran R. "Introduction to Environmental Engineering and Science", Pearson Education, New Delhi. 2/e 2007
5. Ram Ahuja. Social Problems in India, Rawat Publications, New Delhi.

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities.
2. Institutes are required to provide instructor to mentor the students.

Evaluation Guidelines:

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

COMMUNICATIVE ENGLISH

(Common to All Branches)

I Year – II Semester

Lecture :2	Internal Marks : 30
Credits :2	External Marks : 70

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Course Objective

The main objective of introducing this course, Communicative English, is to facilitate effective Listening, Reading, Speaking and Writing skills among the students. It enhances the same in their comprehending abilities, oral presentations, reporting useful information and providing knowledge of grammatical structures and vocabulary. This course helps the students to make them effective in speaking and writing skills and to make them industry ready.

Course Outcomes

Upon successful completion of the course, the students will be able to

- Understand the context, topic, and pieces of information from social or Transactional dialogues.
- Apply grammatical structures to formulate sentences and correct word forms.
- Analyze discourse markers to speak clearly on a specific topic in informal discussions.
- Evaluate reading / listening texts and to write summaries based on global comprehension of the texts.
- Create a coherent paragraph, essay, and resume.

Course Content

UNIT – I:

Lesson : HUMAN VALUES: Gift of Magi **(Short Story)**

Listening : Identifying the topic, the context and specific pieces of information by listeningto short audio texts and answering a series of questions.

Speaking : Asking and answering general questions on familiar topics such as home,family, work, studies and interests; introducing oneself and others.

Reading : Skimming to get the main idea of a text; scanning to look for specific pieces of information.

Writing : Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences.

Grammar : Parts of Speech, Basic Sentence Structures-forming questions

Vocabulary : Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words.

UNIT – II:

Lesson : NATURE: The Brook by Alfred Tennyson (Poem)

Listening : Answering a series of questions about main ideas and supporting ideas after listening to audio texts.

Speaking : Discussion in pairs/small groups on specific topics followed by short structuretalks.

Reading : Identifying sequence of ideas; recognizing verbal techniques that help to linkthe ideas in a paragraph together.

Writing : Structure of a paragraph - Paragraph writing (specific topics)

Grammar : Cohesive devices - linkers, use of articles and zero article; repositions.

Vocabulary : Homonyms, Homophones, Homographs.

UNIT – III:

Lesson : BIOGRAPHY: Elon Musk

Listening : Listening for global comprehension and summarizing what is listened to.

Speaking : Discussing specific topics in pairs or small groups and reporting what is discussed

Reading : Readinga text in detail by making basic inferences -recognizing and interpreting specific context clues; strategies to use text clues for comprehension.

Writing : Summarizing, Note-making, paraphrasing

Grammar : Verbs - tenses; subject-verb agreement; Compound words, Collocations

Vocabulary : Compound words, Collocations

UNIT – IV:

Lesson : INSPIRATION: The Toys of Peace by Saki

Listening : Making predictions while listening to conversations/ transactional dialogues without video; listening with video.

Speaking : Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.

Reading : Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data.

Writing : Letter Writing: Official Letters, Resumes

Grammar : Reporting verbs, Direct & Indirect speech, Active & Passive Voice

Vocabulary : Words often confused, Jargons

UNIT – V: The Power of Intrapersonal Communication (An Essay)

Lesson : MOTIVATION

Listening : Identifying key terms, understanding concepts and answering a series ofrelevant questions that test comprehension.

Speaking : Formal oral presentations on topics from academic contexts

Reading : Reading comprehension.

Writing : Writing structured essays on specific topics.

Grammar : Editing short texts identifying and correcting common errors in grammar andusage (articles, prepositions, tenses, subject verb agreement)

Vocabulary : Technical Jargons

Text Books:

1. Pathfinder: Communicative English for Undergraduate Students, 1st Edition, OrientBlack Swan, 2023

2. **Extensive Reading (for internal assessment only)**
   The following simplified classics, one for each mid-semester, from the series, Great Stories in Easy English, published by S. Chand & Company Limited:
   - Kidnapped by R L Stevenson
   - Little Women by Louisa May Alcott

Reference Books:

1. Dubey, Sham Ji & Co. English for Engineers, Vikas Publishers, 2020
2. Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge,2014.
3. Murphy, Raymond. English Grammar in Use, Fourth Edition, Cambridge University Press, 2019.
4. Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary. Anchor, 2014.

e-Learning Resources:

Grammar:

1. www.bbc.co.uk/learningenglish
2. https://dictionary.cambridge.org/grammar/british-grammar/
3. www.eslpod.com/index.html
4. https://www.learngrammar.net/
5. https://english4today.com/english-grammar-online-with-quizzes/
6. https://www.talkenglish.com/grammar/grammar.aspx

Vocabulary:

1. https://www.youtube.com/c/DailyVideoVocabulary/videos
2. https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA

ENGINEERING CHEMISTRY

(Common to CE & ME)

I Year – II Semester

Lecture :3	Internal Marks : 30
Credits :3	External Marks : 70

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Course Objectives

- To impart the knowledge of water treatment methods, electrochemical energy systems, corrosion and its prevention.
- To impart the knowledge of fuels, modern engineering materials and lubricants.

Course Outcomes

Upon successful completion of the course, the students will be able to

- solve the numerical problems on hardness of water and explain water treatment methods and their significance in industry and daily life.
- solve the numerical problems on emf and identify the electrochemistry involved in batteries; analyze the corrosion of metals and suggest a suitable method for its prevention.
- analyze the quality of fuels and explain the applications of polymers.
- explain the properties and applications of modern engineering materials.
- identify the applications of adsorption, colloids and nano materials.

Course Content

UNIT – I: Water Technology

Soft and hardwater, Estimation of hardness of water by EDTA Method, Estimation of dissolved Oxygen - Boiler troubles –Priming, foaming, scale and sludge, Caustic embrittlement, Industrial water treatment – Specifications for drinking water, Bureau of Indian Standards (BIS) and World Health Organization (WHO) standards, Ion-exchange processes - desalination of brackish water, Reverse Osmosis (RO) and electrodialysis.

UNIT – II: Electrochemistry and Applications

Electrodes –electrochemical cell, Nernst equation, cell potential calculations.

Primary cells – Zinc-air battery, Secondary cells – Nickel-Cadmium (NiCad),and lithium ion batteries-working principle of the batteries including cell reactions; Fuel cells-Basic Concepts, the principle and working of hydrogen-oxygen Fuel cell.

Corrosion: Introduction to corrosion, electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion, metal oxide formation by dry electrochemical corrosion, Pilling Bedworth ratios and uses, Factors affecting the corrosion, cathodic and anodic protection, electroplating and electro less plating (Nickel and Copper).

UNIT – III: Polymers and Fuel Chemistry

Introduction to polymers, functionality of monomers, Mechanism of chain growth, step growth polymerization.

Thermoplastics and Thermo-setting plastics-: Preparation, properties and applications of poly styrene. PVC Nylon 6,6 and Bakelite.

Elastomers – Preparation, properties and applications of Buna S, Buna N, Thiokol rubbers. Fuels – Types of fuels, calorific value of fuels, numerical problems based on calorific value; Analysis of coal (Proximate and Ultimate analysis), Liquid Fuels, refining of petroleum, Octane and Cetane number-alternative fuels- propane, methanol, ethanol and bio fuel-bio diesel.

UNIT – IV: Modern Engineering Materials

Composites- Definition, Constituents, Classification- Particle, Fibre and Structural reinforced composites, properties and Engineering applications

Refractories- Classification, Properties, Factors affecting the refractory materials and Applications. Lubricants- Classification, Functions of lubricants, Mechanism, Properties of lubricating oils – Viscosity, Viscosity Index, Flash point, Fire point, Cloud point, saponification and Applications. Building materials- Portland Cement, constituents, Setting and Hardening of cement.

UNIT-V: Surface Chemistry and Nanomaterials

Introduction to surface chemistry, colloids, nanometals and nanometal oxides, micelle formation, synthesis of colloids (Braggs Method), chemical and biological methods of preparation of nanometals and metal oxides, stabilization of colloids and nanomaterials by stabilizing agents, adsorption isotherm (Freundlich and Longmuir), BET equation (no derivation) applications of colloids and nanomaterials – catalysis, medicine, sensors, etc.

Text Books:

1. Jain and Jain, Engineering Chemistry, 16/e, Dhanpat Rai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.

Reference Books:

1. H.F.W. Taylor, Cement Chemistry, 2/e, Thomas Telford Publications, 1997.
2. D.J.Shaw, Introduction to Colloids and Surface Chemistry Butterworth- Heineman, 1992.
3. Textbook of Polymer Science, Fred W. Billmayer Jr, 3rd Edition

DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

(Common to All Branches)

I Year – II Semester

Lecture :3	Internal Marks : 30
Credits :3	External Marks : 70

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Course Objectives

- To enlighten the learners in the concept of differential equations and multivariable calculus.
- To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real-world applications.

Course Outcomes

Upon successful completion of the course, the students will be able to

- solve the first order differential equations related to various engineering fields.
- find the solutions of higher order linear differential equations.
- identify solution methods for partial differential equations that model physical processes.
- interpret the physical meaning of different operators such as gradient, curl and divergence.
- estimate the work done against a field, circulation and flux using vector calculus also verify the relation between line, surface and volume integrals using integral theorems.

Course Content

UNIT – I: Differential equations of first order and first degree

Linear differential equations – Bernoulli's equations- Exact equations and equations reducible to exact form. Applications: Newton's Law of cooling – Law of natural growth and decay- Electrical circuits.

UNIT – II: Linear differential equations of higher order (Constant Coefficients)

Definitions, homogeneous and non-homogeneous, complimentary function, general solution, particular integral, Wronskian, Method of variation of parameters. Simultaneous linear equations, applications to L-C-R Circuit problems and Simple Harmonic motion.

UNIT – III: Partial Differential Equations

Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method. Homogeneous Linear Partial differential equations with constant coefficients.

UNIT – IV: Vector differentiation

Scalar and vector point functions, vector operator Del, Del applies to scalar point functions- Gradient, Directional derivative, Del applied to vector point functions-Divergence and Curl, vector identities.

UNIT – V: Vector integration

Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and related problems.

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition
2. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10th Edition.

Reference Books

1. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018, 14th Edition.

2. Advanced Engineering Mathematics, Dennis G. Zill and Warren S. Wright, Jones and Bartlett, 2018.
3. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5th Edition.
4. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 2021 5th Edition (9th reprint).
5. Higher Engineering Mathematics, B. V. Ramana, , McGraw Hill Education, 2017

BASIC CIVIL AND MECHANICAL ENGINEERING

(Common to All Branches)

I Year – II Semester

Lecture :3	Internal Marks : 30
Credits :3	External Marks : 70

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PART A: BASIC CIVIL ENGINEERING

Course Objectives

- Get familiarized with the scope and importance of Civil Engineering sub-divisions.
- Introduce the preliminary concepts of surveying.
- Acquire preliminary knowledge on Transportation and its importance in nation's economy.
- Get familiarized with the importance of quality, conveyance and storage of water.
- Introduction to basic civil engineering materials and construction techniques.

Course Outcomes

Upon successful completion of the course, the students will be able to

- gain knowledge on various sub-divisions of Civil Engineering and to appreciate their role in ensuring better society
- apply the concepts of surveying and to determine the distances, angles and levels
- realize the importance of Water Storage & Conveyance Structures, Transportation and Environmental Engineering in Nation's economy

Course Content

UNIT – I:

Basics of Civil Engineering: Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geo-technical Engineering- Transportation Engineering - Hydraulics and Water Resources Engineering - Environmental Engineering-Scope of each discipline - Building Construction and Planning- Construction Materials-Cement - Aggregate - Bricks- Cement concrete- Steel. Introduction to Prefabricated construction Techniques.

UNIT – II:

Surveying: Objectives of Surveying- Horizontal Measurements- Angular Measurements- Introduction to Bearings Levelling instruments used for levelling -Simple problems on levelling and bearings- Contour mapping.

UNIT – III:

Transportation Engineering Importance of Transportation in Nation's economic development- Types of Highway Pavements- Flexible Pavements and Rigid Pavements - Simple Differences. Basics of Harbour, Tunnel, Airport, and Railway Engineering.

Water Resources and Environmental Engineering: Introduction, Sources of water- Quality of water- Specifications- Introduction to Hydrology–Rainwater Harvesting-Water Storage and Conveyance Structures (Simple introduction to Dams and Reservoirs).

Text Books:

1. Basic Civil Engineering, M.S.Palanisamy, Tata Mcgraw Hill publications (India) Pvt. Ltd. Fourth Edition.
2. Introduction to Civil Engineering, S.S. Bhavikatti, New Age International Publishers. 2022. First Edition.
3. Basic Civil Engineering, Satheesh Gopi, Pearson Publications, 2009, First Edition.

Reference Books:

1. Surveying, Vol- I and Vol-II, S.K. Duggal, Tata McGraw Hill Publishers 2019. Fifth Edition.
2. Hydrology and Water Resources Engineering, Santosh Kumar Garg, Khanna Publishers, Delhi. 2016
3. Irrigation Engineering and Hydraulic Structures - Santosh Kumar Garg, Khanna Publishers, Delhi 2023. 38th Edition.
4. Highway Engineering, S.K.Khanna, C.E.G. Justo and Veeraraghavan, Nemchand and Brothers Publications 2019. 10th Edition.
5. Indian Standard DRINKING WATER — SPECIFICATION IS 10500-2012.

PARTB: BASIC MECHANICAL ENGINEERING

Course Objectives

The students after completing the course are expected to

- Get familiarized with the scope and importance of Mechanical Engineering in different sectors and industries.
- Explain different engineering materials and different manufacturing processes.
- Provide an over view of different thermal and mechanical transmission systems and introduce basics of robotics and its applications.

Course Outcomes

Upon successful completion of the course, the students will be able to

- select suitable material for the given application.
- apply the principles of CNC machining and 3D printing to create simple components.
- examine the working cycles of engines like Otto, Diesel, and IC engines.
- apply the knowledge of mechanical power transmission systems to solve real-world engineering problems.
- evaluate the potential applications of robotics in different industries.

Course Content

UNIT – I:

Introduction to Mechanical Engineering: Role of Mechanical Engineering in Industries and Society-Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors.

Engineering Materials - Metals-Ferrous and Non-ferrous, Ceramics, Composites, Smart materials.

UNIT – II:

Manufacturing Processes: Principles of Casting, Forming, joining processes, Machining, Introduction to CNC machines, 3D printing, and smart manufacturing.

Thermal Engineering: Working principle of Boilers, Otto cycle, Diesel cycle, Refrigeration and air-conditioning cycles, IC engines, 2-Stroke and 4-Stroke engines, S I CI Engines, Components of Electric and Hybrid Vehicles.

UNIT – III:

Powerplants - Working principle of Steam, Diesel, Hydro, Nuclear power plants.

Mechanical Power Transmission - Belt Drives, Chain, Rope drives, Gear Drives and their applications.

Introduction to Robotics - Joints & links, configurations, and applications of robotics.

(Note: The subject covers only the basic principles of Civil and Mechanical Engineering systems. The evaluation shall be intended to test only the fundamentals of the subject.)

Text Books:

1. Internal Combustion Engines by V.Ganesan, By Tata Mc Graw Hill publications (India) Pvt. Ltd.
2. A text book of Theory of Machines by S. S. Rattan, Tata Mc Graw Hill Publications, (India) Pvt. Ltd.
3. An introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, Cengage learning India Pvt. Ltd.

Reference Books:

1. G. Shanmugamand M.S.Palanisamy, Basic Civil and the Mechanical Engineering, Tata Mc Graw Hill publications (India)Pvt. Ltd.
2. Thermal Engineering by Mahesh M Rathore Tata Mc Graw Hill publications (India) Pvt. Ltd.
3. 3D printing & Additive Manufacturing Technology - L. Jyothish Kumar, Pulak M Pandey, Springer publications
4. Appuu Kuttan K K, Robotics, I. K. International Publishing House Pvt. Ltd. Volume-I

ENGINEERING MECHANICS

(Common to CE & ME)

I Year – II Semester

Lecture :3	Internal Marks : 30
Credits :3	External Marks : 70

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Course Objectives

- To get familiarized with different types of force systems.
- To draw accurate free body diagrams representing forces and moments acting on a body to analyze the equilibrium of system of forces.
- To teach the basic principles of center of gravity, centroid and moment of inertia and determine them for different simple and composite bodies.
- To apply the Work-Energy method to particle motion.
- To understand the kinematics and kinetics of translational and rotational motion of rigid bodies.

Course Outcomes

Upon successful completion of the course, the students will be able to

- Understand the fundamental concepts in mechanics and determine the frictional forces for bodies in contact.
- Analyze different force systems such as concurrent, coplanar and spatial systems and calculate their resultant forces and moments.
- Calculate the centroids, center of gravity and moment of inertia of different geometrical shapes.
- Apply the principles of work-energy and impulse-momentum to solve the problems of rectilinear and curvilinear motion of a particle.
- Solve the problems involving the translational and rotational motion of rigid bodies.

Course Content

UNIT – I:

Introduction to Engineering Mechanics – Basic Concepts. Scope and Applications

Systems of Forces: Coplanar Concurrent Forces– Components in Space–Resultant–Moment of Force and its Application – Couples and Resultant of Force Systems.

Friction: Introduction, limiting friction and impending motion, Coulomb'slaws of dryfriction, coefficient of friction, Cone of Static friction.

UNIT – II:

Equilibrium of Systems of Forces: Free Body Diagrams, Lami's Theorm, Equations of Equilibrium of Coplanar Systems, Graphical method for the equilibrium, Triangle law of forces, converse of the law of polygon of forces condition of equilibrium, Equations of Equilibrium for Spatial System of forces, Numerical examples on spatial system of forces using vector approach, Analysis of plane trusses.

Principle of virtual work with simple examples

UNIT – III:

Centroid: Centroids of simple figures (from basic principles)–Centroids of Composite Figures. Centre of Gravity: Centre of gravity of simple body (from basic principles), Centre of gravity of composite bodies, Pappus theorems.

Area Moments of Inertia: Definition– Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia.

Mass Moment of Inertia: Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, Mass Moment of Inertia of composite bodies.

UNIT – IV:

Rectilinear and Curvilinear motion of a particle: Kinematics and Kinetics –D'Alembert's Principle - Work Energy method and applications to particle motion-Impulse Momentum method.

UNIT – V:

Rigid body Motion: Kinematics and Kinetics of translation, Rotation about fixed axis and plane motion, Work Energy method and Impulse Momentum method.

Text Books:

1. Engineering Mechanics, S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., , McGraw Hill Education 2017. 5th Edition.
2. Engineering Mechanics, P.C.Dumir- S.Sengupta and Srinivas V veeravalli , University press. 2020. First Edition.
3. A Textbook of Engineering Mechanics, S.S Bhavikatti. New age international publications 2018. 4th Edition.

Reference Books:

1. Engineering Mechanics, Statics and Dynamics, Rogers and M A. Nelson., McGraw Hill Education. 2017. First Edition.
2. Engineering Mechanics, Statics and Dynamics, I.H. Shames., PHI, 2002. 4th Edition.
3. Engineering Mechanics, Volume-I: Statics, Volume-II: Dynamics, J. L. Meriam and L.G. Kraige., John Wiley, 2008. 6th Edition.
4. Introduction to Statics and Dynamics, Basudev Battachatia, Oxford University Press, 2014. Second Edition
5. Engineering Mechanics: Statics and Dynamics, Hibbeler R.C., Pearson Education, Inc., New Delhi, 2022, 14th Edition

COMMUNICATIVE ENGLISH LAB

(Common to All Branches)

I Year – II Semester

Practical :2	Internal Marks : 30
Credits :1	External Marks : 70

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Course Objectives: The main objective of introducing this course, Communicative English Laboratory, is to expose the students to a variety of self-instructional, learner friendly modes of language learning. The students will get trained in basic communication skills and also make them ready to face job interviews.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand the different aspects of the English language proficiency with emphasis on LSRW skills.
- apply communication skills through various language learning activities.
- analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension.
- evaluate and exhibit professionalism in participating in debates and group discussions.
- create effective Course Objectives:

List of Experiments:

1. Vowels & Consonants
2. Neutralization/Accent Rules
3. Communication Skills & JAM
4. Role Play or Conversational Practice
5. E-mail Writing
6. Resume Writing, Cover letter, SOP
7. Group Discussions-methods & practice
8. Debates - Methods & Practice
9. PPT Presentations/ Poster Presentation
10. Interviews Skills

Suggested Software:

Walden Infotech Young
India Films
K- Van

Reference Books:

1. Raman Meenakshi, Sangeeta-Sharma. Technical Communication. Oxford Press.2018.
2. Taylor Grant: English Conversation Practice, Tata McGraw-Hill Education India,2016
3. Hewing's Martin. Cambridge Academic English (B2). CUP, 2012.
4. J. Sethi & P.V. Dhamija. A Course in Phonetics and Spoken English, (2nd Ed),Kindle, 2013.

ENGINEERING CHEMISTRY LAB

(Common to CE & ME)

I Year – II Semester

Practical :2	Internal Marks : 30
Credits :1	External Marks : 70

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Course Objectives

- To impart skills in analysing the quality of water, lubricating oils and fuels.

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyze the quality of water.
- analyze the percentage of Iron and Calcium in cement.
- synthesize polymers and nanomaterials.
- determine the strength of acid in batteries.
- analyze the quality of fuels and lubricants.

List of Experiments:

(Any TEN of the listed experiments are to be conducted)

1. Determination of Hardness of a groundwater sample.
2. Estimation of Dissolved Oxygen by Winkler's method
3. Determination of Strength of an acid in Pb-Acid battery
4. Preparation of a polymer (Bakelite)
5. Determination of percentage of Iron in Cement sample by colorimetry
6. Estimation of Calcium in port land Cement
7. Preparation of nanomaterials by precipitation method.
8. Adsorption of acetic acid by charcoal
9. Determination of percentage Moisture content in a coal sample
10. Determination of Viscosity of lubricating oil by Redwood Viscometer 1
11. Determination of Viscosity of lubricating oil by Redwood Viscometer 2
12. Determination of Calorific value of gases by Junker's gas Calorimeter

Reference Books:

1. "Vogel's Quantitative Chemical Analysis 6th Edition" Pearson Publications by J. Mendham, R.C. Denney, J.D. Barnes and B. Siva sankar

ENGINEERING MECHANICS LAB

(ME)

I Year – II Semester

Practical :3	Internal Marks : 30
Credits :1.5	External Marks : 70

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Course Objectives

- To Verify the Law of Parallelogram and Triangle of Forces.
- To determine the coefficients of friction of Static and Rolling friction and centroids of different plane Lamina.
- To analyze the system of Pulleys and Moment of Inertia of Compound Pendulum and Flywheel.

Course Outcomes

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

- verify Law of Polygon of forces and Law of Moment using force polygon and bell crank lever.
- evaluate the coefficient of friction between two different surfaces
- determine the Centroids and Moment of Inertia of different configurations
- verify the equilibrium conditions of a rigid body under the action of different force systems.
- evaluate acceleration due to gravity .

Note: Students have to perform any 10 of the following Experiments

List of Experiments:

1. Verification of Law of Parallelogram of Forces.
2. Verification of Law of Triangle of Forces.
3. Verification of the Law of polygon for coplanar-concurrent forces acting on a particle in equilibrium and to find the value of unknown forces considering particle to be in equilibrium using universal force table.
4. Determination of coefficient of Static and Rolling Frictions
5. Determination of Centroids of different shaped Plane Lamina.
6. Verification of the conditions of equilibrium of a rigid body under the action of coplanar non-concurrent, parallel force system with the help of a simply supported beam.
7. Study of the systems of pulleys and draw the free body diagram of the system.
8. Determination of acceleration due to gravity using a compound pendulum.
9. Determination of Moment of Inertia of the compound pendulum about an axis perpendicular to the plane of oscillation and passing through its centre of mass.
10. Determination of Moment of Inertia of a Flywheel.
11. Verification of Law of Moment using Rotation Disc Apparatus and Bell Crank Lever.

Reference Books:

1. S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., Engineering Mechanics, 5th Edition, McGraw Hill Education.
2. Hibbeler R.C., Engineering Mechanics: Statics and Dynamics, 14th Edition, Pearson Education, Inc., New Delhi, 2022

ENGINEERING WORKSHOP

(Common to All Branches)

I Year – II Semester

Practical :3	Internal Marks : 30
Credits :1.5	External Marks : 70

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Course Objectives

- To familiarize students with wood working, sheet metal operations, fitting, electrical house wiring skills, and basic repairs of two-wheeler vehicle.

Course Outcomes

Upon successful completion of the course, the students will be able to

- demonstrate the correct use of safety equipment and procedures
- fabricate the lap joint, dovetail joint with the use of woodworking tools.
- utilize sheet metal tools to create tapered tray, conical funnel, elbow pipe and perform brazing.
- perform fitting exercises such as v-fit, dovetail fit, semicircular fit, and bicycle tire puncture and change.
- create electrical connections, including parallel and series circuits, and tube lights
- create green sand moulds for provided patterns.
- perform arc and gas welding to create lap and butt joints.
- create pipe joints with couplings for the same diameter and reducers for different diameters. perform basic repairs and maintenance on a two-wheeler vehicle

Course Content

1. **Demonstration**: Safety practices and precautions to be observed in workshop.
2. **Wood Working:** Familiarity with different types of woods and too lsused in wood working and make following joints.
   a) Half Lap joint b) Mortise and Tenon joint c) Corner Dovetail joint or Bridle joint
3. **Sheet Metal Working**: Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets.
   a) Tapered tray b) Conical funnel c) Elbow pipe d)Brazing
4. **Fitting:** Familiarity with different types of tools used in fitting and do the following fitting exercises.
   a) V- fit b) Dovetail fit c) Semi-circular fit
   b) d) Bicycle tire puncture and change of two-wheeler tyre
5. **Electrical Wiring**: Familiarity with different types of basic electrical circuits and make the following connections.
   a) Parallel and series b)Two-way switch c) Go down lighting
   b) d) Tube light e) Three phase motor f) Soldering of wires
6. **Foundry Trade:** Demonstration and practice on Moulding tools and processes, Preparation of Green sand Moulds for given Patterns.
7. **Welding Shop**: Demonstration and practice on Arc Welding and Gas welding. Preparation of Lap joint and Butt joint.
8. **Plumbing:** Demonstration and practice of Plumbing tools, Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters.
9. **Basic repairs of Two-wheeler vehicle** Demonstration of working of two-wheeler vehicle and its repairs.

Text Books:

1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published, 2019. Work shop Processes, Practices and Materials; Bruce J. Black, Routl edge publishers, 5th Edn. 2015.
2. A Course in Workshop Technology Vol I. & II, B.S. Raghu wanshi, Dhanpath Rai & Co., 2015 & 2017.

Reference Books:

1. Elements of Workshop Technology, Vol. I by S.K. Hajra Choudhary & Others, Media Promoters and Publishers, Mumbai, 2007, 14th Edition.
2. Workshop practice by H.S. Bawa, Tata-McGraw Hill, 2004.
3. Wiring Estimating, Costing and Contracting; Soni P.M. &Upadhyay P.A; Atul Prakasham, 2022.

HEALTH AND WELLNESS, YOGA AND SPORTS

(Common to All Branches)

I Year – II Semester

Practice :1 Internal Marks : 100

Credits :0.5

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Course Objectives

- The main objective of introducing this course is to make the students maintain their mental and physical wellness by balancing emotions in their life. It mainly enhances the essential traits required for the development of the personality.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand the importance of yoga and sports for Physical fitness and sound health
- demonstrate an understanding of health-related fitness components.
- compare and contrast various activities that help enhance their health
- assess current personal fitness levels.
- develop Positive Personality

Course Content:

UNIT – I:

Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index (BMI) of all age groups.

Activities:

i) Organizing health awareness programmes in community
ii) Preparation of health profile
iii) Preparation of chart for balance diet for all age groups

UNIT – II:

Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.

Activities:

i) Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

UNIT – III:

Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games.

Activities:

i) Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc. Practicing general and specific warm up, aerobics
ii) Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.

Reference Books:

1. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning, 2022
2. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice
3. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
4. Wiseman, John Lofty, SAS Survival Handbook: The Ultimate Guide to Surviving Anywhere Third Edition, William Morrow Paperbacks, 2014
5. The Sports Rules Book/ Human Kinetics with Thomas Hanlon. -- 3rd ed. Human Kinetics, Inc.2014

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities of Health/Sports/Yoga.
2. Institutes must provide field/facility and offer the minimum of five choices of as many as Games/Sports.
3. Institutes are required to provide sports instructor / yoga teacher to mentor the students.

Evaluation Guidelines

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totaling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

NUMERICAL METHODS AND TRANSFORM TECHNIQUES

II Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To elucidate the different numerical methods to solve engineering problems.
- To understand the basic concepts and techniques of different transforms.

Course Outcomes

Upon successful completion of the course, the students will be able to

- obtain numerical solutions for different engineering problems using iterative methods and interpolate given data.
- evaluate integrals numerically and solve ordinary differential equations.
- apply Laplace transforms to find the solutions of initial value problems.
- find the Fourier series representation of periodic signals.
- use Fourier transforms to solve partial differential equations.

Course Content

UNIT - I: Iterative Methods

Introduction – Solutions of algebraic and transcendental equations: Bisection method – Method of false position – Iteration method and Newton - Raphson method.

Interpolation: Newton's forward and backward formulae for interpolation – Interpolation with unequal intervals – Lagrange's interpolation formula

UNIT - II: Numerical integration, Solution of ordinary differential equations with initial conditions

Trapezoidal rule– Simpson's 1/3rd and 3/8th rule– Solution of initial value problems by Taylor's series– Picard's method of successive approximations– Euler's method – Runge - Kutta method (second and fourth order).

UNIT - III: Laplace Transforms

Definition of Laplace transform - Laplace transforms of standard functions – Properties of Laplace Transforms – Shifting theorems–Transforms of derivatives and integrals – Unit step function – Inverse Laplace transforms – partial fraction method.

Applications: Solving ordinary differential equations (initial value problems).

UNIT - IV: Fourier series

Introduction– Periodic functions – Fourier series of periodic function – Dirichlet's conditions – Even and odd functions –Change of interval– Half-range sine and cosine series.

UNIT - V: Fourier Transforms

Fourier integral theorem (without proof) – Fourier sine and cosine integrals – Infinite Fourier transforms – Sine and cosine transforms – Properties– Inverse transforms.

Text Books

1. B. S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.
2. B. V. Ramana, "Higher Engineering Mathematics", 6th Edition, Tata Mc. Graw Hill Education, 2017.

Reference Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley-India, 2018.
2. Steven C. Chapra, "Applied Numerical Methods with MATLAB for Engineering and Science", 3rd Edition, Tata Mc. Graw Hill Education, 2012.
3. M. K. Jain, S.R.K. Iyengar and R.K. Jain, "Numerical Methods for Scientific and Engineering Computation", 4th Edition, New Age International Publications, 2021.
4. Lawrence Turyn, “Advanced Engineering Mathematics”, 1st Edition, CRC Press, 2013.

THERMODYNAMICS

II Year – I Semester

Lecture : 2	Internal Marks : 30
Credits : 2	External Marks : 70

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Course Objectives

- To introduce the laws of thermodynamics and their applications to various thermodynamic processes and cycles.
- To familiarize with various thermodynamic properties of a pure substances and gas power cycles.

Course Outcomes

Upon successful completion of the course, the students will be able to

- apply fundamental thermodynamic principles to analyze and classify different types of systems and processes.
- apply the conservation of energy principle to various thermodynamic processes and estimate the performance of heat engines, refrigerators and heat pumps.
- estimate the entropy for identifying the disorder and feasibility of a thermodynamic process and introduce the concept of available energy for maximum work conversion.
- plot p-V, p-T, T-s and h-s diagrams of a pure substance and find the energy interactions during the change of state.
- analyse various gas power cycles and steam power cycles.

Course Content

UNIT - I:

Introduction: Basic Concepts - System, Boundary, Surrounding, Control volume, Universe, types of systems - Macroscopic and Microscopic viewpoints - Concept of Continuum - Thermodynamic Equilibrium, State, Property, Process, Cycle – Reversibility – Quasi static Process, Irreversible Process, Causes of Irreversibility.

UNIT - II:

Energy: Energy in State and in Transition, types, Work and Heat, Point and Path function - Zeroth Law of Thermodynamics – PMM-I, Joule's Experiment – First Law of Thermodynamics applied to closed and open systems - Limitations of the First Law, Enthalpy - Thermal Reservoir, Heat Engine, Refrigerator, Heat pump, Parameters of Performance.

UNIT - III:

Second Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence - PMM-II - Carnot cycle, Carnot's principle, corollaries, Absolute Thermodynamic scale of Temperature - Clausius Inequality - Entropy, Principle of Entropy Increase - Availability and Irreversibility, Thermodynamic Potentials - Gibbs and Helmholtz Functions, Maxwell Relations - Elementary Treatment of the Third Law of Thermodynamics.

UNIT - IV:

Pure Substances: Pure substance, p-V, p-T- phase diagrams, p-V-T- surfaces, T-s and h-s diagrams, Phase Transformations – Triple point, Critical point, Dryness Fraction, Property tables and Mollier charts – analysis of Various Thermodynamic processes and energy Transfer - Steam Calorimetry- Throttling calorimeter, Separating and Throttling Calorimeter.

UNIT - V:

Power Cycles: Otto cycle, Diesel cycle, Duel cycle and Brayton cycle on air standard basis - Thermodynamic analysis, comparison of Otto, Diesel, Duel cycles - Simple Rankine cycle.

Text Books:

1. P. K. Nag, "Engineering Thermodynamics", 6th Edition, Tata McGraw Hill, 2017.
2. Claus Borgnakke Richard E. Sonntag, "Fundamentals of Thermodynamics", 10th Edition, Wiley, 2020.

Reference Books:

1. J.B. Jones, and R.E. Dugan, "Engineering Thermodynamics", 1st Edition, Prentice Hall, 1995.
2. Y.A.Cengel & M.A.Boles , "Thermodynamics – An Engineering Approach", 9th Edition, Mc Graw Hill, 2019.
3. P.Chattopadhyay, "Engineering Thermodynamics", 1st Edition, Oxford University Press, 2011.
4. E. Radhakrishnan, "Fundamentals of Engineering Thermodynamics", 2nd Edition, PHI Learning, 2005.

e-Learning Resources

1. https://www.edx.org/learn/thermodynamics.
2. https://archive.nptel.ac.in/courses/112/106/112106310.
3. https://www.youtube.com/watch?v=7NI5P4KqrAs&t=1s
4. https://kp.kiit.ac.in/pdf_files/02/Study-Material_3rdSemester_Winter_2021_Mechanical-Engg.-_Thermal-Engineering-1_Abhijit Samant.pdf
5. https://www.coursera.org/learn/thermodynamics-intro

MECHANICS OF SOLIDS

II Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To impart knowledge on behavior of mechanical elements under the action of different loads.
- To design and analysis the structures like bars and beams and Industrial components like and pressure vessels.

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyse the stress-strain behavior of materials under various loading conditions and determine the principal stresses using Mohr's circle.
- construct shear force and bending moment diagrams for various types of beams under different loading conditions and identify points of contra flexure.
- apply the theory of simple bending to calculate flexural and shear stresses in beams and design beam sections for different shapes.
- compute the slope and deflection of beams using different methods and analyze the torsional stresses in circular shafts for power transmission.
- evaluate the stresses and strains in thin and thick cylinders under internal and external pressures and determine the critical load for columns using Euler's and Rankine's formulas.

Course Content

UNIT – I:

Simple Stresses & Strains: Elasticity and Plasticity – Types of stresses & strains–Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain, Relation between elastic constants– Bars of varying section – composite bars – Temperature stresses- Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

UNIT – II:

Shear Force and Bending Moment: Definition of beam – Types of beams –Shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed load, uniformly varying load and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam, statically indeterminate beams.

UNIT – III:

Flexural Stresses: Theory of simple bending, Derivation of bending equation, Determination of bending stresses – section modulus of rectangular, circular, I and T sections– Design of simple beam sections.

Shear Stresses: Derivation of Shear stress distribution across various beams sections like rectangular, circular, triangular, I and T sections.

UNIT – IV:

Deflection of Beams: Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, Uniformly Distributed Loads and Uniformly Varying Loads. Mohr's theorem and Moment area method – application to simple cases.

Torsion: Introduction-Derivation- Torsion of Circular shafts- Pure Shear-Transmission of power by circular shafts, Shafts in series, Shafts in parallel.

UNIT – V:

Thin and Thick Cylinders: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and volumetric strains – changes in diameter, and volume of thin cylinders– Thin spherical shells. Wire wound thin cylinders. Lame's equation – cylinders subjected to inside & outside pressures – compound cylinders.

Columns: Buckling and Stability, Columns with Pinned ends, Columns with other support Conditions, Limitations of Euler's Formula, Rankine's Formula

Text Books:

1. G H Ryder, Strength of materials, International Student Edition, Palgrave Macmillan publishers India Ltd, 1961.
2. B.C. Punmia, Strength of materials,10th Edition, Lakshmi publications Pvt. Ltd, New Delhi, 2018.

Reference Books:

1. Gere & Timoshenko, "Mechanics of materials", 2nd Edition, CBS publications, 2004.
2. U.C.Jindal, "Strength of Materials", 2nd Edition, Pearson Education, 2017.
3. Timoshenko, "Strength of Materials Part – I& II", 3rd Edition, CBS Publishers, 2004.
4. Andrew Pytel and Ferdinand L. Singer, "Strength of Materials", 4th Edition, Longman Publications, 1990.
5. Popov, "Mechanics of Solids", 2nd Edition, New Pearson Education, 2015.

e-Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc19_ce18/preview.
2. https://youtube/iY_ypychVNY?si=310htc4ksTQJ8Fv6.
3. https://www.youtube.com/watch?v=WEy939Rkd_M&t=2s
4. https://www.classcentral.com/course/swayam-strength-of-materials-iitm-184204
5. https://www.coursera.org/learn/mechanics-1
6. https://www.edx.org/learn/engineering/massachusetts-institute-of-technology-mechanical-behavior-of-materials-part-1-linear-elastic-behavior
7. https://archive.nptel.ac.in/courses/112/107/112107146/

MATERIAL SCIENCE & METALLURGY

II Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To familiarize with the fundamentals of solidification, phase diagrams, heat treatment and properties of metallic and non metallic materials.

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyse the effect of grain boundaries and solid solutions on the properties of alloys.
- compare the structure and properties of various ferrous and non-ferrous metals and alloys, and classify steels and their applications based on their properties.
- analyze the effects of heat treatment processes on the microstructure and mechanical properties of steels using TTT diagrams and apply surface-hardening techniques.
- evaluate the suitability of powder metallurgy techniques for specific manufacturing scenario.
- demonstrate the knowledge of advanced materials.

Course Content

UNIT – I:

Structure of Metals and Constitution of alloys: Crystallization of metals, Packing Factor - SC, BCC, FCC& HCP-line density, plane density. Grain and grain boundaries, effect of grain boundaries– determination of grain size - Imperfections, Slip and Twinning. Necessity of alloying, types of solid solutions, Hume Rothery's rules, intermediate alloy phases, and electron compounds

Equilibrium Diagrams: Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys - Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys - study of binary phase diagrams such as Cu-Ni and Fe-Fe_3C.

UNIT – II:

Ferrous metals and alloys: Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheriodal graphite cast iron, Alloy cast iron - Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.

Non-ferrous Metals and alloys: Structure and properties of Copper and its alloys - Aluminium and its alloys - Titanium and its alloys - Magnesium and its alloys, Super alloys**.**

UNIT – III:

Heat treatment of Steels: Effect of alloying elements on Fe-Fe_3C system, annealing, normalizing, hardening, TTT diagrams, tempering, harden ability, surface - hardening methods, age hardening treatment, Cryogenic treatment.

UNIT – IV:

Powder Metallurgy: Basic processes- Methods of producing metal powders- milling atomization-Granulation-Reduction-Electrolytic Deposition. Compacting methods – Sintering - Methods of manufacturing sintered parts - secondary operations, applications of powder metallurgical products.

UNIT – V:

Ceramic and Advanced materials: Crystalline ceramics, glasses, cermets, abrasive materials - Classification of composites, manufacturing methods, particle reinforced composites, fiber reinforced composites, PMC, MMC, CMC and CCCs - Introduction to Nano materials and smart materials.

Text Books:

1. S.H.Avner, "Introduction to Physical Metallurgy", 2nd Edition, Tata McGraw- Hill, 1997.
2. Donald R.Askeland, "Essentials of Materials science and Engineering", 4th Edition, CL Engineering publications, 2018.

Reference Books:

1. Dr. V.D.kodgire, "Material Science and Metallurgy", 39th Edition, Everest Publishing House, 2017.
2. V.Raghavan, "Material Science and Engineering", 5th Edition, Prentice Hall of India, 2004.
3. William D. Callister Jr, "Materials Science and Engineering: An Introduction", 8th Edition, John Wiley and Sons, 2009.
4. George E. Dieter, "Mechanical Metallurgy", 3rd Edition, McGraw-Hill, 2013.
5. Yip-Wah Chung, "Introduction to Material Science and Engineering", 2nd Edition, CRC Press, 2022.
6. A V K Suryanarayana, "Material Science and Metallurgy", 1st Edition, B S Publications, 2014.
7. U. C. Jindal, "Material Science and Metallurgy", 1st Edition, Pearson Publications, 2011.

e-Learning Resources

1. https://archive.nptel.ac.in/courses/113/106/113106032/
2. https://www.edx.org/learn/mechanics/massachusetts-institute-of-technology- mechanical-behavior-of-materials-part-3-time-dependent-behavior.
3. https://www.youtube.com/watch?v=9Sf278j1GTU
4. https://www.coursera.org/learn/fundamentals-of-materials-science
5. https://www.coursera.org/learn/material-behavior.

MECHANICS OF SOLIDS & MATERIALS SCIENCE LAB

II Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 1.5	External Marks : 70

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Course Objectives

- To impart hands on training to examine the mechanical properties of materials.
- To impart hands on training in preparation of metal specimen so as to observe the microstructure.

Course Outcomes

Upon successful completion of the course, the students will be able to

- determine the young's modulus, rigidity modulus of materials and stresses induced in bars and beams of uniform cross section.
- determine the hardness number.
- determine the stiffness of spring.
- determine the impact strength of materials.
- prepare the specimen using rough grinding, finish grinding and polishing.
- use different types of etchants to expose the microstructure of metal and alloys.
- observe the microstructure and ascertaining the same.
- perform Jominy end quench test.

Perform any 5 experiments from each section A and B.

A) Mechanics of Solids Lab

1. Tensile test
2. Bending test on
   a) Simply supported beam b) Cantilever beam
3. Torsion test
4. Hardness test
   a) Brinell's hardness test b) Rockwell hardness test c) Vickers hardness test
5. Test on springs
6. Impact test
   a) Charpy test b) Izod test
7. Punch shear test
8. Liquid penetration test

B) Material Science Lab

1. Preparation and study of the Microstructure of pure metals.
2. Preparation and study of the Microstructure of Mild steel, medium carbon steels, and High carbon steels.
3. Study of the Microstructures of Cast Irons.
4. Study of the Microstructures of Non-Ferrous alloys.
5. Study of the Microstructures of Heat treated steels.
6. Hardenability of steels by Jominy End Quench Test.

Virtual Lab

1. To investigate the principal stresses σa and σb at any given point of a structural element or machine component when it is in a state of plane stress. (https://virtual- labs.github.io/exp-rockwell-hardness-experiment-iiith/objective.html).
2. To find the impact resistance of mild steel and cast iron.(https://sm- nitk.vlabs.ac.in/exp/izod-impact-test).
3. To find the impact resistance of mild steel.(https://sm-nitk.vlabs.ac.in/exp/charpy- impact-test/index.html).
4. To find the Rockwell hardness number of mild steel, cast iron, brass, aluminum and spring steel etc. (https://sm-nitk.vlabs.ac.in/exp/rockwell-hardness-test).
5. To determine the indentation hardness of mild steel, brass, aluminum etc. using Vickers hardness testing machine. (https://sm-nitk.vlabs.ac.in/exp/vickers-hardness- test).

COMPUTER-AIDED MACHINE DRAWING

II Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 1.5	External Marks : 70

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Course Objectives

- To familiarize the students with 2D and 3D modeling of various mechanical elements and their assemblies for real time applications.

Course Outcomes

Upon successful completion of the course, the students will be able to

- demonstrate the conventional representations of materials and machine components.
- model the riveted, welded and key joints using CAD system.
- create solid models and sectional views of machine components.
- generate solid models of machine parts and assemble them.
- translate 3D assemblies into 2D drawings.

Course Content

1. **The following are to be done by any 2D software package Conventional representation of materials and components:**
   Detachable joints: Drawing of thread profiles, hexagonal and square-headed bolts and nuts,bolted joint with washer and locknut, stud joint, screw joint and foundation bolts.
   Riveted joints: Drawing of rivet, lap joint, butt joint with single strap, single riveted, double riveted double strap joints.
   Welded joints: Lap joint and T joint with fillet, butt joint with conventions.
   Keys: Taper key, sunk taper key, round key, saddle key, feather key, woodruff key.
   Couplings: rigid – Muff, flange; flexible – bushed pin-type flange coupling, universal coupling, Oldham's' coupling.

2. **The following exercises are to be done by any 3D software package: Sectional views: Creating solid models of complex machine parts and sectional views.**

3. **Assembly drawings: (Any four of the following using solid model software):** Lathe tool post, tool head of shaping machine, tail-stock, machine vice, gate valve, carburetor, piston, connecting rod, eccentric, screw jack, plumber block, axle bearing, pipe vice, clamping device, Geneva cam, universal coupling.

4. **Production drawing:** Representation of limits, fits and tolerances for mating parts. Use any four parts of above assembly drawings and prepare manufacturing drawing with dimensional and geometric tolerances.

Text Books:

1 K.L.Narayana, P.Kannaiah and K.Venkat Reddy, "Machine Drawing", 3rd Edition, New Age International Publishers, 2014.

2 N. Sideshwar, P. Kannaiah, V.V.S.Sastry, "Machine Drawing", 2nd Edition, TMH Publishers. 2014.

Reference Books:

1. Cecil Jensen, Jay Helsel and Donald D.Voisinet, "Computer Aided Engineering Drawing", Tata McGraw-Hill, NY, 2000.
2. James Barclay, Brain Griffiths, "Engineering Drawing for Manufacture", KoganPage Science, 2003.
3. N.D.Bhatt, "Machine Drawing", 50th Edition, Charotar Publishers, 2014.

e-Learning Resources:

1. https://eeedocs.wordpress.com/wp-content/uploads/2014/02/machinedrawing.pdf
2. https://archive.nptel.ac.in/courses/112/105/112105294/
3. https://www.edx.org/learn/engineering/dassault-systemes-solidworks-solidworks-cad-fundamentals?index=product&queryID=c90b35a82a6ef58b0d6f89679c63f6a1&position=2&linked_from=autocomplete&c=autocomplete
4. https://www.youtube.com/watch?v=0bQkS3_3Fq4

PYTHON PROGRAMMING LAB

II Year – I Semester

Lecture : 2	Internal Marks : 30
Credits : 1	External Marks : 70

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Course Objectives

- To develop a solid foundation in Python programming, covering essential syntax, semantics, and constructs.
- To equip students with skills to handle and manipulate data using Python libraries like Pandas and NumPy.
- To enhance problem-solving abilities by implementing various algorithms and data structures in Python.
- To foster software development skills, including version control, package management, and project documentation.
- To introduce advanced Python topics such as web scraping, API interaction, and database management.

Course Outcomes

Upon successful completion of the course, the students will be able to

- demonstrate the fundamental concepts of python and use of control flow statements to write effective and readable code.
- develop python programs including functions,modules, lists, tuples, dictionaries, sets for efficient problem solving.
- make use of python data structures for efficient data handling, and apply relevant methods to manipulate and retrieve data in python programs.
- apply object-oriented concepts to develop reusable code.
- use NumPy for numerical computations and evaluate pandas for data analysis in python.

List of Experiments:

Experiment 1: Introduction to Python

Objective: Install Python and set up the development environment.

Tasks: Install Python and an IDE (e.g., PyCharm, VSCode, or Jupyter Notebook).
Write and run a simple "Hello, World!" program.
Understand and demonstrate basic Python syntax and semantics.

Experiment 2: Basic Python Programming

Objective: Learn basic programming constructs in Python.

Tasks: Create programs using variables, data types, and operators.
Implement basic input and output functions.
Write programs using control structures (if statements, for loops, while loops).

Experiment 3: Functions and Modules

Objective: Understand functions and module usage in Python.

Tasks: Define and call functions with different types of arguments and return values.
Explore and use built-in Python modules.
Write a script that imports and utilizes at least two different standard library modules.

Experiment 4: Lists and Tuples

Objective: Work with Python lists and tuples.

Tasks: Create, modify, and iterate over lists and tuples.
Perform list comprehensions to create new lists.
Demonstrate the immutability of tuples.

Experiment 5: Dictionaries and Sets

Objective: Explore dictionaries and sets in Python.

Tasks: Create and manipulate dictionaries.
Use dictionary comprehension.

Create and perform operations on sets.

Experiment 6: Strings and File I/O

Objective: Manipulate strings and perform file I/O operations.

Tasks: Demonstrate various string methods.
Write programs to read from and write to text files.
Work with different file formats, including CSV and JSON.

Experiment 7: Error Handling and Exceptions

Objective: Implement error handling in Python programs.

Tasks: Write programs using try, except, else, and finally blocks.
Handle specific exceptions.
Create and raise custom exceptions.

Experiment 8: Object-Oriented Programming (OOP)

Objective: Understand and implement OOP concepts in Python.

Tasks: Define classes and create objects.
Demonstrate inheritance and polymorphism.
Use class and instance variables in programs.

Experiment 9:Libraries and Packages

Objective: Utilize third-party libraries and create Python packages.

Tasks: Install and use libraries like NumPy and Pandas.
Create a simple Python package and distribute it.
Work with virtual environments to manage dependencies.

Experiment 10: Working with Data

Objective: Perform data manipulation and visualization.

Tasks: Use Pandas to load, manipulate, and analyze datasets.
Create visualizations using Matplotlib and Seaborn.
Conduct basic data analysis tasks and summarize findings.

Experiment 11: Web Scraping and APIs

Objective: Extract data from the web and interact with APIs.

Tasks: Access and parse data from RESTful APIs.
Process and analyze JSON data from APIs.

Experiment 12: Databases

Objective: Work with databases in Python.

Tasks: Connect to a database using SQ Lite and SQL Alchemy.
Perform CRUD operations on the database.
Write queries to manage and retrieve data.

Reference Books:

1. Gowri Shankar S, Veena A., "Introduction to Python Programming", CRC Press.

Reference Books:

1. S Sridhar, J Indumathi, V M Hariharan, "Python Programming", 2nd Edition, Pearson, 2024
2. Y. Daniel Liang, "Introduction to Programming Using Python", Pearson.

e-Learning Resources:

- https://www.coursera.org/learn/python-for-applied-data-science-ai
- https://www.w3schools.com/python/python_intro.asp
- https://www.youtube.com/watch?v=eWRfhZUzrAc
- https://onlinecourses.nptel.ac.in/noc20_cs83/preview
- https://www.edx.org/learn/python
- Virtual Labs - https://python-iitk.vlabs.ac.in/
- Virtual Labs - https://virtual-labs.github.io/exp-arithmetic-operations-iitk/
- Virtual Labs - https://cse02-iiith.vlabs.ac.in/
- https://mlritm.ac.in/assets/cse/cse_lab_manuals/R20_cse_manuals/Python% 0Lab%20Manual.pdf

EMBEDDED SYSTEMS & IoT

II Year – I Semester

Lecture : 2	Tutorial : 1	Internal Marks	: 30
Credits : 3		External Marks	: 70

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Course Objectives

- To comprehend Microcontroller-Transducers Interface techniques.
- To establish Serial Communication link with Arduino.
- To analyse basics of SPI interface.
- To interface Stepper Motor with Arduino.
- To analyse Accelerometer interface techniques.
- To introduce the Raspberry PI platform, that is widely used in IoT applications.
- To introduce the implementation of distance sensor on IoT devices.

Course Outcomes

Upon successful completion of the course, the students will be able to

- comprehend Microcontroller-Transducers Interface techniques.
- establish Serial Communication link with Arduino.
- analyse basics of SPI interface.
- understand the concept of M2M (machine to machine) with necessary protocols and get awareness in implementation of distance sensor.
- realize the revolution of internet in mobile devices, cloud and sensor networks.

List of Experiments:

(Perform any 5 experiments from each section A and B)

A) Embedded Systems

1. Measure Analog signal from Temperature Sensor.
2. Generate PWM output.
3. Drive single character generation on Hyper Terminal.
4. Drive a given string on Hyper Terminal.
5. Full duplex Link establishment using Hyper terminal.
6. Drive a given value on a 8 bit DAC consisting of SPI.
7. Drive Stepper motor using Analog GPIOs.
8. Drive Accelerometer and Display the readings on Hyper Terminal.

Components / Boards

1. Arduino Duemilanove Board
2. Arduino Software IDE.

Text Books:

1 Tammy Noergaard, "Embedded Systems Architecture" Elsevier Publications, 2013.
2 Shibu. K.V, "Embedded Systems" Tata McGraw Hill Education Private Limited,2013.
3 Frank Vahid, Tony Givargis, "Embedded System Design", John Wiley Publications,2013.
4 Lyla B.Das, "Embedded Systems" Pearson Publications, 2013.

B) Internet of Things Experiments

1. Getting started with Raspberry Pi, Install Raspian on your SD card.
2. Python-based IDE (integrated development environments) for the Raspberry Pi andhow to trace and debug Python code on the device.

3. Using Raspberry pi (a) Calculate the distance using distance sensor. (b) Basic LEDfunctionality.
4. Raspberry Pi interact with online services through the use of public APIs and SDKs.
5. Study and Install IDE of Arduino and different types of Arduino.
6. Study and Implement Zigbee Protocol using Arduino / Raspberry Pi.
7. Calculate the distance using distance sensor Using Arduino.
8. Basic LED functionality Using Arduino.
9. Calculate temperature using temperature sensor Using Arduino.
10. Calculate the distance using distance sensor Using Node MCU.
11. Basic LED functionality Using Node MCU.

Text Books:

1. Arsheep Bahga &Vijay Madisetti, "Internet of Things - A Hands-on Approach", 1st Edition, Orient Blackswan Prt. Ltd. - New Delhi, 2015.
2. Arshdeep Bahga and Vijay Madisetti, "Internet of Things A hands on Approach" Universities Press, 2015.
3. Matt Richardson & Shawn Wallace, "Getting Started with Raspberry Pi", O'Reilly, 2014

E-Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs17/preview
2. https://onlinecourses.nptel.ac.in/noc20_ee98/preview
3. https://archive.nptel.ac.in/courses/108/105/108105057/
4. https://www.edx.org/learn/embedded-systems/the-university-of-texas-at-austin- embedded-systems-shape-the-world microcontroller input output?index=product &objectID=course-785cf551-7f66-4350-b736-64a93427b4db&webview=false&campaign=Embedded+Systems+-+Shape+The+World%3A+Microcontroller+Input%2FOutput &source=edX& product_category=course&placement_url=https%3A%2F%2Fwww.edx.org%2Flearn%2Fembedded-systems
5. https://www.edx.org/learn/iot-internet-of-things/universitat-politecnica-de-valencia-introduction-to-the-internet-of-things?index=product&queryID=e1322674dcb3d246be981d0669265399&position=4&linked_from=autocomplete&c=autocomplete
6. https://www.edx.org/learn/iot-internet-of-things/curtin-university-iot-sensors-and-devices?index=product&queryID=94ff5bcb80b8e4f427a0985bb2a5e07f&position=3&results_level=first-level-results&term=IOT&objectID=course-967eee29-87e8-4f2d9257a1b38ec07e85&campaign=IoT+Sensors+and+Devices&source=edX&product_category=course&placement_url=https%3A%2F%2Fwww.edx.org%2Fsearch
7. Virtual Labs - http://vlabs.iitkgp.ac.in/rtes/
8. Virtual Labs - https://cse02-iiith.vlabs.ac.in/
9. Virtual Labs - https://iotvirtuallab.github.io/vlab/Experiments/index.html

DESIGN THINKING & INNOVATION

(Common to CE, ME, IT, CSE (AI&ML), IOT)

II Year – I Semester

Lecture : 1	Practical : 2	Internal Marks	: 30
Credits : 3		External Marks	: 70

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Course Objectives

- To develop a comprehensive understanding of design thinking, its history, principles, and application in various contexts, including product development and business innovation.
- To apply the design thinking process and tools to foster creativity, drive innovation, and address real-world challenges in both social and business settings.

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyse the elements and principles of design.
- implement the design thinking process (empathize, analyze, ideate, and prototype) to drive inventions and social innovations.
- analyse the difference between innovation and creativity, to foster innovation within organization.
- create a comprehensive product design by forming and solving problems, setting product strategies, values, planning, and specifications, and evaluating case studies for practical insights.
- apply design thinking principles to redefine business strategies and address business challenges.

Course Content

UNIT – I: Introduction to Design Thinking

Introduction to elements and principles of design, basics of design-dot, line, shape, form as fundamental design components - Principles of design - Introduction to design thinking, history of design thinking, new materials in industry.

UNIT – II: Design Thinking Process

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brain storming, product development

Activity: Every student presents their idea in three minutes, every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

UNIT – III: Innovation

Art of innovation, difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to innovation. Teams for innovation, measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, flow and planning from idea to innovation, debate on value-based innovation.

UNIT – IV: Product Design

Problem formation, introduction to product design, product strategies, product value, product planning, product specifications. Innovation towards product design case studies.

Activity: Importance of modeling, how to set specifications, explaining their own product design.

UNIT – V: Design Thinking in Business Processes

Design thinking applied in business & strategic Innovation, design thinking principles that redefine business – Business challenges: growth, predictability, change, maintaining relevance, extreme competition, standardization. Design thinking to meet corporate needs. Design thinking for startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes.

Activity: How to market our own product, about maintenance, Reliability and plan for startup.

Text Books:

1. Tim Brown, "Change by Design", 1st Edition, Harper Bollins, 2009.
2. Idris Mootee, "Design Thinking for Strategic Innovation", 1st Edition, Adams Media, 2014.

Reference Books:

1. David Lee, "Design Thinking in the Classroom", Ulysses press, 2018.
2. Shrrutin N Shetty, "Design the Future", 1st Edition, Norton Press, 2018.
3. William lidwell, Kritina holden, Jill butter, "Universal principles of design", 2nd Edition, Rockport Publishers, 2010.
4. Henry W. Chesbrough, "The Era of Open Innovation", MIT Sloan Management Review, 2003.
5. Anuja Agarwal, "Design Thinking: A Framework for Applying Design Thinking in Problem Solving", 1st Edition, Cengage learning India Pvt. Ltd., 2023

e-Learning Resources:

1. https://nptel.ac.in/courses/110/106/110106124/
2. https://nptel.ac.in/courses/109/104/109104109/
3. https://swayam.gov.in/nd1_noc19_mg60/preview
4. https://onlinecourses.nptel.ac.in/noc2

ENVIRONMENTAL SCIENCE

(Common to All Branches)

II YEAR – I SEMESTER

Lecture : 2	Internal Marks : 30
Credits : -	External Marks : 70

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Course Objectives

- To impart basic knowledge about the environment and natural resources.
- To develop an attitude of concern for biodiversity conservation and ecosystems.
- To acquire knowledge and skills on environmental pollution control.

Course Outcomes

Upon successful completion of the course, the students will be able to

- create awareness among the people in protection of environment and natural resources.
- analyze structure and functional attributes of an ecosystem and biodiversity conservation.
- identify the sources of environmental pollution, assess their effects and suggest suitable control measures.
- adopt sustainable management practices for various environmental issues.
- recognize the relationship between population growth and health.

Course Content

UNIT – I:

Multidisciplinary Nature of Environmental Studies: Definition, Scope and Importance - Need for Public Awareness.

Natural Resources: Renewable and non-renewable resources - Natural resources and associated problems - Forest resources: Use and over - exploitation, deforestation, case studies - Timber extraction - Mining, dams and other effects on forest and tribal people - Water resources: Use and over utilization of surface and ground water - Floods, drought, conflicts over water, dams - benefits and problems - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies - Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources.

UNIT – II:

Ecosystems: Concept of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem - Ecological succession - Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem:

a. Forest ecosystem.
b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity And Its Conservation: Introduction and Definition: genetic, species and ecosystem diversity - Bio-geographical classification of India - Value of biodiversity: consumptive use, Productive use social, ethical, aesthetic and option values - Biodiversity at global, national and local levels - India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT – III:

Environmental Pollution: Definition, causes, effects and control measures of:

a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Pollution case studies - Disaster management: floods, earthquake, cyclone and landslides.

UNIT – IV:

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 - Public awareness.

UNIT – V:

Human Population and The Environment: Population growth, variation among nations. Population explosion - Family Welfare Programmes - 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.

Field Work: 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, and birds - river, hill slopes, etc.

Text Books:

1. Erach Bharucha, "Text book of Environmental Studies for Undergraduate Courses", Universities Press (India) Private Limited, 2019.
2. Palaniswamy, "Environmental Studies", 2nd Edition, Pearson Education, 2014.
3. S.Azeem Unnisa, "Environmental Studies", Academic Publishing Company, 2021.
4. K.Raghavan Nambiar, "Text book of Environmental Studies for Undergraduate Courses (as per UGC model syllabus)", Scitech Publications (India) Pvt. Ltd, 2010.

Reference Books:

1. Deeksha Dave and E. Sai Baba Reddy, "Textbook of Environmental Science", 2nd Edition, Cengage Publications, 2012.
2. M. Anji Reddy, "Textbook of Environmental Sciences and Technology", BS Publication, 2014.
3. J. P. Sharma, "Comprehensive Environmental Studies", Laxmi Publications, 2006.
4. J. Glynn Henry and Gary W. Heinke, "Environmental Sciences and Engineering", Prentice Hall of India Private Limited, 1988.
5. G. R. Chatwal, "A Text Book of Environmental Studies", Himalaya Publishing House, 2018.
6. Gilbert M. Masters and Wendell P. Ela, "Introduction to Environmental Engineering and Science", 1st Edition, Prentice Hall of India Private Limited, 1991.

e-Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc23_hs155/preview
2. https://www.edx.org/learn/environmental-science/rice-university-ap-r-environmental-science-part-3-pollution-and-resources?index=product&objectID=course-3a6da9f2-d84c-4773-8388-1b2f8f6a75f2&webview=false&campaign=AP%C2%AE+Environmental+Science++Part+3%3A+Pollution+and+Resources&source=edX&product_category=course&placement_url=https%3A%2F%2Fwww.edx.org%2Flearn%2Fenvironmental-science.
3. http://ecoursesonline.iasri.res.in/Courses/Environmental%20Science-I/Data%20Files/pdf/lec07.pdf
4. https://www.youtube.com/watch?v=5QxxaVfgQ3k

UNIVERSAL HUMAN VALUES – UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT

(Common to All Branches)

II Year – II Semester

Lecture : 2	Tutorial : 1	Internal Marks	: 30
Credits : 3		External Marks	: 70

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Course Objectives

- To help understand the need, basic guidelines, content and process of value education.
- To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
- To understand the harmony in nature and existence.
- To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life.

Course Outcomes:

Upon the successful completion of this course, the students will able to:

- analyze the essentials of human values and skills, self-exploration, happiness and prosperity.
- evaluate coexistence of the "I" with the body.
- identify and evaluate the role of harmony in family, society and universal order.
- examine the holistic perception of harmony at all levels of existence.
- develop appropriate technologies and management patterns to create harmony in professional and personal lives.

Course Content

The course has 28 lectures and 14 tutorials in 5 modules. The lectures and tutorials are of 1hour duration. Tutorial sessions are to be used to explore and practice what has been proposed during the lecture sessions.

The Teacher's Manual provides the outline for lectures as well as practice sessions. The teacher is expected to present the issues to be discussed as propositions and encourage the students to have a dialogue.

UNIT – I: Introduction to Value Education (6 lectures and 3 tutorials for practice session)

Lecture 1 : Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)

Lecture 2 : Understanding Value Education

Tutorial 1 : Practice Session PS1 Sharing about Oneself

Lecture 3 : self-exploration as the Process for Value Education

Lecture 4 : Continuous Happiness and Prosperity – the Basic Human Aspirations

Tutorial 2 : Practice Session PS2 Exploring Human Consciousness

Lecture 5 : Happiness and Prosperity – Current Scenario

Lecture 6 : Method to Fulfill the Basic Human Aspirations

Tutorial 3 : Practice Session PS3 Exploring Natural Acceptance

UNIT – II: Harmony in the Human Being (6 lectures and 3 tutorials for practice session)

Lecture 7 : Understanding Human being as the Co-existence of the self and the body.

Lecture 8 : Distinguishing between the Needs of the self and the body

Tutorial 4 : Practice Session PS4 Exploring the difference of Needs of self and body.

Lecture 9 : The body as an Instrument of the self

Lecture 10 : Understanding Harmony in the self

Tutorial 5 : Practice Session PS5 Exploring Sources of Imagination in the self

Lecture 11 : Harmony of the self with the body
Lecture 12 : Programme to ensure self-regulation and Health
Tutorial 6 : Practice Session PS6 Exploring Harmony of self with the body

UNIT – III: Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)
Lecture 13 : Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14 : 'Trust' – the Foundational Value in Relationship
Tutorial 7 : Practice Session PS7 Exploring the Feeling of Trust
Lecture 15 : 'Respect' – as the Right Evaluation
Tutorial 8 : Practice Session PS8 Exploring the Feeling of Respect
Lecture 16 : Other Feelings, Justice in Human-to-Human Relationship
Lecture 17 : Understanding Harmony in the Society
Lecture 18 : Vision for the Universal Human Order
Tutorial 9 : Practice Session PS9 Exploring Systems to fulfill Human Goal

UNIT – IV: Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)
Lecture 19 : Understanding Harmony in the Nature
Lecture 20 : Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature
Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature
Lecture 21 : Realizing Existence as Co-existence at All Levels
Lecture 22 : The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence.

UNIT – V: Implications of the Holistic Understanding – a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)
Lecture 23 : Natural Acceptance of Human Values
Lecture 24 : Definitiveness of (Ethical) Human Conduct
Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct
Lecture 25 : A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture 26 : Competence in Professional Ethics
Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education
Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies
Lecture 28 : Strategies for Transition towards Value-based Life and Profession
Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

Practice Sessions:

UNIT – I: Introduction to Value Education
PS1 Sharing about Oneself
PS2 Exploring Human Consciousness
PS3 Exploring Natural Acceptance

UNIT – II: Harmony in the Human Being
PS4 Exploring the difference of Needs of self and body
PS5 Exploring Sources of Imagination in the self
PS6 Exploring Harmony of self with the body

UNIT – III: Harmony in the Family and Society
PS7 Exploring the Feeling of Trust
PS8 Exploring the Feeling of Respect
PS9 Exploring Systems to fulfil Human Goal

UNIT – IV: Harmony in the Nature (Existence)
PS10 Exploring the Four Orders of Nature

PS11 Exploring Co-existence in Existence

UNIT – V: Implications of the Holistic Understanding – a Look at Professional Ethics

PS12 Exploring Ethical Human Conduct
PS13 Exploring Humanistic Models in Education
PS14 Exploring Steps of Transition towards Universal Human Order

Readings:

Text Book and Teachers Manual

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

b. The Teacher's Manual: R R Gaur, R Asthana, and G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books:

1. A Nagaraj, "JeevanVidya: EkParichaya", JeevanVidya Prakashan, Amarkantak, 1999.
2. A. N. Tripathi, "Human Values", New Age International Publishers, 2004.
3. Annie Leonard, "The Story of Stuff", Free Press Publishers, 2010.
4. Mohandas Karamchand Gandhi, "The Story of My Experiments with Truth", 1st edition, Fingerprint Publishers, 2009.
5. E. F Schumacher, "Small is Beautiful", Vintage Publishers, 2010.
6. Cecile Andrews , "Slow is Beautiful", New Society Publishers, 2006.
7. J C Kumarappa, "Economy of Permanence", Sarva Seva Sangh Prakashan, 2017.
8. Pandit Sunderlal, "Bharat Mein Angreji Raj", Publications Division, M/O Information & Broadcasting, Govt. of India, 2016.
9. Dharampal,"Rediscovering India", Stosius Inc/Advent Books Division, 1983.
10. Mohandas K. Gandhi, "Hind Swaraj or Indian Home Rule", 15th edition, Educa Books, 2011.
11. Maulana Abdul Kalam Azad, "India Wins Freedom", 1st edition, Orient BlackSwan, 1988.
12. Romain Rolland, "Life of Vivekananda", 4th Impression edition, Advaita Ashrama press, 2010.
13. Romain Rolland, "Mahatma Gandhi**",** Maple Press , 2010.

Mode of Conduct:

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions.

While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses. This course is to be taught by faculty from every teaching department, not exclusively by any one department.

Teacher preparation with a minimum exposure to at least one 8-day Faculty Development Program on Universal Human Values is deemed essential.

e-Learning Resources:

1. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201Introduction%20to%20Value%20Education.pdf
2. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf
3. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf
4. https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3S2%20Respect%20July%2023.pdf
5. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf
6. https://fdp-si.aicte-india.org/download/FDPTeachingMaterial/3-days%20FDPSI%20UHV%20Teaching%20Material/Day%203%20Handouts/UHV%203D%20D3-S2A%20Und%20Nature-Existence.pdf
7. https://fdp-si.aicteindia.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%202325%20Ethics%20v1.pdf
8. https://www.studocu.com/in/document/kiet-group-of-institutions/universal-humanvalues/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385
9. https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

COMPLEX VARIABLES, PROBABILITY AND STATISTICS

II Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To understand the concepts of complex functions.
- To know basics of probability and its implementation.

Course Outcomes

Upon successful completion of the course, the students will be able to

- verify whether the given function is analytic or not and evaluate complex integration using cauchy's integral formulae.
- make use of the Cauchy residue theorem to evaluate certain integrals
- apply discrete and continuous probability distributions
- construct sampling distributions, confidence intervals and to find maximum error of estimates for population parameters.
- apply the inference tests when the sample data is large and/or small.

Course Content

UNIT – I: Functions of a complex variable and Complex integration

Introduction–Continuity –Differentiability–Analyticity –Cauchy-Riemann equations in Cartesian coordinates–Harmonic and conjugate harmonic functions – Milne Thompson method. Complex integration: Line integral – Cauchy's integral theorem – Cauchy's integral formula – Generalized integral formula (all without proofs) and problems on above theorems.

UNIT – II: Series expansions and Residue Theorem

Radius of convergence – Expansion in Taylor's series, Maclaurin's series and Laurent series. Types of Singularities: Isolated – Essential – Pole of order m – Residues – Residue theorem (without proof) – Evaluation of contour integration using Residue theorem.

UNIT – III: Probability and Distributions

Review of probability and Baye's theorem – Random variables – Discrete and Continuous random variables – Distribution functions – Probability mass function, Probability density function and Cumulative distribution functions – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

UNIT – IV: Sampling Theory

Introduction – Population and Samples – Sampling distribution of Means and Variances (definition only)–Central limit theorem (without proof) – Introduction to t, $\chi 2$ and F-distributions - point and interval estimations - maximum error of estimate.

UNIT – V: Tests of Hypothesis

Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors– Level of significance – One tail and two-tail tests – Tests concerning one mean and two means (Large and Small samples)–Tests on proportions.

Text Books:

1. B. S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers.
2. Miller and Freund's, "Probability and Statistics for Engineers",7th Edition, Pearson,2008.

Reference Books:

1. J. W. Brown and R. V. Churchill, "Complex Variables and Applications", 9th Edition, Mc-Graw Hill, 2013.
2. S.C.Gupta and V.K. Kapoor, "Fundamentals of Mathematical Statistics",11th Edition, Sultan Chand & Sons Publications,2012.
3. Jay l. Devore, "Probability and Statistics for Engineering and the Sciences", 8th Edition, Cengage.
4. ShronL. Myers, KeyingYe, Ronald E Walpole, "Probability and Statistics Engineers and the Scientists", 8th Edition, Pearson 2007.
5. Sheldon, M. Ross, "Introduction to Probability and Statistics Engineers and the Scientists", 4th Edition, Academic Foundation, 2011.

INDUSTRIAL MANAGEMENT

II Year – II Semester

Lecture : 2	Internal Marks : 30
Credits : 2	External Marks : 70

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Course Objectives

- To introduce the scope and role of industrial engineering and the techniques for optimal design of layouts
- To illustrate how work study is used to improve productivity
- To explain TQM and quality control techniques
- To introduce financial management aspects and
- To discuss human resource management and value analysis.

Course Outcomes

Upon successful completion of the course, the students will be able to

- learn about how to design the optimal layout
- demonstrate work study methods
- explain Quality Control techniques
- discuss the financial management aspects
- understand the human resource management methods.

Course Content

UNIT – I:

Introduction: Definition of industrial engineering (I.E), development, applications, role of an industrial engineer, differences between production management and industrial engineering, quantitative tools of IE and productivity measurement. concepts of management, importance, functions of management, scientific management, Taylor's principles, theory X and theory Y, Fayol's principles of management.

Plant Layout: Factors governing plant location, types of production layouts, advantages and disadvantages of process layout and product layout, applications, quantitative techniques for optimal design of layouts, plant maintenance, preventive and break down maintenance.

UNIT – II:

Work Study: Importance, types of production, applications, work study, method study and time study, work sampling, PMTS, micro-motion study, rating techniques, MTM, work factor system, principles of Ergonomics, flow process charts, string diagrams and Therbligs.

UNIT – III:

Statistical Quality Control: Quality control, Queuing assurance and its importance, SQC, attribute sampling inspection with single and double sampling, Control charts – $\bar{X}$ and R –charts $\bar{X}$ and S charts and their applications, numerical examples.

Total Quality Management: zero defect concept, quality circles, implementation, applications, ISO quality systems. Six Sigma–definition, basic concepts

UNIT – IV:

Financial Management: Scope and nature of financial management, Sources of finance, Ratio analysis, Management of working capital, estimation of working capital requirements, stock management, Cost accounting and control, budget and budgetary control, Capital budgeting – Nature of Investment Decisions – Investment Evaluation criteria- NPV, IRR, PI, Payback Period, and ARR, numerical problems.

UNIT – V:

Human Resource Management: Concept of human resource management, personnel management and industrial relations, functions of personnel management, Job- evaluation, its importance and types, meritrating, quantitative methods, wage incentive plans, and types.

Value Analysis: Value engineering, implementation procedure, enterprise resource planning and supply chain management.

Text Books:

1. O.P Khanna, "Industrial Engineering and Management", Dhanpat Rai Publications (P) Ltd, 2018.
2. Mart and Telsang, "Industrial Engineering and Production Management", S.Chand & Company Ltd. New Delhi, 2006.

Reference Books:

1. Bhattacharya DK, "Industrial Management", S. Chand, Publishers, 2010.
2. J.G Monks, "Operations Management", 3rd Edition, Mc Graw Hill Publishers1987.
3. T.R. Banga, S.C.Sharma, N. K. Agarwal, "Industrial Engineering and Management Science", Khanna Publishers, 2008.
4. Koontz O' Donnell, "Principles of Management", 4th Edition, Mc Graw Hill Publishers, 1968.
5. R.C. Gupta, "Statistical Quality Control", Khanna Publishers, 1998.
6. N V S Raju, "Industrial Engineering and Management", 1st Edition, Cengage India Private Limited, 2013.

e-Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc21_me15/preview
2. https://onlinecourses.nptel.ac.in/noc20_mg43/preview
3. https://www.edx.org/learn/industrial-engineering
4. https://youtube.com/playlist?list=PL299B5CC87110A6E7&si=TghLCbEobuxjEaXi
5. https://youtube.com/playlist?list=PLbjTnj-t5Gkl0z3OHOGK5RB9mvNYvnImW&si=oaX_5RG69hS3v2ll

MANUFACTURING PROCESSES

II Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To introduce the principles of manufacturing Science to convert materials into desired shapes and sizes.

Course Outcomes

Upon successful completion of the course, the students will be able to

- create patterns and core boxes for metal casting processes.
- analyse different welding processes.
- illustrate the different types of bulk forming processes.
- evaluate sheet metal forming processes.
- identify the different types of additive manufacturing processes.

Course Content

UNIT – I:

Casting: Steps involved in making a casting – Advantage of casting and its applications. Patterns and Pattern making – Types of patterns – Materials used for patterns, pattern allowances and their construction, Molding, different types of cores , Principles of Gating, Risers, casting design considerations. Methods of melting and types of furnaces, Solidification of castings and casting defects- causes and remedies. Basic principles and applications of special casting processes - Centrifugal casting, Die casting, Investment casting and shell molding.

UNIT – II:

Welding: Classification of welding processes, types of welded joints and their characteristics, Gas welding, Different types of flames and uses, Oxy – Acetylene Gas cutting. Basic principles of Arc welding, power characteristics, Manual metal arc welding, submerged arc welding, TIG & MIG welding. Electro–slag welding.

Resistance welding, Friction welding, Friction stir welding, Forge welding, Explosive welding; Thermit welding, Plasma Arc welding, Laser welding, electron beam welding, Soldering &Brazing. Heat affected zones in welding, pre & post heating, welding defects –causes and remedies.

UNIT – III:

Bulk Forming: Plastic deformation in metals and alloys-recovery, re-crystallization and grain growth. Hot working and Cold working. Bulk forming processes: Forging-Types of Forging, forging defects and remedies; Rolling – fundamentals, types of rolling mills and products, Forces in rolling and power requirements. Extrusion and its characteristics. Types of extrusion, Impact extrusion, Hydrostatic extrusion; Wire drawing and Tube drawing.

UNIT – IV:

Sheet metal forming: Blanking and piercing, Forces and power requirement in these operations, Deep drawing, Stretch forming, Bending, Spring back and its remedies, Coining, Spinning, Types of presses and press tools.

High energy rate forming processes: Principles of explosive forming, electromagnetic forming, Electro hydraulic forming, rubber pad forming, advantages and limitations.

UNIT – V:

Additive Manufacturing - Steps in Additive Manufacturing (AM), classification of AM processes, advantages of AM, and types of materials for AM, VAT photo polymerization AM Processes, extrusion based AM Processes, Powder Bed Fusion AM Processes, Direct Energy Deposition AM processes, post processing of AM parts, applications. comparison with conventional manufacturing of plastics- injection molding and blow molding.

Text Books:

1. Kalpakjian S and Steven R Schmid, "Manufacturing Processes for Engineering Materials", 5th edition, Pearson Publications, 2007.
2. P.N. Rao, "Manufacturing Technology -Vol I", 5th edition, McGraw Hill Education, 2018.

Reference Books:

1. A.Ghosh & A.K.Malik, "Manufacturing Science", East West Press Pvt. Ltd, 2010.
2. Lindberg and Roy, "Processes and Materials of Manufacture", 4th Edition, Prentice Hall India Learning Private Limited, 1990.
3. R.K. Jain, "Production Technology", Khanna Publishers, 2022.
4. Sharma P.C., "A Text book of Production Technology", 8th Edition, S Chand Publishing, 2014.
5. H.S. Shaun, "Manufacturing Processes", 1st Edition, Pearson Publishers, 2012.
6. WAJ Chapman, "Workshop Technology", 5th Edition, CBS Publishers & Distributors Pvt. Ltd, 2001.
7. "Hindustan Machine Tools, Production Technology," Tata McGraw Hill Publishers, 2017.
8. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", 2nd Edition, Springer, 2015.

e-Learning Resources:

1. https://www.edx.org/learn/manufacturing/massachusetts-institute-of-technology-fundamentals-of-manufacturing-processes
2. https://onlinecourses.nptel.ac.in/noc21_me81/preview
3. www.coursera.org/learn/introduction-to-additive-manufacturing-processessera
4. https://archive.nptel.ac.in/courses/112/103/112103263/
5. https://elearn.nptel.ac.in/shop/nptel/principles-of-metal-forming-technology/?v=c86ee0d9d7ed

FLUID MECHANICS & HYDRAULIC MACHINES

II Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To introduce the fluid properties, basic laws, principles of conservation of mass, momentum and energy and their application in the study of fluid flow.
- To introduce the principles of hydraulic turbines and pumps, along with their performance characteristics.

Course Outcomes

Upon successful completion of the course, the students will be able to

- elaborate the properties of fluid and determine the differential pressure head recorded by the pressure measuring devices, analyse the stability of bodies in floating and submerged condition.
- describe the types of fluid flow and fluid flow patterns and apply the principles of conservation of mass, momentum and energy to various engineering problems involving fluid flow.
- explain the concepts of boundary layer fluid flows and determine the various losses in a pipe.
- analyse the forces exerted by the jet of water on vanes.
- classify and analyze the performance of hydraulic turbines under various operating conditions, hydraulic systems.
- analyse the performance of centrifugal and reciprocating pumps.

Course Content

UNIT – I:

Fluid Statics: Dimensions and units: physical properties of fluids - specific gravity, viscosity and its significance, surface tension, capillarity, vapor pressure - Atmospheric, gauge and vacuum pressure, Pascal's & hydrostatic laws, Measurement of pressure – Manometers - Piezometer, U-tube, inverted and differential manometers.

Buoyancy and Floatation: Meta center, stability of floating body - submerged bodies - Calculation of meta center height - stability analysis and applications.

UNIT – II:

Fluid Kinematics: Introduction, flow types. Equation of continuity for one dimensional flow, circulation and vorticity, Stream line, path line and streak lines and stream tube. Stream function and velocity potential function, differences and relation between them - condition for rotational flow, flow net, source, sink, doublet and vortex flow.

Fluid Dynamics: surface and body forces – Euler's and Bernoulli's equations for flow along a streamline, momentum equation and its applications, force on pipe bend.

UNIT – III:

Boundary Layer Theory: Introduction, momentum Integral equation, displacement, momentum and energy thickness, separation of boundary layer, control of flow separation, Stream lined body, Bluff body and its applications, basic concepts of velocity profiles.

Closed Conduit Flow: Reynold's experiment - Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel.

UNIT – IV:

Basics of Turbo Machinery: hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

Hydraulic Turbines: classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design –draft tube-theory-functions and efficiency.

UNIT – V:

Performance of Hydraulic Turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer - Hydraulic systems- hydraulic ram, hydraulic lift, hydraulic coupling. Fluidics – amplifiers, sensors and oscillators - advantages, limitations and applications.

Centrifugal Pumps: classification, working, work done – manometric head- losses and efficiencies-specific speed- pumps in series and parallel-performance characteristic curves, cavitation & NPSH.

Reciprocating Pumps: Working, Discharge, slip, indicator diagrams.

Text Books:

1. Y. A. Cengel, J. M. Cimbala, "Fluid Mechanics, Fundamentals and Applications", 6th Edition, McGraw Hill Publications, 2019.
2. Dixon, "Fluid Mechanics and Thermodynamics of Turbo machinery", 7th Edition, Elsevier Publishers, 2014.

Reference Books:

1. P N Modi and S M Seth, "Hydraulics & Fluid Mechanics including Hydraulics Machines", Standard Book House, 2017.
2. R K Bansal, "Fluid Mechanics and Hydraulic Machines", 10th Edition, Laxmi Publications (P) Ltd, 2019.
3. Rajput, "Fluid Mechanics and Hydraulic Machines", S Chand & Company, 2016.
4. D. S. Kumar, "Fluid Mechanics and Fluid Power Engineering", S K Kataria &Sons, 2013.
5. D. Rama Durgaiah, "Fluid Mechanics and Machinery", 1st Edition, New Age International, 2002.

e-Learning Resources:

1. https://archive.nptel.ac.in/courses/112/105/112105206/
2. https://archive.nptel.ac.in/courses/112/104/112104118/
3. https://www.edx.org/learn/fluid-mechanics
4. https://onlinecourses.nptel.ac.in/noc20_ce30/previewnptel.ac.in
5. www.coursera.org/learn/fluid-powerera

THEORY OF MACHINES

II Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To familiarize with the concepts of kinematic analysis of mechanisms.
- To familiarize with the dynamic force analysis of machines and their effects.

Course Outcomes

Upon successful completion of the course, the students will be able to

- select a mechanism for a given application.
- determine the velocities and accelerations of links in mechanisms.
- evaluate the effect of gyroscopic couple on the stability of vehicles and perform kinematic analysis of gears and gear trains
- analyse balancing problems in rotating machinery and construct cam profiles for different types of follower motions.
- determine the natural frequency of vibrating systems and perform force analysis of mechanisms and design the flywheel for different applications.

Course Content

UNIT – I: Simple Mechanisms

Simple Mechanisms: Classification of mechanisms – Basic kinematic concepts and definitions Degree of freedom, mobility – Grashof's law, kinematic inversions of four bar chain and slider crank chains- Limit positions – Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line mechanisms – Universal Joint – Rocker mechanisms.

UNIT – II: Plane and motion analysis

Plane and motion analysis: Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations – kinematic analysis of simple mechanisms – slider crank mechanism dynamics – Coincident points – Coriolis component of acceleration.

UNIT – III: Gyroscope & Gear Profile

Gyroscope: Principle of gyroscope, gyroscopic effect in an aeroplane, ship, car and two wheeler, simple problems

Gear Profile: 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, epicyclic and regular gear train kinematics.

UNIT – IV: Balancing of rotating masses & Cams

Balancing of rotating masses: Need for balancing, balancing of single mass and several masses in different planes, using analytical and graphical methods.

Cams: 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.

UNIT – V: Vibrations & Turning Moment Diagrams and Flywheels

Vibrations: Introduction, degree of freedom, types of vibrations, free natural vibrations, Newton method and energy method for single degree of freedom. Damped vibrations- under damped, critically damped; and over damped systems, forced vibrations with and without damping in single degree of freedom, Vibration isolation and transmissibility.

Turning Moment Diagrams and Flywheels: Turning moment diagrams for steam engine, I.C engine and multi cylinder engine. Crank effort – coefficient of fluctuation of energy, coefficient of fluctuation of speed – Fly Wheel and their design, fly wheels for punching press.

Text Books:

1. S.S.Rattan, "Theory of Machines", 4th Edition, Tata Mc-Graw Hill, 2014.
2. P.L.Ballaney, "Theory of Machines & Mechanisms", 25th Edition, Khanna Publishers, Delhi, 2003.

Reference Books:

1. F. Haidery, "Dynamics of Machines", 5th Edition, Nirali Prakashan, Pune, 2003.
2. J.E.Shigley, "Theory of Machines and Mechanisms", 4th Edition, Oxford, 2014.
3. G.K.Groover, "Mechanical Vibrations", 8th Edition, Nemchand Bros, 2009.
4. Norton, R.L., "Design of Machinery – An Introduction to Synthesis and Analysis of Mechanisms and Machines", 2nd Edition, McGraw Hill, New York, 2000.
5. William T. Thomson, "Theory of vibration with applications", 4th Edition, Englewood Cliffs, N.J. Prentice Hall, 1993.

FLUID MECHANICS & HYDRAULIC MACHINES LAB

II Year – II Semester

Practical : 3	Internal Marks : 30
Credits : 1.5	External Marks : 70

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Course Objectives

- To impart practical exposure on the performance evaluation methods of various flow measuring equipment and hydraulic turbines and pumps.

Course Outcomes

Upon successful completion of the course, the students will be able to

- measure the fluid flow using different flow measuring devices
- conduct a performance test on hydraulic machines at different operating conditions

List of Experiments:

(Perform any 10 of the following experiments)

1. Impact of jets on Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Kaplan Turbine.
5. Performance Test on Single Stage Centrifugal Pump.
6. Performance Test on Multi Stage Centrifugal Pump.
7. Performance Test on Reciprocating Pump.
8. Calibration of Venturimeter.
9. Calibration of Orificemeter.
10. Determination of friction factor for a given pipeline.
11. Determination of loss of head due to sudden contraction in a pipeline.
12. Turbine flow meter.

Virtual Lab

1. To study different patterns of a flow through a pipe and correlate them with the Reynolds number of the flow. (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/reynolds/introduction.html)
2. To calculate Total Energy at different points of venture meter. (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/bernoulli/introduction.html).
3. To calculate the flow (or point) velocity at center of the given tube usingdifferent flow rates. (https://me.iitp.ac.in/Virtual-Fluid- Laboratory/pitot/introduction.html)
4. To determine the hydrostatic force on a plane surface under partial submergeand full submerge condition. (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/cop/introduction.html).
5. To determine the discharge coefficient of a triangular notch. (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/notch/introduction.html)
6. To determine the coefficient of impact of jet on vanes. (https://fm-nitk.vlabs.ac.in/exp/impact-of-jet).
7. To determine friction in pipes. (https://fm-nitk.vlabs.ac.in/exp/friction-in-pipes/index.html).

MANUFACTURING PROCESSES LAB

II Year – II Semester

Practical : 3	Internal Marks : 30
Credits : 1.5	External Marks : 70

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Course Objectives

- Acquire practical knowledge on Metal Casting, Welding, Press Working and Processing of Plastics.

Course Outcomes

Upon successful completion of the course, the students will be able to

- design a pattern.
- test the properties of sand and prepare a casting.
- perform arc welding, spot welding, TIG welding
- perform deep drawing and extrusion operations.
- apply the principles of mould design to achieve accurate and defect-free castings
- prepare simple parts using 3D printing machine

List of Experiments:

(Perform any 10 of the following experiments)

1. Design and making of pattern
   i) Single piece pattern ii) Split pattern
2. Sand properties testing
   i) Sieve analysis(dry sand) ii) Clay content test iii) Moisture content test
   iv) Strength test (Compression test & Shear test) v) Permeability test
3. Mould preparation
   i) Straight pipe ii) Bent pipe iii) Dumble iv) Gear blank
4. Gas cutting and welding
5. Manual metal arc welding
   i) Lap joint ii) Butt joint
6. Injection Molding
7. Blow Molding
8. Simple models using sheet metal operations
9. Study of deep drawing and extrusion operations
10. To make weldments using TIG/MIG welding
11. To weld using Spot welding machine
12. To join using Brazing and Soldering
13. To make simple parts on a 3D printing machine
14. Demonstration of metal casting.

Virtual Lab

1. To study and observe various stages of casting through demonstration of casting process.(https://virtual-labs.github.io/exp-sand-casting-process-dei/theory.html)
2. To weld and cut metals using an oxyacetylene welding setup. (https://virtual-labs.github.io/exp-gas-cutting-processes-iitkgp/index.html).
3. To simulate Fused deposition modelling process (FDM) (https://3dpdei.vlabs.ac.in/exp/simulation-modelling-process)
4. https://altair.com/inspire-mold/
5. https://virtual-labs.github.io/exp-simulation-cartesian-system-dei/theory.html

SOFT SKILLS

II Year – II Semester

Tutorial : 1	Practical : 2	Internal Marks	: 30
Credits : 3		External Marks	: 70

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Course Objectives

- To prepare to face global competition for employment and excellence in profession.
- To help the students understand and build interpersonal and interpersonal skills that will enable them to lead meaningful professional life.

Course Outcomes

Upon successful completion of the course, the students will be able to

- assimilate and understood the meaning and importance of soft skills and learn how to develop them.
- understand the significance of soft skills in the working environment for professional excellence.
- prepare to undergo the placement process with confidence and clarity.
- ready to face any situation in life and equip themselves to handle them effectively.
- understand and learn the importance of etiquette in both professional and personal life

Course Content

UNIT – I: Introduction

Introduction- Emergence of life skills, Definition & Meaning, Importance& need, reasons for skill gap, Analysis--Soft Skills vs Hard skills, Linkage between industry and soft skills, Challenges, Personality Developments. Soft Skills, Soft Skills vs English - Improving Techniques.

UNIT – II: Intra-Personal

Definition-Meaning – Importance-SWOT analysis, Johari windows - Goal Setting- quotient skills - Emotional Intelligence- Attitudinal skills - Right thinking- Problem Solving-Time management, stress management.

UNIT – III: Inter-Personal

Definition – Meaning – Importance-Communications skills- Team Work, managerial skills - Negotiation skills- Leadership skills, corporate etiquettes.

UNIT – IV: Verbal Skills

Definition and Meaning-Listening skills, need- types, advantages, Importance-Improving Tips for Listening, Speaking, need- types, advantages, Importance- Improving Tips, Reading- Writing Skills, Report, Resume, statement of purpose, need- types, advantages, Importance-Improving Tips.

UNIT – V: Non Verbal Skills& Interview skills

Definition and Meaning – Importance- Facial Expressions- Eye Contact – Proxemics - Haptics - Posture, cross cultural body language, body languagein interview room, appearance and dress code – Kinetics- Para Language - tone, pitch, pause, neutralization of accent, use of appropriate language, Interview skills, interview methods and questions.

Text Books:

1. Sherfield, M. Robert, Corner stone "Developing Soft Skills", 4th Edition, Pearson Publication, New Delhi, 2014.

2. Alka Wadkar, “Life Skills for Success”, 1st Edition, Sage Publications India Private Limited, 2016.

Reference Books:

1. Sambaiah M., “Technical English”, Wiley publishers India. New Delhi. 2014.
2. Gangadhar Joshi, “From Campus to Corporate”, Sage Text.
3. Alex.K, “Soft Skills”, 3rd ed. S. Chand Publication, New Delhi, 2014.
4. Meenakshi Raman and Sangita Sharma, “Technical Communication: Principle and Practice”, Oxford University Press, 2009.
5. Shalini Varma, “Body Language for Your Success Mantra”, 4th Edition, S. Chand Publication, New Delhi, 2014.
6. Stephen Covey, “Seven Habits of Highly Effective People”, JMD Book, 2013.

e-Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc20_hs60/preview
2. http://www.youtube.com/@softskillsdevelopment6210
3. https://youtube.com/playlist?list=PLLy_2iUCG87CQhELCytvXh0E_y-bOO1_q&si=Fs05Xh8ZrOPsR8F4
4. https://www.coursera.org/learn/people-soft-skills-assessment?language=English
5. https://www.edx.org/learn/soft-skills

MACHINE TOOLS AND METROLOGY

III Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To expose the students to the mechanics of metal cutting
- To impart the knowledge related to construction and operations of the basic machine tools.
- To instruct the principles of interchangeable manufacture and mechanical measurements.

Course Outcomes

Upon successful completion of the course, the students will be able to

- apply principles of metal cutting in machining operations and assess the cutting forces
- illustrate the construction and operation of basic machine tools
- design the limit gauges for interchangeable manufacture
- apply the basic principles of mechanical measurements for engineering practice

Course Content

UNIT – I:

Fundamentals of Machining: Elementary treatment of metal cutting theory – element of cutting process – Single point cutting tools, nomenclature, tool signature, mechanism of metal cutting, types of chips, mechanics of orthogonal and oblique cutting –Merchant's force diagram, cutting forces, Taylor's tool life equation, simple problems - Tool wear, tool wear mechanisms, machinability, economics of machining, coolants, tool materials and properties.

UNIT – II:

Lathe Machines: Introduction- types of lathe - Engine lathe – principle of working - construction - specification of lathe - accessories and attachments – lathe operations – taper turning methods and thread cutting – drilling on lathes.

Shaping, Slotting and Planning Machines: Introduction - principle of working – principle parts – specifications - operations performed - slider crank mechanism - machining time calculations.

UNIT – III:

Drilling & Boring Machines: Introduction – construction of drilling machines – types of drilling machines - principles of working – specifications- types of drills - operations performed – machining time calculations - Boring Machines – types.

Milling Machines: Introduction - principle of working – specifications – milling methods - classification of Milling Machines –types of cutters - methods of indexing- machining time calculations

UNIT – IV:

Finishing Processes: Classification of grinding machines- types of abrasives- bonds, specification and selection of a grinding wheel- Lapping, Honing & Broaching operations- comparison to grinding.

Systems of Limits and Fits: Types of fits -Unilateral and bilateral tolerance system, hole and shaft basis systems- interchangeability & selective assembly- International standard system of tolerances, simple problems related to limits and fits, Taylor's principle – design of go and no go gauges; plug, ring, snap, gap, taper, profile and position gauges.

Linear Measurement: Length standards, end standards, slip gauges- calibration of the slip Gauges, dial indicators, micrometers.

UNIT – V:

Angular Measurement: Bevel protractor, angle slip gauges- angle dekkor- spirit levels- sine bar- sine table.

Surface Roughness Measurement: Differences between surface roughness and surface waviness – Numerical assessment of surface finish, Profilograph, Talysurf, ISI symbols.

Optical Measuring Instruments: Tools maker's microscope, Autocollimators, Optical projector, Optical flats-working principle, construction, merits, demerits and their uses. optical comparators.

Text Books:

1. J. P. Kaushish, "Manufacturing Processes", 2nd Edition, PHI Publishers, 2010.
2. P.N Rao, "Manufacturing Technology Vol-II", 4th Edition, Tata McGraw Hill, 2013.
3. R.K. Jain, "Engineering Metrology", 18th Edition, Khanna Publishers, 2018.

Reference Books:

1. Geoffrey Boothroyd and Winston A. Knight, "Metal Cutting and Machine Tools", 3rd Edition, Taylor & Francis, 2006.
2. K.C. Jain and A.K. Chitaley, "Production Engineering", 7th Edition, PHI Publishers, 2012.
3. S.F. Krar, A.R. Gill, and Peter Smid, "Technology of Machine Tools", 8th Edition, Tata McGraw Hill, 2018.
4. S. Kalpakjian and Steven R. Schmid, "Manufacturing Processes for Engineering Materials", 5th Edition, Pearson Publications, 2008.

THERMAL ENGINEERING

III Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To impart fundamental knowledge on thermal systems for power generation.
- To familiarize with the concepts of solar engineering.

Course Outcomes

Upon successful completion of the course, the students will be able to

- compare actual internal combustion engine cycles with ideal air standard and fuel-air cycles and identify various performance losses
- distinguish between 4-stroke and 2-stroke engines and determine the performance of I.C engines at various loads.
- analyze the Rankine steam power cycle and basic components of steam power plant such as boilers, nozzles, condensers and turbines
- evaluate the performance of single stage and multistage reciprocating compressors, centrifugal and axial flow compressors and estimate the power consumption..
- analyze the gas turbine cycles and introduce the principle of operation of jet and rocket engines
- explore the application of solar energy

Course Content

UNIT – I:

Actual Cycles and their Analysis: Introduction, Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blowdown-Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines.

UNIT – II:

I.C Engines: Classification - Working principles of SI and CI engines, Valve and Port Timing Diagrams – Engine systems – Fuel, Carburetor, Fuel Injection System, Ignition, Cooling and Lubrication, principles of supercharging and turbocharging, Measurement, Testing and Performance.
Boilers: Principles of L.P & H.P boilers, mountings and accessories, Draught- induced and forced.

UNIT – III:

Steam nozzles: Functions, applications, types, flow through nozzles, condition for aximum discharge, critical pressure ratio, criteria to decide nozzle shape, Wilson line.

Steam turbines: Classification – impulse turbine; velocity diagram, effect of friction, diagram efficiency, De-leval turbine - methods to reduce rotor speed, combined velocity diagram.
Reaction turbine: Principle of operation, velocity diagram, Parson's reaction turbine – condition for maximum efficiency.

Steam condensers: Classification, working principles of different types – vacuum efficiency and condenser efficiency.

UNIT – IV:

Compressors: Classification, Reciprocating type - Principle, multi-stage compression, Rotary type – Lysholm compressor –principle and efficiency considerations.

Centrifugal Compressors: Principle, velocity and pressure variation, velocity diagrams.

Axial flow Compressors: Principle, pressure rise and efficiency calculations.

Gas Turbines: Simple gas turbine plant – ideal cycle, components –regeneration, inter cooling and reheating.

UNIT – V:

Jet Propulsion: Principle, classification, t-s diagram - turbo jet engines –thermodynamic cycle, performance evaluation.

Rockets: Principle, solid and liquid propellant rocket engines.

Solar Engineering: Solar radiation, Solar collectors, PV cells, storage methods and applications

Text Books:

1. Mahesh Rathore, "Thermal Engineering: Vol. I and Vol. II", 1st Edition, McGraw Hill Education, 2010.
2. R. K. Rajput, "Thermal Engineering", 10th Edition, Lakshmi Publications, 2017.
3. V. P. Vasandani and D. S. Kumar, "Heat Engineering", 4th Revised Edition, Metropolitan Book Company, 2015.

Reference Books:

1. V. Ganesan, "Internal Combustion Engines", 4th Edition, Tata McGraw Hill Publishers, 2017.
2. M. L. Mathur and M. S. Mehta, "Thermal Engineering", 11th Edition, Jain Bros. Publishers, 2018.
3. P. L. Ballaney, "Thermal Engineering", 24th Edition, Khanna Publishers, 2016..

DESIGN OF MACHINE ELEMENTS

III Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To impart the knowledge of the basic engineering design against static and fluctuating loads by considering strength and rigidity.

Course Outcomes

Upon successful completion of the course, the students will be able to

- perform stress analysis and design the members under the action of static and fluctuating loads.
- design structural members with bolted and welded joints.
- design the power transmission elements like shafts and couplings.
- design various mechanical elements like brakes, clutches, bearings & gears.

Course Content

UNIT – I: Introduction, Design for Static and Dynamic loads

Mechanical Engineering Design: Design process, design considerations, codes and standards of designation of materials, selection of materials.

Design for Static Loads: Modes of failure, design of components subjected to axial, bending, torsional and impact loads. Theories of failure for static loads.

Design for Dynamic Loads: Endurance limit, fatigue strength under axial, bending and torsion, stress concentration, notch sensitivity. Types of fluctuating loads, fatigue design for infinite life. Soderberg, Goodman and modified Goodman criterion for fatigue failure. Fatigue design under combined stresses.

UNIT – II: Design of Bolted and Welded Joints

Design of Bolted Joints: Threaded fasteners, preload of bolts, various stresses induced in the bolts. Torque requirement for bolt tightening, gasketed joints.

Welded Joints: Strength of lap and butt welds, Joints subjected to bending and torsion.

UNIT – III: Power transmission shafts and Couplings

Power Transmission Shafts: Design of shafts subjected to bending, torsion and axial loading. Shafts subjected to fluctuating loads using shock factors.

Couplings: Design of flange and bushed pin couplings, universal coupling.

UNIT – IV: Design of Clutches, Brakes and Springs

Friction Clutches: Torque transmitting capacity of disc and centrifugal clutches. Uniform wear theory and uniform pressure theory.

Brakes: Different types of brakes. Concept of self-energizing and self-locking of brake. Band and block brakes, disc brakes.

Springs: Design of helical compression, tension, torsion and leaf springs.

UNIT – V: Design of Bearings and Gears

Design of Sliding Contact Bearings: Lubrication modes, bearing modulus, McKee's equations, design of journal bearing. Bearing Failures.

Design of Rolling Contact Bearings: Static and dynamic load capacity, Stribeck's Equation, equivalent bearing load, load-life relationships, load factor, selection of bearings from manufacturer's catalogue.

Design of Gears: Spur gears, beam strength, Lewis equation, design for dynamic and wear loads.

Text Books:

1. R. L. Norton, Machine Design an Integrated approach, 2e, Pearson Education, 2004.
2. V. B. Bhandari, Design of Machine Elements, 3e, Tata McGraw Hill, 2010.
3. Dr.N.C. Pandya & Dr.C.S. Shah, Machine design, 17e, Charotar Publishing House Pvt. Ltd, 2009.

Reference Books:

1. R.K. Jain, Machine Design, Khanna Publications, 1978.
2. J.E. Shigley, Mechanical Engineering Design, 2e, Tata McGraw Hill, 1986.
3. M.F.Spotts and T.E.Shoup, Design of Machine Elements, 3e, Pearson Education, 2013.

e-Learning Resources:

1. https://www.yumpu.com/en/document/view/18818306/lesson-3-course-name-design-ofmachine-elements-1-npte
2. https://www.digimat.in/nptel/courses/video/112105124/L01.html
3. https://dokumen.tips/documents/nptel-design-of-machine-elements-1.html
4. http://www.nitttrc.edu.in/nptel/courses/video/112105124/L25.html

Professional Elective – I

DESIGN FOR MANUFCTURING

III Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To familiarize with the design considerations for ease of manufacturing and assembly

Course Outcomes

Upon successful completion of the course, the students will be able to

- explore design considerations for various manufacturing processes.
- suggest an assembly for ease of manufacture and automation

Course Content

UNIT – I:

Introduction to DFM, DFMA: How Does DFMA Work? Reasons for Not Implementing DFMA, What Are the Advantages of Applying DFMA During Product Design? Typical DFMA Case Studies, Overall Impact of DFMA on Industry.

Design for Manual Assembly: General Design Guidelines for Manual Assembly, Development of the Systematic DFA Methodology, Assembly Efficiency, Effect of Part Symmetry, Thickness, weight on Handling Time, Effects of Combinations of Factors and application of the DFA Methodology.

UNIT – II:

Machining processes: Overview of various machining processes-general design rules for machining dimensional tolerance and surface roughness-Design for machining – ease –redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

UNIT – III:

Metal casting: Appraisal of various casting processes, selection of casting process,-general design considerations for casting-casting tolerance-use of solidification, simulation in casting design product design rules for sand casting.

Extrusion & Sheet metal work: Design guide lines extruded sections-design principles for punching, blanking, bending, and deep drawing-Keeler Goodman forging line diagram – component design for blanking.

UNIT – IV:

Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints-design of brazed joints.

Forging: Design factors for forging – closed die forging design – parting lines of dies –drop forging die design – general design recommendations.

UNIT – V:

Design for Assembly Automation: Fundamentals of automated assembly systems, System configurations, parts delivery system at workstations, various escapement and placement devices used in automated assembly systems, Quantitative analysis of Assembly systems, Multi station assembly systems, and single station assembly lines.

Design for Additive Manufacturing: Design considerations, allowances

Text Books:

1. Corbett, John. Design for Manufacture: Strategies, Principles, and Techniques. Addison Wesley, 1995.
2. Boothroyd, Geoffrey, Peter Dewhurst, and Winston A. Knight. Product Design for Manufacture and Assembly. 3rd Edition, CRC Press, 2010.
3. Bralla, James G. (Editor). Design for Manufacturability Handbook. 2nd Edition, McGraw-Hill Professional, 1999.

Reference Book:

1. Dieter, George E. (Editor). ASM Handbook, Volume 20: Materials Selection and Design. ASM International, 1997.

Professional Elective – I

CONVENTIONAL AND FUTURISTIC VEHICLE TECHNOLOGY

III Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To impart the fundamental knowledge on various technologies of conventional and futuristic vehicles.

Course Outcomes

Upon successful completion of the course, the students will be able to

- explore advances in engine technologies
- analyze different combustion modes
- explore low-carbon fuel technology
- illustrate various hybrid and electrical vehicles
- select a fuel cell system for a given application.

Course Content

UNIT – I:

Advanced Engine Technology: Gasoline Direct Injection, Common Rail Direct Injection, Variable Compression Ratio Turbocharged Engines, Electric Turbochargers, VVT, Intelligent Cylinder De-activation, After Treatment Technologies, Electric EGR, Current EMS architecture.

UNIT – II:

Combustion Technology: Spark Ignition combustion, Compression Ignition Combustion, Conventional Dual Fuel Combustion, Low Temperature Combustion Concepts– Controlled Auto Ignition, Homogeneous Charge Compression Ignition, Premixed Charge Compression Ignition, Partially Premixed Compression Ignition, Reactivity Controlled Compression Ignition, Gasoline Direct Injection Compression Ignition.

UNIT – III:

Low Carbon Fuel Technology: Alcohol Fuels, Ammonia Fuel and Combustion, Methane Technology, Dimethyl Ether, Hydrogen Fuel Technology, Challenges, and way forward

UNIT – IV:

Hybrid And Electric Vehicle (Battery Powered): Conventional Hybrids (Conventional ICE + Battery), Modern Hybrids (RCCI/GDCI Engine + Battery), Pure Electric Vehicle Technology – Challenges and Way forward

UNIT – V:

Fuel Cell Technology: Fuel cells for automotive applications - Technology advances in fuel cell vehicle systems - Onboard hydrogen storage - Liquid hydrogen and compressed hydrogen - Metal hydrides, Fuel cell control system - Alkaline fuel cell - Road map to market.

Text Books:

1. Ehsani, Mehrdad, Yimi Gao, Sebastian E. Gay, and Ali Emadi. Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design. 1st Edition, CRC Press, 2004.
2. Maurya, Rakesh Kumar. Characteristics and Control of Low Temperature Combustion Engines. 1st Edition, Springer International Publishing (ISBN 978-3-319-68507-6), 2018.

Reference Books:

1. Hussein, Iqbal. Electric and Hybrid Vehicles: Design Fundamentals. 1st Edition, CRC Press, 2003.
2. Larminie, James, and John Lowry. Electric Vehicle Technology Explained. 1st Edition, Wiley, 2003.
3. Rand, D. A. J., R. Woods, and R. M. Dell. Batteries for Electric Vehicles. 1st Edition, John Wiley & Sons, 1998.

Professional Elective – I

RENEWABLE ENERGY TECHNOLOGIES

III Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To impart knowledge on Renewable Energy sources and techniques
- To introduce direct energy conversion systems

Course Outcomes

Upon successful completion of the course, the students will be able to

- illustrate the principles of solar radiation and solar PV modules.
- discuss the storage methods in PV systems.
- evaluate solar flat plate collector efficiency and illustrate various solar energy storage methods and applications.
- describe the techniques of exploiting wind, biomass and geothermal energies in power generation.
- exemplify the methods of tapping ocean thermal, tidal and wave energies in power generation.

Course Content

UNIT – I:

Solar Radiation: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems.

Solar PV Modules and PV Systems: PV Module Circuit Design, Module Structure, Packing Density, Interconnections, Mismatch and Temperature Effects, Electrical and Mechanical Insulation, Lifetime of PV Modules, Degradation and Failure, PV Module Parameters, Efficiency of PV Module, Solar PV Systems-Design of Off Grid Solar Power Plant. Installation and Maintenance.

UNIT – II:

Storage in PV Systems: Battery Operation, Types of Batteries, Battery Parameters, Application and Selection of Batteries for Solar PV System, Battery Maintenance and Measurements, Battery Installation for PV System.

UNIT – III:

Solar Energy Collection: Flat plate and concentrating collectors, classification of concentrating collectors, orientation.

Solar Energy Storage and Applications: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney.

UNIT – IV:

Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement.

Bio-Mass: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.

UNIT – V:

Geothermal Energy: Origin, Applications, Types of Geothermal Resources, Relative Merits

Ocean Energy: Ocean Thermal Energy; Open Cycle & Closed Cycle OTEC Plants, Environmental Impacts, Challenges

Fuel Cells: Introduction, Applications, Classification, Different Types of Fuel Cells Such as Phosphoric Acid Fuel Cell, Alkaline Fuel Cell, PEM Fuel Cell, MC Fuel Cell.

Text Books:

1. Sukhatme, S. P. and J. K. Nayak. Solar Energy: Principles of Thermal Collection and Storage. 4th Edition, Tata McGraw Hill (TMH), 2017.
2. Khan, B. H. Non-Conventional Energy Resources. 3rd Edition, Tata McGraw Hill, 2017.

Reference Books:

1. Goswami, D. Yogi, Frank Kreith, and John F. Kreider. Principles of Solar Engineering. 3rd Edition, Taylor & Francis, 2015.
2. Desai, Ashok V. Non-Conventional Energy. 3rd Edition, New Age International (P) Ltd., 2007.
3. Ramesh, R. and K. U. Kumar. Renewable Energy Technologies. 1st Edition, Narosa Publishing House, 2017.
4. Roy, G. D. Non-conventional Energy Sources. 1st Edition, Standard Publishers, 2009.

Professional Elective – I

INDUSTRIAL HYDRAULICS AND PNEUMATICS

III Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To introduce the fundamental principles of hydraulic and pneumatic systems..

Course Outcomes

Upon successful completion of the course, the students will be able to

- illustrate the basic concepts of fluid power
- describe various hydraulic and pneumatic systems.
- suggest the maintenance aspect of hydraulic and pneumatic systems.

Course Content

UNIT – I:

Fluid Power: Power transmission modes, hydraulic systems, pneumatic systems, laws governing fluid flow: Pascal's law, continuity equation, Bernoulli's theorem, Boyle's, Charles', Gay-Lussec' laws, flow through pipes - types, pressure drop in pipes, Working fluids used in hydraulic and pneumatic systems- types, ISO/BIS standards and designations, properties.

UNIT – II:

Hydraulic and Pneumatic Elements: Hydraulic pipes-Types, standards, designation methods and specifications, pressure ratings, applications and selection criteria, pumping theory, Hydraulic Pumps - types, construction, working principle, applications, selection criteria and comparison, hydraulic Actuators, Control valves, Accessories - their types, construction and working, pneumatic Pipes - materials, designations, standards, properties and piping layout, air compressors, Air receivers, air dryers, Air Filters, Regulators, Lubricators (FRL unit): their types, construction, working, specifications and selection criteria of following air preparation and conditioning elements, pneumatic Actuators and Control valves - types, construction, working, materials and specifications.

UNIT – III:

Hydraulic and Pneumatic Circuits: ISO symbols used in hydraulic and pneumatic circuit, basic Hydraulic Circuits – types (such as intensifier, regenerative, synchronizing, sequencing, speed control, safety), circuit diagram, components, working and applications, basic Pneumatic Circuits – types (such as speed control, two step feed control, automatic cylinder reciprocation, time delay, quick exhaust), circuit diagram, components, working and applications, pneumatic Logic circuit design - classic method, cascade method, step counter method, Karnaugh- veitch maps and combinational circuit design.

UNIT – IV:

Hydraulic and Pneumatic Devices: Hydraulic and Pneumatic devices – Concept and applications, construction, working principle, major elements, performance variables of: Automotive hydraulic brake, Industrial Fork lift, Hydraulic jack, Hydraulic press, Automotive power steering, Automotive pneumatic brake, Automotive air suspension, Pneumatic drill, Pneumatic gun.

UNIT – V:

Installation, Maintenance and Trouble-Shooting: Installation of hydraulic and pneumatic system causes and remedies for common troubles arising in hydraulic elements, maintenance of hydraulic systems, causes and remedies for troubles arising in pneumatic elements, maintenance of pneumatic systems.

Text Books:

1. Majumdar, S. R. Oil Hydraulic Systems. 3rd Edition, Tata McGraw-Hill Publication, 2013.
2. Majumdar, S. R. Pneumatic Systems. 3rd Edition, Tata McGraw-Hill Publication, 2013.

Reference Books:

1. Srinivasan, R. Hydraulic and Pneumatic Controls. 2nd Edition, Vijay Nicole Imprints Private Limited, 2008.
2. Jagadeesha, T. Fluid Power Generation, Transmission and Control. 1st Edition, Universities Press (India) Private Limited, 2014.
3. Jagadeesha, T. Pneumatics Concepts, Design and Applications. 1st Edition, Universities Press (India) Private Limited, 2014.
4. Parr, Andrew. Hydraulic and Pneumatics, A Technician's and Engineer's Guide. 2nd Edition, Jaico Publishing House, 2013.
5. Shanmuga Sundaram, K. Hydraulic and Pneumatics Controls: Understanding Made Easy. 1st Edition, S. Chand Company Ltd., 2006.

Open Elective – I

PRINCIPLES OF SUSTAINBLE ENERGY TECHNOLOGIES

III Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To impart knowledge on Renewable Energy sources and techniques
- To introduce direct energy conversion systems

Course Outcomes

Upon successful completion of the course, the students will be able to

- illustrate the principles of solar radiation and solar PV modules.
- discuss the storage methods in PV systems.
- evaluate solar flat plate collector efficiency and illustrate various solar energy storage methods and applications.
- describe the techniques of exploiting wind, biomass and geothermal energies in power generation.
- exemplify the methods of tapping ocean thermal, tidal and wave energies in power generation.

Course Content

UNIT – I:

Solar Radiation: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems.

Solar PV Modules and PV Systems: PV Module Circuit Design, Module Structure, Packing Density, Interconnections, Mismatch and Temperature Effects, Electrical and Mechanical Insulation, Lifetime of PV Modules, Degradation and Failure, PV Module Parameters, Efficiency of PV Module, Solar PV Systems-Design of Off Grid Solar Power Plant. Installation and Maintenance.

UNIT – II:

Storage in PV Systems: Battery Operation, Types of Batteries, Battery Parameters, Application and Selection of Batteries for Solar PV System, Battery Maintenance and Measurements, Battery Installation for PV System.

UNIT – III:

Solar Energy Collection: Flat plate and concentrating collectors, classification of concentrating collectors, orientation.

Solar Energy Storage and Applications: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney.

UNIT – IV:

Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement.

Bio-Mass: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.

UNIT – V:

Geothermal Energy: Origin, Applications, Types of Geothermal Resources, Relative Merits

Ocean Energy: Ocean Thermal Energy; Open Cycle & Closed Cycle OTEC Plants, Environmental Impacts, Challenges

Fuel Cells: Introduction, Applications, Classification, Different Types of Fuel Cells Such as Phosphoric Acid Fuel Cell, Alkaline Fuel Cell, PEM Fuel Cell, MC Fuel Cell.

Text Books:

1. Sukhatme, S. P. and J. K. Nayak. Solar Energy: Principles of Thermal Collection and Storage. 4th Edition, Tata McGraw Hill (TMH), 2017.
2. Khan, B. H. Non-Conventional Energy Resources. 3rd Edition, Tata McGraw Hill, 2017.

Reference Books:

1. Goswami, D. Yogi, Frank Kreith, and John F. Kreider. Principles of Solar Engineering. 3rd Edition, Taylor & Francis, 2015.
2. Desai, Ashok V. Non-Conventional Energy. 3rd Edition, New Age International (P) Ltd., 2007.
3. Ramesh, R. and K. U. Kumar. Renewable Energy Technologies. 1st Edition, Narosa Publishing House, 2017.
4. Roy, G. D. Non-conventional Energy Sources. 1st Edition, Standard Publishers, 2009.

Open Elective – I

ADDITIVE MANUFACTURING

III Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To introduce various 3D printing technologies for manufacturing

Course Outcomes

Upon successful completion of the course, the students will be able to

- explain the fundamental principles of Rapid prototyping
- describe the RP processes and analyze their process parameters and formats
- select appropriate 3D printing technique for a given application

Course Content

UNIT – I:

Introduction: Prototyping fundamentals, historical development, fundamentals of rapid prototyping, advantages and limitations of rapid prototyping, commonly used terms, classification of RP process.

Liquid-Based Rapid Prototyping Systems: Stereo lithography Apparatus (SLA): models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. Solid Ground Curing (SGC): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

UNIT – II:

Solid-Based Rapid Prototyping Systems: Laminated object manufacturing (LOM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Fused deposition modelling (FDM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

UNIT – III:

Powder Based Rapid Prototyping Systems: Selective laser sintering (SLS): models and specifications, process, working principle, applications, advantages and disadvantages, case studies. three dimensional printing (3DP): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

UNIT – IV:

Rapid Tooling: Introduction to rapid tooling (RT), conventional tooling Vs RT, Need for RT. rapid tooling classification: indirect rapid tooling methods: spray metal deposition, RTV epoxy tools, Ceramic tools, investment casting, spin casting, die casting, sand casting process. Direct rapid tooling: Direct AIM, LOM Tools, and Direct Metal Tooling using 3DP.

UNIT – V:

Rapid Prototyping Data Formats: STL Format, STL File Problems, consequence of building valid and invalid tessellated models, STL file Repairs: Generic Solution, other Translators, and Newly Proposed Formats.

RP Applications: Application in engineering, analysis and planning, aerospace industry, automotive industry, jewelry industry, coin industry, GIS application, RP medical and bioengineering applications: customized implants and prosthesis, forensic sciences.

Text Books:

1. Chua, Chee Kai, Kah Fai Leong, and Chu Sing Lim. Rapid Prototyping: Principles and Applications. 3rd Edition, World Scientific Publishing Company, 2010

Reference Books:

1. Pham, Duc Truong and S. S. Dimov. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling. 1st Edition, Springer, 2001.
2. Wohlers, Terry T. Wohlers Report 2000: The State of the Industry. Wohlers Associates, 2000.
3. Jacobs, Paul F. Rapid Prototyping & Manufacturing: Fundamentals of Stereolithography. 1st Edition, Society of Manufacturing Engineers, 1992.
4. Chua, Chee Kai, and F. H. Liou. Rapid Prototyping: Principles and Applications in Manufacturing. World Scientific Publishing Company, 1997.

MACHINE TOOLS & METROLOGY LAB

III Year – I Semester

Practical : 4	Internal Marks : 30
Credits : 2	External Marks : 70

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Course Objectives

- To impart hands on training in the operation of basic machine tools.
- To impart hands on training on measuring methods and metrology instruments and calibration of various measuring instruments.

Course Outcomes

Upon successful completion of the course, the students will be able to

- operate basic machine tools to perform various machining operations.
- use various metrology instruments in carrying out measurement of dimensional parameters.

List of Experiments:

Machine Tools Lab

1. Introduction of general purpose machines -Lathe, Drilling machine, Milling machine, Shaper, Planing machine, Slotting machine, Cylindrical grinder, Surface grinder and Tool and cutter grinder.
2. Operations on Lathe machines- Step turning, Knurling, Taper turning,Thread cutting and Drilling
3. Operations on Drilling machine - Drilling, reaming, tapping, Rectangular drilling, circumferential drilling
4. Operations on Shaping machine - (i) Round to square (ii) Round to Hexagonal
5. Operations on Slotter - (i) Keyway (T –slot) (ii) Keyway cutting
6. Operations on milling machines - (i) Indexing (ii) Gear manufacturing

Metrology Lab

1. Calibration of vernier calipers, micrometers, vernier height gauge and dial gauges.
2. Measurement of bores by internal micrometers and dial bore indicators.
3. Use of gear tooth vernier caliper for tooth thickness inspection and flange micrometer for checking the chordal thickness of spur gear.
4. Machine tool alignment test on the lathe.
5. Machine tool alignment test on drilling machine.
6. Machine tool alignment test on milling machine.
7. Angle and taper measurements with bevel protractor, Sine bar, rollers and balls.
8. Use of spirit level in finding the straightness of a bed and flatness of a surface.
9. Thread inspection with two wire/ three wire method & tool makers microscope.
10. Surface roughness measurement with roughness measuring instrument.

Note: The students have to conduct at least 6 experiments from each lab

THERMAL ENGINEERING LAB

III Year – I Semester

Practical : 3	Internal Marks : 30
Credits : 1.5	External Marks : 70

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Course Objectives

- To study experimentally the fuel properties, performance of IC engines, compressors.

Course Outcomes

Upon successful completion of the course, the students will be able to

- determine the various fuel properties and characteristics.
- conduct various performance tests on I.C engines and plot the performance characteristic curves.
- conduct the load test and evaluate the performance of a reciprocating air compressor.

List of Experiments:

1. To determine the actual Valve Timing diagram of a four stroke Compression/Spark Ignition Engine.
2. To determine the actual Port Timing diagram of a two stroke Compression/Spark Ignition Engine.
3. Determination of Flash & Fire points of Liquid fuels / Lubricants using (i) Abels Apparatus; (ii) Pensky Martin's apparatus and (iii) Cleveland's apparatus.
4. Determination of Viscosity of Liquid lubricants/Fuels using (i) Saybolt Viscometer and (ii) Redwood Viscometer.
5. Evaluation of engine friction by conducting Morse test on 4-stroke multi cylinder petrol/diesel engine.
6. To perform the Heat Balance Test on Single Cylinder four Stroke Petrol/Diesel Engine.
7. To conduct a load test on a single cylinder Petrol/Diesel engine to study its performance under various loads.
8. To conduct a performance test on a VCR engine, under different compression ratios and determine its heat balance sheet.
9. To conduct a performance test on an air compressor and determine its different efficiencies.
10. Study of boilers with accessories and mountings
11. Experimentation on installation of Solar PV Cells
12. Demonstration of electronic controls in an automobile.

THEORY OF MACHINES LAB

III Year – I Semester

Practical : 3	Internal Marks : 30
Credits : 1.5	External Marks : 70

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Course Objectives

- To demonstrate experimentally about the dynamic response of machine elements.

Course Outcomes

Upon successful completion of the course, the students will be able to

- determine the characteristics of governors
- determine gyroscopic effect on a rotating body.
- perform dynamic balancing of rotating and reciprocating masses.
- determine natural vibrations of vibrating systems
- determine the whirling speed of shaft

List of Experiments:

1. To determine whirling speed of shaft theoretically and experimentally.
2. To determine the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation.
3. To analyse the motion of a motorized gyroscope when the couple is applied along its spin axis
4. To determine the frequency of undamped free vibration of an equivalent spring mass system.
5. To determine the frequency of damped force vibration of a spring mass system
6. To study the static and dynamic balancing using rigid blocks.
7. To find the moment of inertia of a flywheel
8. To plot follower displacement vs cam rotation for various Cam Follower systems.
9. To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism/Four bar mechanism
10. To find the coefficient of friction between the belt and pulley.
11. To study simple and compound screw jack and determine the mechanical advantage, velocity ratio, and efficiency.
12. To study various types of gears- Spur, Helical, Worm and Bevel Gears.

TINKERING LAB

III Year – I Semester

Practical : 2	Internal Marks : 30
Credits : 1	External Marks : 70

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The aim of tinkering lab for engineering students is to provide a hands-on learning environment where students can explore, experiment, and innovate by building and testing proto\types. These labs are designed to demonstrate practical skills that complement theoretical knowledge.

Course Objectives

- Encourage innovation and Creativity
- Provide Hands-on Learning
- Impart Skill Development
- Foster Collaboration and Teamwork
- Enable Interdisciplinary Learning
- Impart Problem-Solving mind-set
- Prepare for Industry and Entrepreneurship

These labs bridge the gap between academia and industry, providing students with the practical experience. Some students may also develop entrepreneurial skills, potentially leading to start-ups or innovation-driven careers. Tinkering labs aim to cultivate the next generation of engineers by giving them the tools, space, and mind-set to experiment, innovate, and solve real-world challenges.

Course Outcomes

Upon successful completion of the course, the students will be able to

- Experiment, innovate, and solve real-world challenges.

List of Experiments:

1. Make your own parallel and series circuits using breadboard for any application of your choice.
2. Demonstrate a traffic light circuit using breadboard.
3. Build and demonstrate automatic Street Light using LDR.
4. Simulate the Arduino LED blinking activity in Tinkercad.
5. Build and demonstrate an Arduino LED blinking activity using Arduino IDE.
6. Interfacing IR Sensor and Servo Motor with Arduino.
7. Blink LED using ESP32.
8. LDR Interfacing with ESP32.
9. Control an LED using Mobile App.
10. Design and 3D print a Walking Robot
11. Design and 3D Print a Rocket.
12. Build a live soil moisture monitoring project, and monitor soil moisture levels of a remote plan in your computer dashboard.
13. Demonstrate all the steps in design thinking to redesign a motor bike.

e-Learning Resources:

1. https://aim.gov.in/pdf/equipment-manual-pdf.pdf
2. https://atl.aim.gov.in/ATL-Equipment-Manual/
3. https://aim.gov.in/pdf/Level-1.pdf
4. https://aim.gov.in/pdf/Level-2.pdf
5. https://aim.gov.in/pdf/Level-3.pdf

Honor's Degree

ANALYSIS AND SYNTHESIS OF MECHANISMS

III Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To familiarize with the concepts used for kinematic analysis and synthesis of mechanisms.
- To familiarize with the concepts of force analysis of mechanisms.

Course Outcomes

Upon successful completion of the course, the students will be able to

- determine the displacement , velocity and accelerations of links of mechanism.
- determine the forces and torque acting by performing force analysis.
- apply path curvature characteristics in analysis of mechanisms.
- apply analytical and synthesis techniques in design of mechanisms.

Course Content

UNIT – I: Introduction

Elements of mechanisms, degrees of freedom, Kutchback equation and Grublers criterion, applications of Grublers criterion, transmission angles- extreme values of transmission angles, toggle positions.

Displacement, Velocity and Acceleration Analysis (Analytical methods only): Analysis for four bar and single slider crank mechanisms.

Analysis of Complex Mechanisms: Goodman indirect method and Hall Ault auxiliary point method

UNIT – II: Static Force Analysis

Static equilibrium, equilibrium of two and three force members, equilibrium of four force members, static force analysis of four bar and slider crank mechanisms.

Dynamic Force Analysis: D Alembert Principle, dynamic analysis of four bar mechanism and single slider crank mechanism – dynamically equivalent system – inertia of Connecting Rod –inertia force and torque in reciprocating Engine.

UNIT – III: Path Curvature Theory

Introduction, fixed and moving centrodes, inflection points and inflection circle, Euler Savary Equation, Bobilliers Construction, Collineation axis, Bobillier, theorem, Hartmann construction

UNIT – IV: Kinematic Synthesis

Introduction, type, dimensional and number Synthesis, synthesis for function generation, path and motion generation, Chebyschev Spacing of accuracy points.

Graphical Synthesis Techniques: Motion generation for two prescribed positions and three prescribed positions –path generation for three prescribed positions without and with prescribed timing – function generation for three prescribed positions.

UNIT – V: Analytical Synthesis Techniques

Four bar and slider crank function generator with three accuracy points – use ofcomplex numbers and dyads – three prescribed positions for motion, path and function generation using dyad.

Text Books:

1. S.S. Rattan, "Theory of Machines", Tata Mc Graw Hill, 3rd Edition.
2. Erdman and Sandor ,"Advanced Mechanism Design ",Prentice Hall International ,2nd Edition.

Reference Books:

1. Uicker, Pennock and Shigley," Theory of machines and Mechanisms", Oxford Univ Press.
2. Amitabha Ghosh and Ashok Kumar Mallik, "Theory of Mechanism and Machines", East West Press pvt Ltd,2nd edition.
3. Robert L. Norton," Design of Machinery", Tata McGraw Hill, 3rd edition.

Honor's Degree

ADVANCED MECHANICS OF SOLIDS LAB

III Year – I Semester

Lecture : 3	Internal Marks : 30
Credits : 1.5	External Marks : 70

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Course Objectives

- To study the behavior of machine elements experimentally when subjected to dynamic forces.
- To observe and analyse vibration behavior of mechanical systems.

Course Outcomes

Upon successful completion of the course, the students will be able to

- estimate gyroscopic couple on given rotor system
- estimate the moment of inertia of given component
- estimate the natural frequency of free and forced and torsional vibration systems
- perform dynamic balancing of rotating and reciprocating masses.

List of Experiments:

1. Gyroscopic Couple Apparatus
2. Moment of inertia of bifilar.
3. Moment of inertia of Trifilar.
4. Natural frequency of single rotor system.
5. Natural frequency of two rotor system.
6. Natural frequency of Flywheel with and without damping.
7. Journal Bearing Apparatus.
8. Balancing of Reciprocating Masses.
9. Friction and Wear Apparatus.
10. Whriling Speed of rotating shaft.

HEAT TRANSFER

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To familiarize with the principles of various modes of heat transfer in engineering applications.

Course Outcomes

Upon successful completion of the course, the students will be able to

- determine the rate of heat transfer through simple geometries in steady state without internal heat sources and apply heat transfer principles to analyze the performance of Fins.
- apply the concepts of transient heat conduction and fundamentals of convective heat transfer.
- apply the empirical equations for forced convection and free convection problems.
- determine the rate of heat transfer with phase change and in the heat exchangers.
- illustrate the concepts of radiation heat transfer.

Course Content

UNIT – I:

Introduction: Modes and mechanisms of heat transfer – Basic laws of heat transfer –General discussion about applications of heat transfer.

Conduction Heat Transfer: Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates – simplification and forms of the field equation – steady, unsteady and periodic heat transfer – Initial and boundary conditions

One Dimensional Steady State Conduction Heat Transfer: Homogeneous slabs, hollow cylinders and spheres- Composite systems– overall heat transfer coefficient – Electrical analogy – Critical radius of insulation. Variable Thermal conductivity, Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature.

UNIT – II:

One Dimensional Transient Conduction Heat Transfer: Systems with negligible internal resistance – Significance of Biot and Fourier Numbers –Infinite bodies- Chart solutions of transient conduction systems- Concept of Semi-infinite body.

Convective Heat Transfer: Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow – Dimensional analysis as a tool for experimental investigation – Buckingham π Theorem and method, application for developing semi – empirical non-dimensional correlation for convection heat transfer – Significance of non-dimensional numbers – Concepts of Continuity, Momentum and Energy Equations.

UNIT – III:

Forced convection: External Flows: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -Flat plates and Cylinders.

Internal Flows: Concepts about Hydrodynamic and Thermal Entry Lengths – Division of internal flow based on this –Use of empirical relations for Horizontal Pipe Flow and annulus flow.

Free Convection: Development of Hydrodynamic and thermal boundary layer along a vertical plate - Use of empirical relations for Vertical plates and pipes.

UNIT – IV:

Heat Transfer with Phase Change:

Boiling: Pool boiling – Regimes – Calculations on Nucleate boiling, CriticalHeat flux and Film boiling.

Condensation: Film wise and drop wise condensation –Nusselt's Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.

Heat Exchangers: Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

UNIT – V:

Radiation Heat Transfer: Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchhoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks

Note: Heat transfer data book by C P Kothandaraman and Subrahmanyan is allowed.

Text Books:

1. R.C. Sachdeva, "Fundamentals of EngineeringHeat& Mass Transfer" 5th edition, New Age International Publishers.
2. S.K. Som, "Introduction to Heat transfer", PHI learning Private Limited.
3. P.K. Nag, "Heat and mass transfer", 3rd edition, TATA MC GRAW Hill education Private Ltd.

Reference Books:

1. Incropera& Dewitt, "Fundamentals of Heat Transfer",9th edition, John Wiley publications.
2. P.K. Sarma and K. Rama Krishna, "Heat Transfer, A conceptual approach", New age International publishers.
3. Yunus A. Cengel, " Heat and Mass Transfer : Fundamentals and applications", 5th Edition, Tata Mc Graw Hill education PVT Ltd.
4. Sarit K. Das, "Engineering Heat and Mass Transfer", Dhanpat Rai Publications.

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To impart the basic concepts of artificial intelligence and machine learning the principles of knowledge representation and reasoning.
- To familiarize with neural networks and genetic algorithms.

Course Outcomes

Upon successful completion of the course, the students will be able to

- explain the basic concepts of artificial intelligence and knowledge representation.
- apply the principles of supervised learning methods.
- apply the principles of unsupervised learning methods and Bayesian learning.
- demonstrate neural networks and deep learning models.
- describe the ensemble methods and genetic algorithms.

Course Content

UNIT – I:

Introduction: Definition of Artificial Intelligence, Evolution, Need, and applications in real world. Intelligent Agents, Agents and Environments,Search Algorithms – Best first search, A-star algorithm.

Knowledge–Representation and Reasoning: Logical Agents: Knowledge-based agents, the Wumpus world, logic. Patterns in Propositional Logic, Inference in First-Order Logic-Propositional vs first order inference, unification.

UNIT – II:

Introduction to Machine Learning (ML): Definition, Evolution, Need, applications of ML in industry and real-world, types of machine learning, performance metrics - regression and classification problems, bias, variance, overfitting and under fitting.

Supervised Learning: Linear regression, logistic regression,Nearest-Neighbours, Decision Trees, Support Vector Machines.

UNIT – III:

Unsupervised Learning: Distance measurements,Clustering -K-Means, K-Medoids, DB Scan, Hierarchical learning.

Bayesian Learning: Bayes theorem, Concepts Learning, Naïve Bayes Classifier.

UNIT – IV:

Neural Networks: Biological neuron**,** Neural network representation, Perceptron, multilayer networks and backpropagation, Convolutional neural networks – architecture and applications, Recurrent Neural Networks – architecture and applications.

De**ep Learning:** Deep generative models, Boltzmann Machines, Auto-encoders, and Applications of Deep Networks – image processing, NLP and speech recognition.

UNIT – V:

Machine Learning Algorithm Analytics: Model Selection, Ensemble Methods - Boosting, Bagging, and Random Forests.

Genetic Algorithms: Local vs Global optima, Genetic algorithms- binary coded GA, operators, convergence criteria.

Text Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2/e, Pearson Education, 2010.
2. S. Sridhar, M. Vijayalakshmi, Machine Learning, 3/e, 2024, Oxford University Press.

Reference Books:

1. Elaine Rich, Kevin Knight and Shivashankar B. Nair, Artificial Intelligence, 3/e, McGraw Hill Education, 2008.
2. Tom M. Mitchell, Machine Learning, McGraw Hill, 2013.
3. Amit Kumar Das, Saptarsi Goswami, Pabitra Mitra, Amlan Chakrabarti, Deep Learning, 4/e, Pearson India Education Services Pvt, Ltd., 2021.

FINITE ELEMENT METHODS

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To familiarize with the concepts of finite element method for structural, thermal and dynamic analysis.

Course Outcomes

Upon successful completion of the course, the students will be able to

- explain fundamentals of finite element formulations using energy principles and weighted residual methods.
- formulate and solve one dimensional bar and truss problems
- analyze beams using beam elements to determine deflections, slopes, stresses, and reactions.
- describe two-dimensional element formulations and perform iso-parametric numerical integration procedures.
- perform steady heat transfer and basic dynamic analysis using finite elements.

Course Content

UNIT – I:

Introduction to finite element method, stress and equilibrium, strain–displacement relations, stress–strain relations, plane stress and plane strain conditions, concept of potential energy- Rayleigh –Ritz method, weighted residual methods.

UNIT – II:

Finite Element Method: Introduction to finite element methods, steps in finite element method, applications, advantages and disadvantages of finite element method.

One Dimensional Bar Problems: 1-D bar element - shape functions – stiffness matrix and load vector– assembly of matrices – treatment of boundary conditions- One dimensional quadratic element.

Analysis of Trusses: Finite element modeling, coordinates and shape functions, assembly of global stiffness matrix and load vector, finite element equations, treatment of boundary conditions, stress, strain and support reaction calculations.

UNIT – III:

Analysis of Beams: Element stiffness matrix for Hermite beam element, derivation of load vector for concentrated loads, simple problems on beams.

UNIT – IV:

Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions.

Higher order and iso-parametric elements: One dimensional, quadratic and cubic elements in natural coordinates, two dimensional four nodeiso-parametric elements and numerical integration. Numerical integration- Gauss Quadrature method.

UNIT – V:

Steady state heat transfer analysis: one dimensional steady –state analysis of uniform slabs and fins.

Dynamic Analysis: Formulation of finite element model, element consistent and lumped mass matrices, evaluation of eigen values and eigen vectors, free vibration analysis.

Text Books:

1. Chandrupatla, Tirupathi R. and Ashok D. Belegundu. Introduction to Finite Elements in Engineering. 2nd Edition, Prentice-Hall, 1997.
2. Rao, S. S. The Finite Element Method in Engineering. 1st Edition, Pergamon Press (Elsevier), 1982.

Reference Books:

1. Desai, Y. M., T. I. Eldho, and A. H. Shah. Finite Element Method with Applications in Engineering. 1st Edition, Pearson Education, 2011.
2. Reddy, J. N. An Introduction to the Finite Element Method. 3rd Edition, McGraw-Hill, 2006.
3. Huebner, Kenneth H., Donald L. Dewhirst, Douglas E. Smith, and Ted G. Byrom. The Finite Element Method for Engineers. 4th Edition, John Wiley & Sons (ASIA) Pvt Ltd, 2001.
4. Moaveni, Saeed. Finite Element Analysis: Theory and Application with ANSYS. 4th Edition, Pearson Education, 2015.
5. Narasaiah, G. Lakshmi. Finite Element Analysis: for Students & Practicing Engineers. 1st Edition, BS Publications, 2008.

Professional Elective – II

ADVANCED MANUFACTURING ROCESSESS

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To provide a foundational understanding of various advanced and non-traditional machining processes and Additive Manufacturing techniques.
- To familiarize students with the processing and fabrication of modern engineering materials, including ceramics, composites, nanomaterials, and specialized surface treatment methods.

Course Outcomes

Upon successful completion of the course, the students will be able to

- explain the working principle of various nonconventional machining processes and their applications.
- explain the working principles of additive manufacturing methods.
- explain the underlying mechanisms and applications of various surface coating methods and processing steps for engineering ceramics.
- differentiate the processing techniques used for manufacturing composite materials and synthesizing various types of nanomaterials.
- describe the sequence of fabrication steps to lithography, bonding, and packaging and Printed Circuit Boards.

Course Content

UNIT – I:

Advanced Machining Processes: Introduction, Need, AJM, WJM, Wire-EDM, ECM, LBM, EBM, PAM–Principle, working, advantages, limitations, Process Parameters & capabilities and applications.

UNIT – II:

Additive Manufacturing: Working Principles, Methods, Stereo Lithography, LENS, LOM, Laser Sintering, Fused Deposition Method, 3DP Applications and Limitations, Direct and Indirect Rapid tooling techniques.

UNIT – III:

Surface Treatment: Scope, Cleaners, Methods of cleaning, Surface coating types, Electro forming, Chemical vapour deposition, Physical vapour deposition, thermal spraying methods, Ion implantation, diffusion coating, ceramic and organic methods of coating, and cladding methods.

Processing of Ceramics: Applications, characteristics, classification Processing of particulate ceramics, Powder preparations, consolidation, hot compaction, drying, sintering, and finishing of ceramics, Areas of application.

UNIT – IV:

Processing of Composites: Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, processing methods for MMC, CMC, Polymer matrix composites.

Processing of Nanomaterials: Introduction, Top down Vs Bottom up techniques-Ball milling, Lithography, Plasma Arc Discharge, Pulsed Laser Deposition, Sputtering, Sol-Gel, Molecular beam Epitaxy.

UNIT – V:

Fabrication Of Microelectronic Devices: Crystal growth and wafer preparation, Film Deposition, oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, surface mount technology, Integrated circuit economics.

Text Books:

1 Kalpakjian, Serope. Manufacturing Engineering and Technology. 3rd Edition, Addison-Wesley, 1995.

2 Lindberg, Roy A. Process and Materials of Manufacturing. 4th Edition, PHI Learning/Allyn and Bacon, 1990.

Reference Books:

1 Tummala, Rao R. and Eugene J. Rymaszewski. Microelectronics Packaging Handbook. 1st Edition, Van Nostrand Reinhold, 1989.

2 Hsu, Tai-Ran. MEMS & Microsystems: Design and Manufacture. 1st Edition, Tata McGraw-Hill, 2002.

3 Jain, V. K. Advanced Machining Processes. 1st Edition, Allied Publishers, 2002.

4 Schey, John A. Introduction to Manufacturing Processes. 2nd Edition, McGraw Hill, 1987.

5 Chattopadhyay, K. K. and A. N. Banerjee. Introduction to Nanoscience and Nanotechnology. 1st Edition, PHI Learning, 2009.

Professional Elective – II

NON- DESTRUCTIVE TESTING

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To familiarize with the concepts of various NDT techniques to identify the defect in a mechanical component.

Course Outcomes

Upon successful completion of the course, the students will be able to

- describe the concepts of various NDT methods andprinciples and procedure of liquid penetration test.
- illustrate the principles and procedure of Magnetic particle testing.
- interpret the principles and procedure of ultrasonic testing.
- elaborate the principles and procedure of radiography and eddy current testing.
- interpret the principles and procedure of infrared testing and applications of NDT.

Course Content

UNIT – I:

Introduction to Non-destructive Testing: Overview of NDT, types of materials testing, preliminary NDT methods, NDT methods.

Liquid Penetrant Test: Liquid Penetrant Test, Basic Concepts, Liquid Penetrant System, Test Procedure, Effectiveness, Limitations of Liquid Penetrant Testing**.**

UNIT – II:

Magnetic Particle Test: Magnetic Materials, Magnetization of Materials, Demagnetization of Materials, Principle of Magnetic Particle Test, Magnetic Particle Test Equipment, Magnetic Particle Test Procedure, Limitations of the Magnetic Particle Test.

UNIT – III:

Ultrasonic Test: Principle of Wave Propagation, Reflection, Refraction, Diffraction, Mode Conversion and Attenuation, Piezo-electric Effect, Ultrasonic Transducers and their Characteristics,Ultrasonic Equipment, types of ultrasonic testing, Limitations of Ultrasonic Testing.

UNIT – IV:

Radiographic Test: Sources of X and Gamma Rays and their interaction with Matter, Radiographic equipment, Radiographic Techniques, Safety Aspects of Industrial Radiography, neutron ray radiography, Limitations.

Eddy Current Test: Principle of Eddy Current, Eddy Current Test System, Applications and limitations of Eddy Current Testing.

UNIT – V:

Infrared And Thermal Testing: Introduction and fundamentals to infrared and thermal testing–Heat transfer –Active and passive techniques, Applications and limitations.

Industrial Applications of NDE: Railways, Nuclear and Chemical Industries, Aerospace Industries, Automotive Industries, Coal Mining Industry.

Text Books:

1. Prasad and GCK Nair, “Non-Destructive Test and Evaluation of Materials”, Tata McGraw-Hill Education, 2nd edition, 2011.
2. B Raj, T Jayakumar and M Thavasimuthu, “Practical Non Destructive Testing”, Alpha Science International Limited, 3rd edition, 2017.

Reference Books:

1. V Jayakumar and K Elangovan, “Non-Destructive Testing of Materials”, Lakshmi Publications, 2nd edition, 2018.
2. George V. Crowe, “An Introduction to Nondestructive Testing”, American Society for Nondestructive Testing, 3rd edition, 2009.
3. Ravi Prakash, “Non-Destructive Testing Techniques”, New Age International Publishers, 1st edition, 2021.

Professional Elective – II

MICRO ELECTRO MECHANICAL SYSTEMS

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To comprehend the fundamental principles of microfabrication and the underlying physics of operation in MEMS devices.
- To analyze the design actuation mechanisms, and applications of advanced MEMS.

Course Outcomes

Upon successful completion of the course, the students will be able to

- apply the steps of the microfabrication process to design basic mechanical MEMS devices such as beams, cantilevers, and capacitive sensors.
- classify and describe the working principles of various mechanical and thermal sensors and actuators used in MEMS.
- explain the working principles of MEMS components and relate magnetic phenomena to the function of MEMS magnetic sensors and actuators.
- analyze fluid flow dynamics at the micro scale and evaluate the design and actuation methods used in microfluidic applications, as well as components for RF MEMS.
- evaluate the design and functionality of chemical and biomedical MEMS systems such as lab-on-chip, chemo-resistors, and e-nose sensors.

Course Content

UNIT – I: Introduction and Mechanical Sensors/Actuators

Definition of MEMS, MEMS history and development, Micromachining, lithography principles & methods, Structural and sacrificial materials, Thin film deposition, impurity doping, etching, Surface micromachining, wafer bonding, LIGA, Principles of sensing and actuation, Beam and cantilever, capacitive, piezoelectric, strain sensors, Pressure and flow sensors, MEMS gyroscopes, Piezo actuators: shear mode, gripping, inchworm technology

UNIT – II: Thermal Sensors and Actuators

Basics of thermal energy and heat transfer, Thermistors, thermocouples, micromachined thermocouple probe, Peltier effect heat pumps, thermal flow sensors, Micro hot plate gas sensors, MEMS thermo vessels, Pyroelectricity, shape memory alloys (SMA), U-shaped electro-thermal actuators (horizontal & vertical), MEMS relays, micro spring thermal actuators, data storage cantilevers

UNIT – III: MOEMS and Magnetic Devices

Principles of MOEMS, Properties of light, light modulators, beam splitter, Micro lens, micro mirrors, digital micro mirror device (DMD), Light detectors, grating light valve (GLV), optical switches, Waveguides, optical tuning, shear stress measurement, Magnetic materials for MEMS and their properties, Magnetic sensing: magneto-resistive sensors, Hall effect, magneto-diodes, MEMS magnetic sensors and actuators, MOKE pressure sensors, reluctance actuators, magnetic storage devices

UNIT – IV: Micro-fluidics and RF MEMS

Micro fluidic applications and fluid flow at micro scale, Actuation methods: DEP, electro wetting, electro thermal flow, Thermo capillary effect, electro osmosis, OEW, Micro fluidic tuning, channels, dispensers, micro needles, molecular gates, micro pumps, RF communication systems and RF MEMS, MEMS inductors, filters, tuners, resonators, MEMS switches, phase shifters

UNIT – V: Chemical and Biomedical Micro Systems

Sensing principles in chemical/biomedical systems, Membrane-transducer materials, Chem.-lab-on-a-chip (CLOC), Chemo-resistors, chemo-capacitors, chemo-transistors, Electronic nose (E-nose), mass sensitive chemo-sensors, Fluorescence detection, calorimetric spectroscopy

Text Books:

1. Jeffus, Larry.Welding: Principles and Applications.9th Edition, Cengage Learning, 2021.
2. Kou, Sindo.Welding Metallurgy. 3rd Edition, John Wiley & Sons, 2021.

Reference Books:

1. American Welding Society. Welding Handbook.9th Edition, American Welding Society, 2021
2. Lohwasser, Daniela and Z. W. Chen. Friction Stir Welding: From Basics to Applications.1st Edition, Woodhead Publishing/Elsevier, 2010.
3. Lancaster, J. F. Metallurgy of Welding.6th Edition, Abington Publishing, 1999.

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Professional Elective – III

SENSORS AND INSTRUMENTATION

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To introduce the fundamental principles of measurement, error analysis, and the static/dynamic characteristics of transducers.
- To provide comprehensive knowledge of various sensing technologies in real-world engineering applications.

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyze different sources and classifications of measurement errors and evaluate the static and dynamic characteristics of sensors.
- describe the working principle and characteristics of force, magnetic, heading, pressure and temperature, smart and other sensors and transducers.
- apply the various sensors and transducers in various applications.
- describe the operation of different optical, pressure, and temperature sensors.
- discuss the basic Data Acquisition System (DAQ) by selecting appropriate amplification, filtering, and sample-and-hold circuits

Course Content

UNIT – I:

Introduction: Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT – II:

Motion, Proximity and Ranging Sensors: Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT – III:

Force, Magnetic and Heading Sensors: Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT – IV:

Optical, Pressure and Temperature Sensors: Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT – V:

Signal Conditioning and DAQ Systems: Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi-channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

Text Books:

1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009.
2. Sawney A. K. and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, Dhanpat Rai & Co, 12th edition New Delhi, 2013.

Reference Books:

1. C. Sujatha ... Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons, Canada, 2001.
2. Hans Kurt Tönshoff, Ichiro, “Sensors in Manufacturing” Volume 1, Wiley-VCH April 2001.
3. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 1999.
4. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2011.
5. Richard Zurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press, 2015.

Professional Elective – III

ENERGY STORAGE TECHNOLOGIES

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To provide a broad understanding of the technological landscape, applications, and comparative analysis of various energy storage systems
- To evaluate, select, and analyze the design, performance, and management challenges of battery and super-capacitor systems

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyze the importance of various energy storage systems.
- explain the principles, advantages, and limitations of chemical storage systems and electromagnetic storage systems
- Acquire comprehensive knowledge of chemical and electromagnetic energy storage systems.
- Explain the operational principle and charge storage mechanism of various types of supercapacitors.
- Apply thermal modeling techniques to design batteries for transportation

Course Content

UNIT – I:

Energy Storage Systems Overview: Scope of energy storage, needs and opportunities in energy storage, Technology overview and key disciplines, comparison of time scale of storages and applications, Energy storage in the power and transportation sectors. Importance of energy storage systems in electric vehicles, Current electric vehicle market. Thermal storage system-heat pumps, hot water storage tank, solar thermal collector, application of phase change materials for heat storage-organic and inorganic materials, efficiencies, and economic evaluation of thermal energy storage systems.

UNIT – II:

Chemical Storage System: hydrogen, methane etc., concept of chemical storage of solar energy, application of chemical energy storage system, advantages and limitations of chemical energy storage, challenges, and future prospects of chemical storage systems.

Electromagnetic Storage Systems: double layer capacitors with electrostatically charge storage, superconducting magnetic energy storage (SMES), concepts, advantages and limitations of electromagnetic energy storage systems, and future prospects of electrochemical storage systems.

UNIT – III:

Electrochemical Storage System: Batteries-Working principle of battery, primary and secondary (flow) batteries, battery performance evaluation methods, major battery chemistries and their voltages-Li-ion battery& Metal hydride battery vs lead-acid battery.

UNIT – IV:

Super-capacitors: Working principle of super-capacitor, types of super-capacitors, cycling and performance characteristics, difference between battery and super-capacitors, Introduction to Hybrid electrochemical super-capacitors

Fuel Cell: Operational principle of a fuel cell, types of fuel cells, hybrid fuel cell-battery systems, hybrid fuel cell-supercapacitor systems.

UNIT – V:

Battery Design for Transportation, Mechanical Design and Packaging of Battery Packs for Electric Vehicles, Advanced Battery, Assisted Quick Charger for Electric Vehicles, Charging Optimization Methods for Lithium-Ion Batteries, Thermal run-away for battery systems, Thermal management of battery systems, State of Charge and State of Health Estimation Over the Battery Lifespan, Recycling of Batteries from Electric Vehicles.

Text Books:

1. Frank S. Barnes and Jonah G. Levine, Large Energy Storage Systems Handbook, CRC Press, 2011.
2. Ralph Zito, Energy storage: A new approach, Wiley Publishers, 2010.

Reference Books:

1. Pistoia, Gianfranco, and Boryann Liaw. Behaviour of Lithium-Ion Batteries in Electric Vehicles: Battery Health, Performance, Safety, and Cost. Springer International Publishing AG, 2018.
2. Robert A. Huggins, Energy storage, Springer Science & Business Media, 2010**.**

Professional Elective – III

INDUSTRIAL ROBOTICS

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To impart the knowledge of the robot anatomy, kinematics and programming of industrial robots.

Course Outcomes

Upon successful completion of the course, the students will be able to

- illustrate the significance of automation and robots.
- select suitable actuators and feedback sensors for various applications.
- solve robot motion and kinematic problems using homogeneous transformations and D–H notations.
- analyze robot path planning and trajectory generation for smooth motion.
- interpret the functions of machine vision systems and their applications in robotic inspection and training.

Course Content

UNIT – I:

Introduction: Automation and Robotics– An overview of Robotics –present and future applications – classification by coordinate system and control system.

Components of the Industrial Robotics: Robot anatomy, work volume, components, number of degrees of freedom, common types of end effectors,Control Resolution, Accuracy, Repeatability, and Work Volume of Robots.

Introduction to Cobots: Definition, Differences between the cobots and robots.

UNIT – II:

Robot Actuators and Feedback Components: Actuators: Pneumatic, Hydraulic actuators, electric& stepper motors. Comparison of Electric, Hydraulic and Pneumatic types of actuation devices.
Feedback components: position sensors–potentiometers, resolvers, encoders–Velocity sensors.

Applications of Robots: Material handling, processing operations, assembly and inspection operations.

UNIT – III:

Motion Analysis: Homogeneous transformations as applicable to rotation and translation–problems.

Manipulator Kinematics: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics for 2-DoF & 3-DoF manipulators

UNIT – IV:

Trajectory Planning: Types of motion -Slew motion, joint integrated motion, and straight line motion, joint space trajectory planning and cartesian space trajectory planning.

UNIT – V:

Robot Programming: Lead through programming and textual language programming.
Image Processing and Machine Vision: Introduction to Machine Vision, Sensing and Digitizing function in Machine Vision.

Text Books:

1. M. P. Groover, “Industrial Robotics – Technology, Programming and Applications”, Tata McGraw Hill Publications, 2nd Edition, 2017.
2. Mittal R. K. &Nagrath I. J., “Robotics and Control”. Tata McGraw Hill Publications, 2014.

Reference Books:

1. K.S. Fu, R. C. Gonzalez, C. S. G. Lee, “Robotics: Control, Sensing, Vision and Intelligence”, Tata McGraw Hill Publications, 1987
2. Richard D Klafterk, “Robotics Engineering : An Integrated Approach”, Prentice Hall India Learning Private Limited, 1993.
3. Haruhiko Asada, Hean – Jacques E. Slotine, “Robot Analysis and Control”, Wiley India Pvt. Ltd., 2013
4. John J Craig, “Introduction to Robotics: Mechanics and Control”, Pearson Edu, 3rd Edition, 2004.

Professional Elective – III

MECHATRONICS

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To familiarize with the working of various elements in a mechatronics systems.

Course Outcomes

Upon successful completion of the course, the students will be able to

- identification and demonstration of key elements of mechatronics system and its representation in terms of block diagram.
- illustrate the various hydraulic, pneumatic, mechanical, electrical actuating systems.
- describe the use of solid-state electronic devices, diodes, amplifiers, etc. in various applications.
- describe the working of microprocessors and controllers.
- elaborate data acquisition methods for mechatronics systems.

Course Content

UNIT – I:

Mechatronics systems, elements, levels of mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor-based controllers, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.

UNIT – II:

Hydraulic and pneumatic actuating systems, Fluid systems, Hydraulic and pneumatic systems, components, control valves, Mechanical actuating systems and electrical actuating systems.

UNIT – III:

Solid state electronic devices, PN junction diode, BJT, FET, DIA and TRIAC. Analog signal conditioning, amplifiers, filtering.

UNIT – IV:

Digital electronics and systems, microprocessors and micro controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control.

UNIT – V:

System and interfacing and data acquisition, DAQS, SCADA, A-D and D-A conversions; Applications of mechatronics systems & future trends.

Text Books:

1. Mechatronics Integrated Mechanical Electronics Systems/KP Ramachandran & G K Vijaya Raghavan/WILEY India Edition/2008
2. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005.

Reference Books:

1. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.
2. Mechatronics – N. Shanmugam / Anuradha Agencies Publishers.
3. Mechatronics System Design / Devdas Shetty/Richard/Thomson.
4. Mechatronics/M. D. Singh/J. G. Joshi/PHI.

Professional Elective – III

ADVANCED MATERIAL SCIENCE

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To enable students to understand and analyze the structure, deformation, failure, and characterization of engineering materials for reliable design and performance under various loading and environmental conditions.

Course Outcomes

Upon successful completion of the course, the students will be able to

- Explain the process of crystallization and the role of grain boundaries in influencing material properties.
- Analyze creep behavior under combined stresses using deformation mechanism maps.
- Characterize the resistance of materials to high and low cycle fatigue under various conditions.
- Apply fracture parameters for assessing fracture toughness
- Evaluate suitable characterization techniques for correlating microstructure with material behavior.

Course Content

UNIT – I: Review of Material Science

Introduction to Crystallography: Crystallization of metals, Grain and grain boundaries, effect of grain boundaries – determination of grain size, Recrystallization. Imperfections, Slip and Twinning. Necessity of alloying, types of solid solutions, Hume Rothery's rules, intermediate alloy phases, and electron compounds.

UNIT – II: Creep Behaviour

Creep: Types and mechanisms of creep deformation, Creep under combined stresses, deformation mechanism maps, super plasticity, environmental effects, remaining life assessment.

UNIT – III: Fatigue Behaviour

Fatigue: High and low cycle fatigue, process of fatigue fracture, effect of mean stress, Cyclic stress/strain response of materials, establishment of cyclic stress/strain curve, transition fatigue life, Coffin – Manson relationship, Evaluation of Parameters, Characterizing resistance against high cycle and Low cycle fatigue, Creep fatigue interaction, environmental effects, thermochemical fatigue.

UNIT – IV: Fracture Mechanics and Failure Analysis

Fracture Mechanics: Brief review of the basic concepts of linear elastic and elastic-plastic fracture mechanics, stress intensity parameter, J – integral and crack tip opening displacement as fracture criteria, standard procedures for experimental determination of these parameters.

Failure Analysis: Analyzing Fractures, Micro mechanisms of brittle and ductile fracture, fracture mechanism maps, fractography, Visual Examination &Mangament of Applied Failure Analysis, Manage Failure Analysis.

UNIT – V: Materials Characterization Techniques

Diffraction techniques – X-ray, electron and neutron diffraction, Optical microscopy techniques, Quantitative metallography, Scanning electron microscopy: Image formation methods in SEM, applications. TEM: including image analysis, fracture surface analysis and electron microprobe analysis.

Text Books:

1. S.H.Avner, Introduction to Physical Metallurgy, 2/e, Tata McGraw- Hill, 1997.
2. George E.Dieter, Mechanical Metallurgy, 3rd Edition, McGraw-Hill, 2013.

Reference Books:

1. Dr. V.D.kodgire, Material Science and Metallurgy, 39th Edition, Everest Publishing House, 2017.
2. V.Raghavan, Material Science and Engineering, 5th Edition, Prentice Hall of India, 2004.
3. William D. Callister Jr, Materials Science and Engineering: An Introduction, 8th Edition, John Wiley and Sons, 2009.
4. Yip-Wah Chung, Introduction to Material Science and Engineering, 2nd Edition, CRC Press, 2022.
5. A V K Suryanarayana, Material Science and Metallurgy, 1st Edition, B S Publications, 2014.
6. U. C. Jindal, Material Science and Metallurgy, 1st Edition, Pearson Publications, 2011.

E-Learning Resources:

1. https://archive.nptel.ac.in/courses/113/106/113106032/
2. https://www.edx.org/learn/mechanics/massachusetts-institute-of-technology-mechanical-behavior-of-materials-part-3-time-dependent-behavior.
3. https://www.youtube.com/watch?v=9Sf278j1GTU
4. https://www.coursera.org/learn/fundamentals-of-materials-science
5. https://www.coursera.org/learn/material-behavior.

Open Elective – II

GREEN ENGINEERING

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To impart the knowledge needed to minimize impacts of products, processes on environment for sustainable development.

Course Outcomes

Upon successful completion of the course, the students will be able to

- evaluate the impact of technology on environment.
- compare biological ecology to industrial ecology.
- create sustainable products, facilities, processes and infrastructure.
- assess the life cycle of a product to evaluate its impact on energy and materials use.
- analyze technological systems.

Course Content

UNIT – I: Introduction

Humanity and technology, the concept of sustainability, quantifying sustainability,

UNIT – II: Frame Work for Green Engineering

Industrial ecology, relevance of biological ecology to industrial ecology, metabolic analysis, technology and risk, the social dimensions of industrial ecology.

UNIT – III: Implementation

Technological product development, design for environment and sustainability- customer products-buildings and infrastructure.

UNIT – IV: Life Cycle Assessment

An introduction to life cycle assessment, the LCA impact and interpretation stages, streamlining the LCA process.

UNIT – V: Analysis of Technological Systems

Systems analysis, industrial ecosystems, material flow analysis, energy and industrial ecology, air quality impacts, carbon cycles and energy balance, water quality impacts.

Text Books:

1. T E Graedel, Braden R Allenby, "Industrial Ecology and Sustainable Engineering", Prentice Hall, 2010.
2. David T. Allen, David R Shonnard, "Sustainable Engineering Concepts, Design and Case Studies", Prentice Hall, 2012.

References Books:

1. Bradley A. Striebig, Adebayo A. Ogundipe, Maria Papadakis, "Engineering Applications in Sustainable Design and Development", Cengage Learning, 2016.
2. Anastas, Paul T, Zimmerman, Julie B, "Innovations in Green Chemistry and Green Engineering", Springer, First Edition, 2013.
3. Daniel A. Vallero, Chris Brasier, "Sustainable Design: The Science of Sustainability and Green Engineering", Wiley, First Edition, 2008.

Open Elective – II

NON DESTRUCTIVE EVALUATION

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To familiarize with the concepts of various NDT techniques to identify the defect in a mechanical component.

Course Outcomes

Upon successful completion of the course, the students will be able to

- describe the concepts of various NDT methods and principles and procedure of liquid penetration test.
- illustrate the principles and procedure of Magnetic particle testing.
- interpret the principles and procedure of ultrasonic testing.
- elaborate the principles and procedure of radiography and eddy current testing.
- interpret the principles and procedure of infrared testing and applications of NDT.

Course Content

UNIT – I:

Introduction to Non-Destructive Testing: Overview of NDT, types of materials testing, preliminary NDT methods, NDT methods.

Liquid Penetrant Test: Liquid Penetrant Test, Basic Concepts, Liquid Penetrant System, Test Procedure, Effectiveness, Limitations of Liquid Penetrant Testing**.**

UNIT – II:

Magnetic Particle Test: Magnetic Materials, Magnetization of Materials, Demagnetization of Materials, Principle of Magnetic Particle Test, Magnetic Particle Test Equipment, Magnetic Particle Test Procedure, Limitations of the Magnetic Particle Test.

UNIT – III:

Ultrasonic Test: Principle of Wave Propagation, Reflection, Refraction, Diffraction, Mode Conversion and Attenuation, Piezo-electric Effect, Ultrasonic Transducers and their Characteristics,Ultrasonic Equipment, types of ultrasonic testing, Limitations of Ultrasonic Testing.

UNIT – IV:

Radiographic Test: Sources of X and Gamma Rays and their interaction with Matter, Radiographic equipment, Radiographic Techniques, Safety Aspects of Industrial Radiography, neutron ray radiography, Limitations.

Eddy Current Test: Principle of Eddy Current, Eddy Current Test System, Applications and limitations of Eddy Current Testing.

UNIT – V:

Infrared And Thermal Testing: Introduction and fundamentals to infrared and thermal testing–Heat transfer –Active and passive techniques, Applications and limitations.

Industrial Applications of NDE: Railways, Nuclear and Chemical Industries, Aerospace Industries, Automotive Industries, Coal Mining Industry.

Text Books:

1. Prasad and GCK Nair, “Non-Destructive Test and Evaluation of Materials”, Tata McGraw-Hill Education, 2nd edition, 2011.
2. B Raj, T Jayakumar and M Thavasimuthu, “Practical Non Destructive Testing”, Alpha Science International Limited, 3rd edition, 2017.

Reference Books:

1. V Jayakumar and K Elangovan, “Non-Destructive Testing of Materials”, Lakshmi Publications, 2nd edition, 2018.
2. George V. Crowe, “An Introduction to Nondestructive Testing”, American Society for Nondestructive Testing, 3rd edition, 2009.
3. Ravi Prakash, “Non-Destructive Testing Techniques”, New Age International Publishers, 1st edition, 2021.

HEAT TRANSFER LAB

III Year – II Semester

Practical : 3	Internal Marks : 30
Credits : 1.5	External Marks : 70

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Course Objectives

- To determine experimentally the conductive and radiating properties of materials and heat transfer coefficients in single and two phase flows.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- able to determine conductive and radiating properties of materials and heat transfer coefficients in single and two phase flows.

List of Experiments:

(Any 10 of the below experiments may performed)

1. Determination of thermal conductivity of a given insulating powder
2. Determination of thermal conductivity of a given liquid
3. Determination of thermal conductivity of a lagged pipe
4. Determination of efficiency of a pin-fin
5. Determination of heat transfer coefficient in transient heat conduction
6. Determination of heat transfer coefficient in forced convection
7. Determination of heat transfer coefficient in natural convection
8. Determination of emissivity of a test plate
9. Determination of Stefan Boltzmann constant
10. Determination of heat transfer coefficient in drop and film wise condensation
11. Determination of critical heat flux during pool boiling
12. Determination of overall heat transfer coefficient in a double pipe heat exchanger.

Part – A

Virtual labs (https://mfts-iitg.vlabs.ac.in/) on

1. Conduction Analysis of a Single Material Slab
2. Conduction Analysis of a single Material Sphere
3. Conduction Analysis of a single Material Cylinder
4. Conduction Analysis of a Double Material Slab
5. Conduction Analysis of a Double Material Sphere
6. Conduction Analysis of Double Material Cylinder
7. To determine the overall heat transfer coefficient (U) in the (i) parallel flow heat exchanger and (ii) Counter flow heat exchanger
8. To investigate the Lambert's distance law.
9. To investigate the Lambert's direction law (cosine law).

Note: Virtual labs are only for learning purpose, and are not for external examination.

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LAB

III Year – II Semester

Practical : 3	Internal Marks : 30
Credits : 1.5	External Marks : 70

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Course Objectives

- To familiarize with different search algorithms used in problem solving.
- To disseminate knowledge on different machine learning algorithms.

Course Outcomes

Upon successful completion of the course, the students will be able to

- learn various Python libraries.
- develop programming for regression methods.
- write coding for different types of neural networks.
- write a program for decision tree, Naïve Bayes and SVM.
- generate code for auto encoders.

List of Experiments:

1. Learning of Python libraries – Numpy, Pandas, Matplotlib, Seaborn and Tensor Flow
2. Numerical examples on Python libraries
3. Data Pre-processing and data cleaning using Python
4. Write a program for Linear regression
5. Write a program for Logistic regression
6. Write a program for ANN
7. Write a program for CNN
8. Write a program for RNN
9. Write a program to build a Decision tree
10. Write a program to build a Naïve Bayes classifier
11. Write a program for SVM
12. Write a program for Auto-encoder

ROBOTICS AND DRONE TECHNOLOGIES LAB

III Year – II Semester

Practical : 4	Internal Marks : 30
Credits : 2	External Marks : 70

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Course Objectives

- Robotics and Drone Technologies Laboratory offers the students hands-on experience in robotics, and unmanned aerial systems.

Course Outcomes

Upon successful completion of the course, the students will be able to

- students at the end of the course will get enough knowledge and knowhow about how to design a variety of robots and drones for diversified applications.

List of Experiments:

Robotics:

1. Simulation of Mathematical Model of Robot.
2. Forward and Inverse Dynamic Analysis of a 2-DOF Robotic Manipulator using Software Tools.
3. Building and Programming a Simple Arduino-Based Robot for basic movement.
4. Build a robot that can navigate through a maze or an environment by using sensors to detect obstacles and avoid them.
5. Construct a robotic arm using servo motors or stepper motors and program the arm to perform various tasks, such as picking up objects, sorting the colour, or drawing shapes.
6. Build a robot that follows a black line on a contrasting surface using line-following sensors.
7. Designing a 3D Model of a Robotic Arm and Grippers Using Software
8. Implement a PID controller for a robotic arm or mobile robot and simulate its performance in tracking a desired trajectory.

Drone Technology:

1. Demonstration of parts and functions of a drone.
2. Demonstration of effects of forces, manoeuvres of a drone by roll, pitch and yaw.
3. Demonstration of various sensors and battery management used in drones.
4. Build a prototype drone to record videos and photos.
5. Make a drone for a certain payload.

e-Learning Resources:

1. https://aim.gov.in/pdf/equipment-manual-pdf.pdf
2. https://atl.aim.gov.in/ATL-Equipment-Manual/
3. https://aim.gov.in/pdf/Level-1.pdf
4. https://aim.gov.in/pdf/Level-2.pdf
5. https://aim.gov.in/pdf/Level-3.pdf
6. https://aim.gov.in/pdf/ATL_Drone_Module.pdf

TECHNICAL PAPER WRITING AND IPR

(Common to CE, ME, CSE, IT, CSE(AI&ML), AI&DS and IoT)

III Year – II Semester

Lecture : 2	Internal Marks : 30
Credits : -	External Marks : 70

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Course Objectives

- To equip students with advanced academic writing and publishing skills.
- To provide a thorough understanding of Intellectual Property Rights.X

Course Outcomes

Upon successful completion of the course, the students will be able to

- compose well-structured, concise, and unambiguous abstracts and introductions.
- critique and synthesize existing scholarly work to write a compelling Literature Review.
- explain the fundamental nature and distinction between different types of Intellectual Property.
- analyze the scope of Patent Rights and the procedures involved in licensing and technology transfer.
- evaluate the legal and administrative challenges posed by new developments in IPR.

Course Content

UNIT – I:

Planning and Preparation: Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness. Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

UNIT – II:

Literature Review: Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Key skills needed when writing a Title, Abstract, Introduction, a Review of the Literature, the Methods, the Results, the Discussion, and the Conclusions. Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

UNIT – III:

Process and Development: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, patenting under PCT.

UNIT – IV:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology, Patent information and databases, Geographical Indications.

UNIT – V:

New Developments In IPR: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies.

Text Books:

1. Day, R. How to Write and Publish a Scientific Paper. Cambridge University Press, 2006.
2. Halbert. Resisting Intellectual Property. Taylor & Francis Ltd, 2007.

Reference Books:

1. Goldbort, R. Writing for Science. Yale University Press, 2006.
2. Highman, N. Handbook of Writing for the Mathematical Sciences. SIAM, 1998.
3. Wallwork, Adrian. English for Writing Research Papers. Springer New York Dordrecht Heidelberg London, 2011.
4. Mayall. Industrial Design. McGraw Hill, 1992.
5. Merges, Robert P., Peter S. Menell, and Mark A. Lemley. Intellectual Property in New Technological Age. Year Unknown, 2016. (The publisher is missing in the original source.)
6. Ramappa, T. Intellectual Property Rights Under WTO. S. Chand, 2008.

Honor's Degree

ADVANCED MECHANISMS AND ROBOTICS

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

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Course Objectives

- To enable students to perform advanced kinematic analysis and synthesis of planar linkages and serial robotic manipulators, enabling the design, modeling, and velocity control of machines with specified motion characteristics.

Course Outcomes

Upon successful completion of the course, the students will be able to

- evaluate the instantaneous center of curvature, acceleration field, and higher-order kinematic properties of plane motion
- synthesize a four-bar linkage using graphical methods to fulfill the design requirements for guiding a body
- formulate and **Solve** Freudenstein's equation and the method of components to analytically to determine the dimensions of a four-bar mechanism
- construct the Denavit-Hartenberg (D-H) transformation matrix for serial manipulators and **Determine** the end-effector position and orientation
- calculate the Jacobian matrix for a multi-degree-of-freedom manipulator to **analyze** differential motions and determine the relationship between joint torques and end-effector forces

Course Content

UNIT – I:

Advanced Kinematics of plane motion–I: The Inflection circle; Euler – Savary Equation; Analytical and graphical determination of d_i; Bobillier's Construction; Collineastion axis; Hartmann's Construction.

Advanced Kinematics of Plane Motion–II: Polode curvature; Hall's Equation; Polode curvature in the four bar mechanism; coupler motion; relative motion of the output and input links; Determination of the output angular acceleration and its Rate of change.

UNIT – II:

Introduction to Synthesis-Graphical Methods–I: The Four bar linkage; Guiding a body through Two distinct positions; Guiding a body through Three distinct positions; The Rotocenter triangle ; Guiding a body through Four distinct positions; Burmester's curve.

Introduction to Synthesis-Graphical Methods–II: Function generation-General discussion; Function generation: Overlay's method; Path generation: Roberts's theorem.

UNIT – III:

Introduction to Synthesis–Analytical Methods: Function Generation: Freudenstien's equation, Precision point approximation, Precision – derivative approximation; Path Generation: Synthesis of Four-bar Mechanisms for specified instantaneous condition; Method of components; Synthesis of Four-bar Mechanisms for prescribed extreme values of the angular velocity of driven link; Method of components.

UNIT – IV:

Manipulator Kinematics: D-H transformation matrix; Direct and Inverse kinematic analysis of Serial manipulators: Articulated, spherical & industrial robot manipulators- PUMA, SCARA, STANFORD ARM, MICROBOT

UNIT – V:

Differential Motions and Velocities: Introduction, differential relationship, Jacobian, differential motions of a frame-translations, rotation, rotating about a general axis, differential transformations of a frame. Differential changes between frames, differential motions of a robot and its hand frame, calculation of Jacobian, relation between Jacobian and the differential operator, Inverse Jacobian.

Text Books:

1. Hirschhorn, J., "Kinematics and Dynamics of Plane Mechanisms", McGraw-Hill, 1962.
2. Sciavicco, L. & Siciliano, B., "Modelling and Control of Robot Manipulators", Springer Publications, 2nd Edition, 2000.
3. Ghosh, A. & Mallik, A.K., "Theory of Mechanisms and Machines", East-West Press Pvt. Ltd., 3rd Edition, 1998.

Reference Books:

1. Allen S Hall, J R, "Kinematics and Linkage Design", Prentice-Hall Inc., 1st Edition 1961.
2. Shigley, J.E. Gorden R P, Uicker, J.J. Jr., "Theory of Machines and Mechanisms", Oxford University press, 5th Edition 2017.
3. Duffy, J., "Analysis of Mechanisms and Robot Manipulators", Edward Arnold prints, 1980.

Honor's Degree

MECHANISMS AND ROBOTICS LAB

III Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 1.5	External Marks : 70

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Course Objectives

- To enable the students get practical knowledge about various mechanisms and robotic configurations.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand the kinematics and dynamics of a variety of mechanisms and robots.

List of Experiments:

Robotics Lab:

1. To demonstrate Forward and inverse Kinematics of articulated robot.
2. To program and perform the following operations by using an articulated robot:
   a) Pick and place operation
   b) To traverse given path (for arc welding)

Kinematics and Dynamics of Mechanisms Laboratory:

Design the following mechanisms and simulate using CATIA Software/ADAMS Software:

3. RRRR mechanism whose coupler curve will pass through 3 given point.
4. RRRR mechanism whose coupler will guide a straight line segment through at least three given positions.
5. RRRR mechanism whose input and output motion is coordinated at atleast three given positions.
6. RRRR mechanism whose coupler will guide a straight line segment through at least three given positions.
7. RRRP mechanism whose input and output motion is coordinated at least two given positions
8. RRRP mechanism whose input and output motion is coordinated at least three given positions.
9. RRRR mechanism whose input and output motion is coordinated at least two given positions.
10. RRRR mechanism whose coupler curve will pass through 4 given points.
11. RRRR mechanism whose coupler curve will pass through 3 given points.