GIET ENGINEERING COLLEGE

(AUTONOMOUS)

(Approved by AICTE, New Delhi, Affiliated to JNTUK, Kakinada)

Accredited by NAAC with 'A+' Grade.

NH-16, CHITANYA KNOWLEDGE CITY,VELUGUBANDA, RAJAMAHENDRAVARAM – 533296, E. G. Dt., A.P., INDIA

Regulation: GE24	**I - B.Tech., I Semester**

Mechanical Engineering

SCHEME OF INSTRUCTION & EXAMINATION
(With effect from 2024-25 admitted Batch onwards)

Course Code	Course Name	Category	L	T	P	Cr	C.I.E	S.E.E	Total Marks
	Engineering Physics	BS&H	3	0	0	3	30	70	100
	Linear Algebra & Calculus	BS&H	3	0	0	3	30	70	100
	Basic Electrical & Electronics Engineering	ES	3	0	0	3	30	70	100
	Engineering Graphics	ES	1	0	4	3	30	70	100
	Introduction to Programming	ES	3	0	0	3	30	70	100
	IT Workshop	ES	0	0	2	1	30	70	100
	Engineering Physics Lab	BS&H	0	0	2	1	30	70	100
	Electrical & Electronics EngineeringWorkshop	ES	0	0	3	1.5	30	70	100
	Computer Programming Lab	ES	0	0	3	1.5	30	70	100
	NSS/NCC/Scouts & Guides/Community Service	BS&H	-	-	1	0.5		100	100
TOTAL			**13**	**00**	**15**	**20.5**	**270**	**730**	**1000**

Regulation: GE24	I - B.Tech., II - Semester

Mechanical Engineering

SCHEME OF INSTRUCTION & EXAMINATION
(With effect from 2024-25 admitted Batch onwards)

Course Code	Course Name	Category	L	T	P	Cr	C.I.E	S.E.E	Total Marks
	Communicative English	BS&H	2	0	0	2	30	70	100
	Engineering Chemistry / Chemistry /Fundamental Chemistry	BS& H	3	0	0	3	30	70	100
	Differential Equations & Vector Calculus	ES	3	0	0	3	30	70	100
	Basic Civil & Mechanical Engineering	ES	3	0	0	3	30	70	100
	Engineering Mechanics	PC	3	0	0	3	30	70	100
	Communicative English Lab	BS&H	0	0	2	1	30	70	100
	Engineering Chemistry / Chemistry /Fundamental Chemistry Lab	BS&H	0	0	2	1	30	70	100
	Engineering Workshop	ES	0	0	3	1.5	30	70	100
	Engineering Mechanics Lab	PC	0	0	3	1.5	30	70	100
	Health and wellness, Yoga and Sports		-	-	1	0.5		100	
	TOTAL		**14**	**00**	**11**	**19.5**	**270**	**730**	**1000**

Regulation: GE24	II - B.Tech., I Semester								
Mechanical Engineering									
SCHEME OF INSTRUCTION & EXAMINATION (With effect from 2024-25 admitted Batch onwards)									
Course Code	**Course Name**	**Category**	**L**	**T**	**P**	**Cr**	**C.I.E**	**S.E.E**	**Total Marks**
	Numerical Methods and Transform Techniques	BS	3	0	0	3	30	70	100
	Universal Human Values– Understanding Harmony& Ethical Human Conduct	HSMC	2	1	0	3	30	70	100
	Thermodynamics	ES	2	0	0	2	30	70	100
	Mechanics of Solids	PC	3	0	0	3	30	70	100
	Material Science and Metallurgy	PC	3	0	0	3	30	70	100
	Mechanics of Solids and Materials Science Lab	PC	0	0	3	1.5	30	70	100
	Computer-aided Machine Drawing	PC	0	0	3	1.5	30	70	100
	Python programming Lab	ES	0	0	2	1.0	30	70	100
	Embedded Systems and IoT	SOC	0	1	2	2	30	70	
	Environmental Science	AC	2	0	0	-	30		
TOTAL			**15**	**02**	**10**	**20**	**300**	**630**	**930**

Regulation: GE24	II - B.Tech., II - Semester

Mechanical Engineering

SCHEME OF INSTRUCTION & EXAMINATION
(With effect from 2024-25 admitted Batch onwards)

Course Code	Course Name	Category	L	T	P	Cr	C.I.E	S.E.E	Total Marks
	Industrial Management	MS	2	0	0	2	30	70	100
	Complex Variables, Probability and Statistics	BS	3	0	0	3	30	70	100
	Manufacturing processes	PC	3	0	0	3	30	70	100
	Fluid Mechanics & Hydraulic Machines	PC	3	0	0	3	30	70	100
	Theory of Machines	PC	3	0	0	3	30	70	100
	Fluid Mechanics & Hydraulic Machines Lab	PC	0	0	3	1.5	30	70	100
	Manufacturing processes Lab	PC	0	0	3	1.5	30	70	100
	Soft Skills	SOC	0	1	2	2	30	70	100
	Design Thinking & Innovation		1	0	2	2	30	70	100
	TOTAL		**15**	**01**	**10**	**21**	**270**	**630**	**900**

Mandatory Community Service Project Internship of 08 weeks duration during summer vacation

Numerical Methods and Transform Techniques

Regulation GE24	GIET Engineering College (Autonomous)	II B. Tech. I Sem. (3rd Semester)			
Course Code	**Numerical Methods and Transform Techniques**	L	T	P	C
Prerequisites	Nil	3	0	0	3

Course Objectives

Upon successful completion of this course, students will be proficient in applying various numerical methods to solve nonlinear algebraic equations and perform numerical integration, while also being equipped with foundational concepts and techniques to tackle advanced real-world applications.

Course Outcomes

After completion of this course, the learners will be able to

CO1	Evaluate the approximate roots of polynomial and transcendental equations by different algorithms. Apply Newton's forward & backward interpolation and Lagrange's formulae for equal and unequal intervals.
CO2	Apply numerical integral techniques to different Engineering problems. Apply different algorithms for approximating the solutions of ordinary differential equations with initial conditions to its analytical computations.
CO3	Apply the Laplace transform for solving differential equations.
CO4	Find or compute the Fourier series of periodic signals.
CO5	Know and be able to apply integral expressions for the forwards and inverse Fourier transform to a range of non-periodic waveforms.

UNIT – I: Iterative Methods CO1 12L

Introduction – Solutions of algebraic and transcendental equations: Bisection method – Secant method – Method of false position – Iteration method – Newton-Raphson method (Simultaneous Equations) 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 CO2 10L

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 – RungeKutta method (second and fourth order) – Milne's Predictor and Corrector Method.

UNIT –III: Laplace Transforms: CO3 10L

Definition of Laplace transform - Laplace transforms of standard functions – Properties of Laplace Transforms – Shifting theorems–Transforms of derivatives and integrals – Unit stepfunction – Dirac's delta function – Inverse Laplace transforms – Convolution theorem (with out proof). Applications: Solving ordinary differential equations (initial value problems) and integro differential equations using Laplace transforms.

UNIT – IV: Fourier series CO4 10L

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 **CO5 10L**

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

Textbook(s)

1. B. S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. B. V. Ramana,Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference book(s)

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

Web reference(s)

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

Universal human Values- Understanding Harmony & Ethical Human Conduct

Regulation GE24	GIET Engineering College (Autonomous)	II B. Tech. I Sem. (1st Semester)			
Course Code	**Universal human Values- Understanding Harmony & Ethical Human Conduct** (Common for all branches of Engineering)	L	T	P	C
Prerequisites		2	1	0	3

Course Objectives

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

Course Outcomes

After completion of this course, the learners will be able to

CO1	Define the terms like Natural Acceptance, Happiness and Prosperity Identify one′s self, and one′s surroundings (family, society nature)
CO2	Apply what they have learnt to their own self in different day-to-day settings in real life Relate human values with human relationship and human society
CO3	Justify the need for universal human values and harmonious existence Develop as socially and ecologically responsible engineers

Unit-1: Universal human Values- Understanding Harmony & Ethical Human Conduct

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
Lecture4: Continuous Happiness and Prosperity – the Basic HumanAspirations
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-2: Harmony in the Human Being

Understanding Human being as the Co-existence of the self and the body.
Distinguishing between the Needs of the self and the body
Practice Session PS4 Exploring the difference of Needs of self and body.
The body as an Instrument of the self
Understanding Harmony in the self
Practice Session PS5 Exploring Sources of Imagination in the self
Harmony of the self with the body
Programme to ensure self-regulation and Health
Practice Session PS6 Exploring Harmony of self with the body

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Unit-3: Harmony in the Family and Society

Harmony in the Family – the Basic Unit of Human Interaction
'Trust' – the Foundational Value in Relationship
Practice Session PS7 Exploring the Feeling of Trust
'Respect' – as the Right Evaluation
Practice Session PS8 Exploring the Feeling of Respect
Other Feelings, Justice in Human-to-Human Relationship
Understanding Harmony in the Society
Vision for the Universal Human Order
Practice Session PS9 Exploring Systems to fulfil Human Goal

Unit-4 Harmony in the Nature/Existence

Understanding Harmony in the Nature
Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature
Practice Session PS10 Exploring the Four Orders of Nature
Realizing Existence as Co-existence at All Levels
The Holistic Perception of Harmony in Existence
Practice Session PS11 Exploring Co-existence in Existence.

Unit-5 Implications of the Holistic Understanding

Natural Acceptance of Human Values
Definitiveness of (Ethical) Human Conduct
Practice Session PS12 Exploring Ethical Human Conduct
A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Competence in Professional Ethics
Practice Session PS13 Exploring Humanistic Models in Education
Holistic Technologies, Production Systems and Management Models-Typical Case Studies

Strategies for Transition towards Value-based Life and Profession
Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

Reference book(s)

1. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Web reference(s)

1. https://fdp-si.aicte-india.org/UHVII%
20Class%20Notes%20&%20Handouts/UHV%20Handout%201-
2. Introduction%20to%20Value%20Education.pdf
3. https://fdp-si.aicte-india.org/UHVII%
20Class%20Notes%20&%20Handouts/UHV%20Handout%202-
4. Harmony%20in%20the%20Human%20Being.pdf
5. https://fdp-si.aicte-india.org/UHVII%
20Class%20Notes%20&%20Handouts/UHV%20Handout%203-
6. Harmony%20in%20the%20Family.pdf
7. https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3
S2%20Respect%20July%2023.pdf
8. https://fdp-si.aicte-india.org/UHVII%
20Class%20Notes%20&%20Handouts/UHV%20Handout%205-
9. Harmony%20in%20the%20Nature%20and%20Existence.pdf
10. https://fdp-si.aicte-india.org/download/FDPTeachingMaterial/3-
days%20FDPSI%20UHV%20Teaching%20Material/Day%203%20Handouts/UHV%203D%2
0D3-S2A%20Und%20Nature-Existence.pdf
11. https://fdp-si.aicteindia.
org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%2023-
25%20Ethics%20v1.pdf

Thermodynamics

Regulation GE24	GIET Engineering College (Autonomous)	I B. Tech. I Sem. (2nd Semester)			
Course Code	**Thermodynamics** (Mechanical Engineering)	L	T	P	C
Prerequisites		2	0	0	2

Course Objectives:

1. Familiarize concepts of heat, work, energy and governing rules for conversion of one form to other.
2. Explain relationships between properties of matter and basic laws of thermodynamics.
3. Teach the concept of entropy for identifying the disorder and feasibility of a thermodynamic process.
4. Introduce the concept of available energy for maximum work conversion. Provide fundamental concepts of Refrigeration and Psychrometry.

Course Outcomes

After completion of this course, the learners will be able to

CO1	Explain the importance of thermodynamic properties related to conversion of heat energy to work
CO2	Apply the Zeroth and First Law of Thermodynamics.
CO3	Understand Second Law of Thermodynamics.
CO4	Analyse the Mollier charts, T-S and h-s diagrams, Steam Calorimetry, phase Transformations
CO5	Evaluate the COP of refrigerating systems and properties, processes of psychometry and sensible and latent heat loads.

Unit – I CO1 8L

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 CO2 9L

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 and applications. Limitations of the First Law – Enthalpy, Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance.

Unit – III CO3 12L

Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM-II, Carnot's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs

and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics.

Unit – IV **CO4 9L**

Pure Substances, P-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry.

Unit – V **CO5 9L**

Introduction to Refrigeration: working of Air Vapour compression,VCR system Components, COP Refrigerants.

Introduction to Air Conditioning: Psychrometric properties & processes – characterization of sensible and latent heat loads – load concepts of SHFRequirements of human comfort and concept of effective temperature- comfort chart – comfort air conditioning, and load calculations.

Text Book (s):

1. P.K.Nag, Engineering Thermodynamics, 5/e, Tata McGraw Hill, 2013.
2. R.K Rajput, Thermal Engineering, ninth edition, Laxmi Publications

Reference Book (s)

1. Y.A.Cengel &M.A.Boles , Thermodynamics – An Engineering Approach, 7/e, McGraw Hill, 2010.
2. CP Arora, Refrigeration and Air-conditioning, 4/e, McGraw Hill, 2021.

Web reference (s):

1. https://www.edx.org/learn/thermodynamics.
2. https://archive.nptel.ac.in/courses/112/106/11210631
3. https://www.youtube.com/watch?v=7NI5P4KqrAs&t
4. https://kp.kiit.ac.in/pdf_files/02/Study-Material_3rd-
5. Semester_Winter_2021_Mechanical-Engg.-_Thermal-Engineering _Abhijit-Samant.pdf
6. https://www.coursera.org/learn/thermodynamics-intro

Regulation R23	GIET Engineering College (Autonomous)	II B. Tech. I Sem. (1st Semester)			
Course Code	**Mechanics Of Solids** (Mechanical Engineering)	L	T	P	C
Prerequisites	Nil	3	0	0	3

Course Objectives

The importance of the different types of stresses acting on a material. Different mechanical properties. Concept of shear force and bending moment diagrams. Clear idea on deflection of beams and problems on thick and thin cylinders.

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Course Outcomes

After completion of this course, the learners will be able to

CO1	Understand the behaviour of basic structural members subjected to uni axial and biaxial loads. Apply the concept of stress and strain to analyze and design structural members and machine parts under axial, shear and bending loads, moment and torsional moment.
CO2	Correct and complete shear and bending moment diagrams for beams.
CO3	Students will learn all the methods to analyse beams, columns, frames for normal, shear, and torsion stresses and to solve deflection problems in preparation for the design of such structural components.
CO4	Students attain a deeper understanding of the loads, stresses, and strains acting on a structure and their relations in the elastic behaviour.
CO5	Design and analysis of Industrial components like pressure vessels.

Unit-1: Simple Stresses & Strains : CO1 9L

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 & volumetric strain – Bars of varying section –composite bars – Temperature stresses- Complex Stresses - Stresses on an inclined plane under different uni axial and biaxial stress conditions - Principal planes and principal stresses - Mohr's circle - Relation between elastic constants, Strain energy – Resilience –Gradual, sudden, impact and shock loadings.

CO2 9L

Unit-2: Shear Force and Bending Moment :

Definition of beam : Types of beams-Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, u.d.l, uniformly varying load sand combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of abeam.

Unit-3: Flexural Stresses and Shear Stresses: CO3 12L

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 formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I and T sections.

Unit-4: Deflection of Beams : CO4 10L

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, UDL and UVL. 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-5: Thin And Thick Cylinders: CO5 10L

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

Textbook(s)

1. S.S.Bhavikatti, Strength of materials,10/e, Vikas Publishing House, NewDelhi, 2018.
2. A Textbook of SOM, R.K. Bansal 5th Edition 2019.

Reference book(s)

1. Gere & Timoshenko, Mechanics of materials, 2/e, CBS publications.
2. U.C.Jindal, Strength of Materials, 2/e, Pearson Education, 2017.
3. Timoshenko, Strength of Materials Part – I& II, 3/e, CBS Publishers, 2004.
4. Popov, Mechanics of Solids, 2/e, New Pearson Education, 2015.

Web reference(s)

1. https://onlinecourses.nptel.ac.in/noc19_ce18/preview.
2. https://youtube/iY_ypychVNY?si=310htc4ksTQJ8Fv6.

Material Science & Metallurgy

Regulation GE24	GIET Engineering College (Autonomous)	II B. Tech. I Sem. (3rd Semester)			
Course Code	**Material Science & Metallurgy** (Mechanical Engineering)	L	T	P	C
Prerequisites	Engineering Chemistry	3	0	0	3

Course Objectives

Understand the crystalline structure of different metals and study the stability of phases in different alloy systems. Study the behaviour of ferrous and non-ferrous metals and alloys and their application in different domains. Able to understand the effect of heat treatment, addition of alloying elements on properties of ferrous metals. Grasp the methods of making of metal powders and applications of powder metallurgy. Comprehend the properties and applications of ceramic, composites and other advanced methods.

Course Outcomes

After completion of this course, the learners will be able to

CO1	Understand the crystalline structure of different metals and study the stability of phases in different alloy systems.
CO2	Study the behaviour of ferrous and non-ferrous metals and alloys and their application in different domains.
CO3	Understand the effect of heat treatment, addition of alloying elements on properties of ferrous metals.
CO4	Grasp the methods of making of metal powders and applications of powder metallurgy.
CO5	Comprehend the properties and applications of ceramic, composites and other advanced methods.

Unit-1: Structure of Metals and Constitution of alloys and Equilibrium Diagrams CO1 13L

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-2: Ferrous metals and alloys & Non-ferrous Metals and Alloys CO2 9L

Ferrous metals and alloys

Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheroidal 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-3: Heat treatment of Steels CO3 10L

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-4: Powder Metallurgy CO4 10L

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-5: Ceramic and Advanced materials CO5 10L

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.

Textbook(s)

1. Dr. V.D. Kodgire, Material Science and Metallurgy, 39/e, Everest Publishing House, 2017.
2. S.H.Avner, Introduction to Physical Metallurgy, 2/e, Tata McGraw- Hill, 1997.

Reference book(s)

1. William D. Callister Jr, Materials Science and Engineering: An Introduction, 8/e, John Wiley and Sons, 2009.
2. Donald R.Askeland, Essentials of Materials science and Engineering, 4/e, CL Engineering publicatios, 2018.
3. V.Raghavan, Material Science and Engineering, 5/e, Prentice Hall of India, 2004
4. George E.Dieter, Mechanical Metallurgy, 3/e, McGraw-Hill, 2013
5. Yip-Wah Chung, Introduction to Material Science and Engineering, 2/e, CRC Press, 2022.
6. A V K Suryanarayana, Material Science and Metallurgy, B S Publications, 2014.
7. U. C. Jindal, Material Science and Metallurgy, 1/e, Pearson Publications, 2011.

Web reference(s)

1. https://archive.nptel.ac.in/courses/113/106/113106032/
2. https://www.edx.org/learn/mechanics/massachusetts-institute-of-technologymechanical-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.

Regulation R23	GIET Engineering College (Autonomous)	II B. Tech.I Sem. (1st Semester)			
Course Code	**Mechanics Of Solids & Materials Science Lab** (Mechanical Engineering)	L	T	P	C
Prerequisites	Nil	0	0	3	1.5

Course Objectives

To study the concepts of yield stress, ultimate stress and bending stress. Have idea on Hardness test. Knowledge of microstructures and characteristics of ferrous and non—ferrous alloys like aluminium, copper, brass, grey cast-iron etc.

Course Outcomes

After completion of this course, the learners will be able to

CO1	Evaluate the values of yield stress, ultimate stress and bending stress of the given specimen under tension test and bending test
CO2	Conduct the torsion test to determine the modulus of rigidity of given specimen.
CO3	Justify the Rockwell hardness test over with Brinell hardness and measure the hardness of the given specimen.
CO4	Examine the stiffness of the open coil and closed coil spring and grade them.
CO5	Analyze the microstructure and characteristics of ferrous and nonferrous alloy specimens.

NOTE: Any 6 experiments from each section A and B.

List of Experiment(s)

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 pendulum.

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.

Textbook(s)

1. B.C. Punmia, Strength of materials,10/e, Lakshmi publications Pvt. Ltd, NewDelhi, 2018.
2. A Textbook of SOM, R.K. Bansal 5th Edition 2019.

Reference book(s)

1. Gere & Timoshenko, Mechanics of materials, 2/e, CBS publications.
2. U.C.Jindal, Strength of Materials, 2/e, Pearson Education, 2017.
3. Timoshenko, Strength of Materials Part – I& II, 3/e, CBS Publishers, 2004.
4. Popov, Mechanics of Solids, 2/e, New Pearson Education, 2015.

Web reference(s)

1. https://onlinecourses.nptel.ac.in/noc19_ce18/preview.
2. https://youtube/iY_ypychVNY?si=310htc4ksTQJ8Fv6.

Computer-Aided Machine Drawing

Regulation GE24	GIET Engineering College (Autonomous)	II B. Tech. I Sem. (3rd Semester)			
Course Code	**Computer-Aided Machine Drawing**	L	T	P	C
Prerequisites	Any 2D and 3D Modelling Software & Engineering Graphics	0	0	3	1.5

Course Objectives

Introduce conventional representations of material and machine components. Train to use software for 2D and 3D modelling. Familiarize with thread profiles, riveted, welded and key joints. Teach solid modelling of machine parts and their sections. Explain creation of 2D and 3D assembly drawings and familiarize with limits, fits, and tolerances in mating components.

Course Outcomes

After completion of this course, the learners will be able to

CO1	Demonstrate the conventional representations of materials and machine components.
CO2	Model riveted, welded and key joints using CAD system.
CO3	Create solid models and sectional views of machine components.
CO4	Generate solid models of machine parts and assemble them.
CO5	Translate 3D assemblies into 2D drawings.

List of Experiment(s)

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.

The following exercises are to be done by any 3D software package:

Sectional views:
Creating solid models of complex machine parts and sectional views.
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, carburettor, piston, connecting rod, eccentric, screw jack, plumber block, axle bearing, pipe vice, clamping device, Geneva cam, universal coupling.
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.

Reference(s)

1. Machine Drawing by K.L.Narayana, P.Kannaiah and K.Venkat Reddy, New Age International Publishers, 3/e, 2014.
2. Machine drawing by N.Sideshwar, P. Kannaiah, V.V.S.Sastry, TMH Publishers. 2014.

Web Resource(s)

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

Python Programming Lab

Regulation GE24	GIET Engineering College (Autonomous)	II B. Tech. I Sem. (3rd Semester)			
Course Code	**Python Programming Lab**	L	T	P	C
Prerequisites	Nil	0	0	3	1.5

Course Objectives

1. **Fundamental Understanding:** Develop a solid foundation in Python programming, covering essential syntax, semantics, and constructs.
2. **Data Manipulation:** Equip students with skills to handle and manipulate data using Python libraries like Pandas and NumPy.
3. **Problem-Solving:** Enhance problem-solving abilities by implementing various algorithms and data structures in Python.
4. **Software Development:** Foster software development skills, including version control, package management, and project documentation.
5. **Advanced Techniques:** Introduce advanced Python topics such as web scraping, API interaction, and database management.

Course Outcomes

After completion of this course, the learners will be able to

CO1	Proficiency in Python Installation and Setup
CO2	Understanding of Basic Python Programming Constructs.
CO3	Competence in Using Functions and Modules
CO4	Skill in Data Structures and File Handling
CO5	Application of Advanced Python Concepts

List of Experiment(s)

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 SQLite and SQLAlchemy.

Perform CRUD operations on the database.

Write queries to manage and retrieve data.

Web Resource(s)

1. https://www.udemy.com/course/python-the-complete-python-developer-course/?matchtype=e&msclkid=0584dfb54dc715f39c0bb9aaf74033be&utm_campaign=BG
2. Python_v.PROF_la.EN_cc.INDIA_ti.7380&utm_content=deal4584&utm_medium=udemyads&utm_source=bing&utm_term=_._ag_1220458320107116_._ad ._kw_Python+language_._de_c_._dm ._pl._ti_kwd-76278984197882%3Aloc-90_._li_116074_._pd._&couponCode=IND21PM
3. https://www.w3schools.com/python/python_intro.asp
4. https://www.youtube.com/watch?v=eWRfhZUzrAc
5. https://onlinecourses.nptel.ac.in/noc20_cs83/preview
6. https://www.edx.org/learn/python
7. Virtual Labs - https://python-iitk.vlabs.ac.in/
8. Virtual Labs - https://virtual-labs.github.io/exp-arithmetic-operations-iitk/
9. Virtual Labs - https://cse02-iiith.vlabs.ac.in/
   https://mlritm.ac.in/assets/cse/cse_lab_manuals/R20_cse_manuals/Python%20Lab%20Manual.pdf

Embedded Systems & IOT

Regulation GE24	GIET Engineering College (Autonomous)	II B. Tech. I Sem. (3rd Semester)			
Course Code 24ME309SC	**Embedded Systems & IOT**	L	T	P	C
Prerequisites	Microcontrollers and Development Boards, Integrated Development Environments (IDEs).	0	1	2	2

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

After completion of this course, the learners will be able to	
CO1	Interpret the impact and challenges posed by IOT networks leading to new architectural models.
CO2	Analyse to introduce the concept of machine to machine with necessary protocol and get awareness in implementation of distance sensor.
CO3	Appraise the role of IOT protocols for efficient network communication.
CO4	Elaborate the need for data analytics and security in IOT.
CO5	Design IoT applications using Arduino/Raspberry Pi /open platform.

List of Experiment(s)

Embedded Systems Experiments

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.

Note: Minimum of Five Experiments has to be performed

Reference(s)

1. Embedded Systems Architecture- By Tammy Noergaard, Elsevier Publications, 2013.
2. Embedded Systems-By Shibu. K.V-Tata McGraw Hill Education Private Limited, 2013.

List of Experiment(s)

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 and how to trace and debug Python code on the device.
3. Using Raspberry pi a. Calculate the distance using distance sensor. b. Basic LED functionality.
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.

Note: Minimum of Five Experiments has to be performed

Reference(s)

1. Arsheep Bahga &Vijay Madisetti, Internet of Things - A Hands-on Approach, 1/e, Orient Blackswan Private Limited - New Delhi, 2015.
2. Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015.

Web Resource(s)

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/

Regulation GE24	GIET Engineering College (Autonomous)	II B. Tech. I Sem. (3rd Semester)			
Course Code	**Environmental Science** (Mechanical Engineering)	L	T	P	C
Prerequisites	Engineering Mechanics	2	0	0	-

Course Objectives

The students completing this course are expected to

To make the students to get awareness on environment.To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day-to-day activities of human life. To save earth from the inventions by the engineers.

Course Outcomes

After completion of this course, the learners will be able to

CO1	Multi-disciplinary nature of environmental studies and various renewable and non-renewable resources.
CO2	Understand flow and bio-geo- chemical cycles and ecological pyramids.
CO3	Understand various causes of pollution and solid waste management and related preventive measures.
CO4	Understand the rainwater harvesting, watershed management, ozone layer depletion and waste land reclamation.
CO5	Illustrate the causes of population explosion, value education and welfare programmes.

Unit-1: CO1 9L

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-2: CO2 9L

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-3: **CO3** **9L**

Environmental Pollution: Definition, Cause, 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-4: **CO4** **9L**

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-5: **CO5** **9L**

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.

Textbook(s)

1.Palaniswamy, Environmental Studies, 2/e, Pearson education, 2014.
2.K.Raghavan Nambiar, “Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus”, SciTech Publications (India), Pvt. Ltd, 2010.

Reference book(s)

1. M.Anji Reddy, “Textbook of Environmental Sciences and Technology”, BS Publication, 2014..
2. Deeksha Dave and E.Sai Baba Reddy, Textbook of Environmental Science, 2/e, Cengage Publications, 2012.

Web reference(s)

1.https://onlinecourses.nptel.ac.in/noc23_hs155/preview
2. http://ecoursesonline.iasri.res.in/Courses/Environmental%20Science-I/Data%20Files/pdf/lec07.pdf

Engineering Graphics

Regulation GE24	GIET Engineering College (Autonomous)	I B. Tech. II Sem. (2nd Semester)			
Course Code	**Engineering Graphics** (Common for all branches of Engineering)	L	T	P	C
Prerequisites		3	0	0	3

Course Objectives

To equip students with foundational concepts like dimensioning, conventions, and engineering drawing standards, the course aims to impart knowledge on projecting points, lines, and plane surfaces, thereby enhancing visualization skills for a comprehensive understanding of solid projections. Additionally, it fosters imaginative abilities crucial for comprehending solid sections and surface developments, while enabling students to grasp the visual perception of solid objects through isometric projections.

Course Outcomes

After completion of this course, the learners will be able to

CO1	Understand the principles of engineering drawing, including engineering curves, scales,orthographic and isometric projections.
CO2	Draw and interpret orthographic projections of points, lines, planes and solids in front,top and side views.
CO3	Understand and draw projection of solids in various positions in first quadrant.
CO4	Explain principles behind development of surfaces.
CO5	Prepare isometric and perspective sections of simple solids

Unit-1: Introduction, Curves and Scales CO1 12L

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing regular polygons by general methods.
Curves: construction of ellipse, parabola and hyperbola by general, Cycloids, Involutes, Normal and tangent to Curves.
Scales: Plain scales, diagonal scales and vernier scales.

Unit-2: Orthographic Projections- Projection of Points, Straight Lines and Planes CO2 12L

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-3: Projection of Solids CO3 9L

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-4: Section of Solids and Development of Surfaces CO4 9L

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shapeof section, Sections of solids in simple position only.
Development of Surfaces: Methods of Development: Parallel line development and radial linedevelopment. Development of a cube, prism, cylinder, pyramid and cone.

Unit-5: Conversion of Views and Computer Graphics CO5 10L

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 Transformationsusing Auto CAD (*Not for end examination*)

Textbook(s)

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

Reference book(s)

1. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2013.
2. Engineering Drawing, Venugopal.K and Prabhu.V, New Age International Publishers ,2011.
3. Engineering Drawing with an Introduction to AutoCAD, Dhananjay Jolhe, TataMcGraw Hill, 2017

Web reference(s)

1. https://onlinecourses.nptel.ac.in/noc21_me128/preview
2. https://www.sdcpublications.com/Textbooks/Engineering-Graphics/85/
3. https://fractory.com/engineering-drawing-basics/
4. https://omicstutorials.com/engineering-graphics-and-design/
5. https://onlinecourses.nptel.ac.in/noc24_mg131/preview
6. https://onlinecourses.swayam2.ac.in/aic22_ts42/preview

Engineering Mechanics

Regulation GE24	GIET Engineering College (Autonomous)	I B. Tech. II Sem. (2nd Semester)			
Course Code	**Engineering Mechanics** (Common for all branches of Engineering)	L	T	P	C
Prerequisites		3	0	0	3

Course Objectives

The course aims to familiarize students with diverse force systems and to cultivate the ability to accurately represent forces and moments acting on a body through free body diagrams for equilibrium analysis. It further focuses on instilling fundamental principles of centre of gravity, centroid, and moment of inertia, enabling their calculation for various simple and composite bodies. The course also emphasizes the application of the Work-Energy method to particle motion and a comprehensive understanding of the kinematics and kinetics of rigid body translational and rotational motion.

Course Outcomes

After completion of this course, the learners will be able to

CO1	Understand the fundamental concepts in mechanics and determine the frictional forces for bodies in contact.
CO2	Analyze different force systems such as concurrent, coplanar and spatial systems and calculate their resultant forces and moments.
CO3	Calculate the centroids, centre of gravity and moment of inertia of different geometrical shapes.
CO4	Apply the principles of work-energy and impulse-momentum to solve the problems of rectilinear and curvilinear motion of a particle.
CO5	Solve the problems involving the translational and rotational motion of rigid bodies.

Unit-1: Introduction, System of forces and Friction CO1 9L

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's laws of dry friction, coefficient of friction, Cone of Static friction.

Unit-2: Equilibrium of Systems of Forces CO2 9L

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-3: Centroid, Centre of Gravity, Area and Mass MOI CO3 12L

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 Momentsof Inertia, Mass Moment of Inertia of composite bodies.

Unit-4: Rectilinear and Curvilinear motion of a particle CO4 10L

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-5: Rigid body Motion CO5 10L

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

Textbook(s)

1. Engineering Mechanics, S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., , McGraw HillEducation 2017. 5th Edition.
2. Engineering Mechanics, R.K.Bansal ,Laxmi Publications. 2020. Twelth Edition.
3. A Textbook of Engineering Mechanics, S.S Bhavikatti. New age international publications 2018. 4th Edition.

Reference book(s)

1. Engineering Mechanics, Statics and Dynamics, Rogers and M A. Nelson., McGraw HillEducation. 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

Web reference(s)

1. https://onlinecourses.swayam2.ac.in/ntr24_ed75/preview
2. https://onlinecourses.swayam2.ac.in/aic22_ts74/preview

Basic Civil and Mechanical Engineering

Regulation GE24	GIET Engineering College (Autonomous)	I B. Tech. II Sem. (2nd Semester)			
Course Code	**Basic Civil and Mechanical Engineering** (Common for all branches of Engineering)	L	T	P	C
Prerequisites		3	0	0	3

Course Objectives

Upon course completion, students should be able to recognize the significance and breadth of mechanical engineering across various sectors and industries, articulate knowledge of different engineering materials and manufacturing processes, and provide a comprehensive overview of thermal and mechanical transmission systems while introducing the fundamentals of robotics and their practical applications.

Course Outcomes

After completion of this course, the learners will be able to

CO1	Upon course completion, students will demonstrate a comprehensive understanding of the role of mechanical engineering in society and industry, including its application across various sectors. They will also exhibit knowledge of fundamental engineering materials and their properties.
CO2	Upon course completion, students will be able to explain the fundamental principles of manufacturing processes, including casting, forming, joining, and machining, and demonstrate knowledge of thermal engineering concepts such as combustion cycles, refrigeration, and air conditioning, as well as an introduction to electric and hybrid vehicles.
CO3	Upon course completion, students will be able to explain the working principles of various power plants (steam, diesel, hydro, and nuclear), analyze different mechanical power transmission systems, and demonstrate a basic understanding of robotics, including its components and applications..

Unit-1: Introduction to Mechanical Engineering, Engineering Materials CO1 9L

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-2: Introduction to Mechanical Engineering, Engineering Materials CO2 9L

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, SI/CI Engines, Components of Electric and Hybrid Vehicles.

Unit-3: Introduction to Mechanical Engineering, Engineering Materials CO3 9L

Power plants – Working principle of Steam, Diesel, Hydro, Nuclear power plants.
Mechanical Power Transmission - Belt Drives, Chain, Rope drives, Gear Drives and theirapplications.
Introduction to Robotics - Joints & links, configurations, and applications of robotics.

Textbook(s)

1. Internal Combustion Engines by V.Ganesan, By Tata McGraw Hill publications (India)Pvt. Ltd.
2. A text book of Theory of Machines by S.S. Rattan, Tata McGraw Hill Publications,(India) Pvt. Ltd.

Reference book(s)

1. G. Shanmugam and M.S.Palanisamy, Basic Civil and the Mechanical Engineering, TataMcGraw Hill publications (India) Pvt. Ltd.
2. Thermal Engineering by Mahesh M Rathore Tata McGraw Hill publications (India) Pvt.Ltd.
3. 3D printing & Additive Manufacturing Technology- L. Jyothish Kumar, Pulak MPandey, Springer publications
4. Appuu Kuttan KK, Robotics, I.K. International Publishing House Pvt. Ltd. Volume-I
5. Nuclear Energy- Fundamentals and Concepts, Dr Yarrapragada Subba Rao, Volume-1, Scientific international publishing House
6. A Text Book of Engineering Thermodynamics, Dr Yarrapragada Subba Rao, Volume-1, Alpha International Publication

Web reference(s)

1. https://onlinecourses.nptel.ac.in/noc24_me104/preview
2. https://archive.nptel.ac.in/courses/112/103/112103108/

PART B: BASIC CIVIL ENGINEERING

Course Objectives

Students will develop an understanding of the breadth and significance of civil engineering disciplines. The course will introduce foundational concepts of surveying and the critical role of transportation in national economic growth. Students will also gain an appreciation for the importance of water quality, conveyance, and storage. Finally, the course will provide a basic overview of civil engineering materials and construction methods.

Course Outcomes

After completion of this course, the learners will be able to

CO1	Upon successful completion of this course, students will demonstrate a comprehensive understanding of the civil engineering profession, including its diverse disciplines, the role of civil engineers in society, and fundamental knowledge of construction materials and techniques.
CO2	Upon completion of this course, students will be able to apply fundamental surveying techniques to accurately determine horizontal and vertical distances, angles, and elevations, and produce basic topographic maps.
CO3	Upon completion of this course, students will be able to evaluate the significance of transportation infrastructure in economic development and possess foundational knowledge of highway pavements, as well as a basic understanding of key transportation systems (harbors, tunnels, airports, and railways). Additionally, students will be introduced to water resources engineering concepts, including water sources, quality, and basic water management structures.

Unit-1: Basics of Civil Engineering, Hydraulics and Water Resources Engineering CO1 9 L

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-2: Surveying CO2 9 L

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-3: Transportation Engineering, Water Resources and Environmental Engineering: CO3 9 L

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 andConveyance Structures (Simple introduction to Dams and Reservoirs).

Textbook(s)

1. Basic Civil Engineering, M.S.Palanisamy, , Tata Mcgraw Hill publications (India) 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 book(s)

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.

Web reference(s)

1. https://onlinecourses.nptel.ac.in/noc24_ce111/preview
2. https://archive.nptel.ac.in/courses/105/106/105106201/
3. https://www.nptelvideos.com/discipline.php?name=civil-engineering
4. https://onlinecourses.nptel.ac.in/noc22_ce42/preview

Engineering Workshop

Regulation GE24	GIET Engineering College (Autonomous)	I B. Tech. II Sem. (2nd Semester)			
Course Code	**Engineering Workshop Lab** (Common for all branches of Engineering)	L	T	P	C
Prerequisites	Nil	0	0	3	1.5

Course Objectives

To impart practical knowledge to learners on woodworking, sheet metal operations, fitting, residential electrical wiring, and basic two-wheeler maintenance.

Course Outcomes

After completion of this course, the learners will be able to

CO1	Identify workshop tools and their operational capabilities.
CO2	Practice on manufacturing of components using workshop trades including fitting,carpentry, foundry and welding.
CO3	Apply fitting operations in various applications.
CO4	Apply basic electrical engineering knowledge for House Wiring Practice

List of Experiment(s)

1. **Demonstration**: Safety practices and precautions to be observed in workshop.
2. **Wood Working:** Familiarity with different types of woods and tools used in woodworking and make following joints.
   a) Half – Lap joint b) Mortise and Tenon joint c) Corner Dovetail joint or Bridlejoint
3. **Sheet Metal Working**: Familiarity with different types of tools used in sheet metalworking, 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 followingfitting exercises.
   a) V-fit b) Square fit
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) Godown lighting
   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 jointswith coupling for same diameter and with reducer for different diameters.
9. **Basic repairs of Two-wheeler vehicle** – Demonstration of working of two-wheelervehicle and its repairs.

Textbooks:

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

Reference(s)

1. Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, MediaPromoters 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 Prakashan, 2021-22.

Web Resource(s)

1. https://www.youtube.com/c/EngineersWorkshop
2. https://www.vlab.co.in/
3. https://www.vlab.co.in/broad-area-mechanical-engineering

Engineering Mechanics Lab

Regulation GE24	GIET Engineering College (Autonomous)	I B. Tech. II Sem. (2nd Semester)			
Course Code	**Engineering Mechanics Lab**	L	T	P	C
Prerequisites	Engineering Physics	0	0	3	1.5

Course Objectives

Upon course completion, students are expected to verify the Law of Parallelogram and Triangle of Forces, determine the coefficients of static and rolling friction as well as the centre of gravity for various plane laminae, and analyse pulley systems, the moment of inertia of compound pendulums, and flywheels.

Course Outcomes

After completion of this course, the learners will be able to

CO1	Evaluate the coefficient of friction between two different surfaces and between the inclined plane and the roller.
CO2	Verify Law of Polygon of forces and Law of Moment using force polygon and bell crank lever.
CO3	Determine the Centre of gravity and Moment of Inertia of different configurations.
CO4	Verify the equilibrium conditions of a rigid body under the action of different force systems.

List of Experiment(s)

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 Centre of Gravity 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. Determine the acceleration due to gravity using a compound pendulum.
9. Determine the Moment of Inertia of the compound pendulum about an axis perpendicular tothe plane of oscillation and passing through its centre of mass.
10. Determine the Moment of Inertia of a Flywheel.
11. Verification of Law of Moment using Rotation Disc Apparatus and Bell Crank Lever.

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

Reference(s)

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

Web Resource(s)

1. https://www.vlab.co.in/broad-area-mechanical-engineering
2. https://vlab.amrita.edu/index.php?sub=1&brch=74

Numerical Methods and Transform Techniques

Regulation GE24	GIET Engineering College (Autonomous)	II B. Tech. II Sem. (1st Semester)			
Course Code	**Industrial Management**	L	T	P	C
Prerequisites		2	0	0	2

Course Objectives

To provide a comprehensive understanding of industrial engineering, encompassing the optimal design of layouts, productivity improvement through work study, Total Quality Management (TQM) and quality control techniques, financial management, and human resource management, including value analysis.

Course Outcomes

After completion of this course, the learners will be able to

CO1	Students will be able to understand the fundamental concepts of industrial engineering, including its development, applications, and the role of an industrial engineer, as well as differentiate between production management and industrial engineering.
CO2	Students will be able to apply various work study techniques, including method study and time study, to improve productivity and efficiency in industrial operations.
CO3	Students will be able to implement statistical quality control methods, such as control charts and sampling inspection, to ensure product quality and process improvement.
CO4	Students will be able to analyze financial statements, manage working capital, and apply capital budgeting techniques to make informed financial decisions in an industrial context.
CO5	Students will be able to understand and apply human resource management principles, including job evaluation, merit rating, and wage incentive plans, to effectively manage personnel and improve organizational performance.

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 – X and R –charts X and S charts and their applications, numerical examples.

Totalqualitymanagement:

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, merit rating, 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. NewDelhi, 2006.

Reference book(s) :

1. Bhattacharya DK, Industrial Management,S.Chand, publishers, 2010.
2. J.G Monks, Operations Management,3/e, McGraw Hill Publishers1987.
3. . T.R. Banga, S.C.Sharma, N. K. Agarwal, Industrial Engineering and Management Science, Khanna Publishers, 2008.
4. KoontzO′ Donnell, Principles of Management, 4/e, McGraw Hill Publishers, 1968.
5. R.C. Gupta, Statistical Quality Control, Khanna Publishers, 1998.
6. NVS Raju, Industrial Engineering and Management,1/e, Cengage India Private Limited 2013.

Web references (s):

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=PLbjTnjt5Gkl0z3OHOGK5RB9mvNYvnImW&si=oaX_5RG69hS3v2ll

Complex Variables, Probability and Statistics

Regulation GE24	GIET Engineering College (Autonomous)	II B. Tech. II Sem. (4th Semester)			
Course Code	**Complex Variables, Probability and Statistics**	L	T	P	C
Prerequisites	Nil	3	0	0	3

Course Objectives

Upon successful completion of this course, students will be able to apply complex variable functions, series expansions, probability distributions, sampling theory, and hypothesis testing to solve real-world problems in engineering and science.

Course Outcomes

After completion of this course, the learners will be able to

CO1	Apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic
CO2	Make use of the Cauchy residue theorem to evaluate certain integrals
CO3	Infer the statistical inferential methods based on small and large sampling tests
CO4	Find the differentiation and integration of complex functions used in engineering problems
CO5	Design the components of a classical hypothesis test

Unit-1: Functions of Complex Variables and Complex integration CO1 12L

Introduction–Continuity –Differentiability–Analyticity –Cauchy-Riemann equations in Cartesian and polar 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-2: Series Expansions and Residue Theorem CO1 12L

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 real integral of th∞e types $\int_{c}^{c+2\pi} f(x)dx$ and $\int_{C} f(\cos\theta,\sin\theta)d\theta$.

Unit-3: Probability and Distributions CO2 12L

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-4: Sampling Theory CO4 10L

Introduction – Population and Samples – Sampling distribution of Means and Variance (definition only)–Central limit theorem (without proof)–Representation of the normal theory distributions– Introduction to t, χ^2 and F-distributions- point and interval estimations – maximum error of estimate.

Unit-5: Tests of Hypothesis CO5 10L

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.

Textbook(s)

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

Reference book(s)

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

Web reference(s)

1. https://archive.nptel.ac.in/courses/111/103/111103070/
2. https://biet.ac.in/pdfs/PROBABILITY%20AND%20STATISTICS%20&%20COMPLEX%20VARIABLES.pdf
3. https://archive.nptel.ac.in/courses/111/105/111105090/
4. http://acl.digimat.in/nptel/courses/video/111102160/L23.html
5. https://onlinecourses.nptel.ac.in/noc21_ma57/preview

Manufacturing Processes

Regulation GE24	GIET Engineering College (Autonomous)	II B. Tech. II Sem. (4th Semester)			
Course Code	**Manufacturing Processes** (Mechanical Engineering)	L	T	P	C
Prerequisites	Nil	3	0	0	3

Course Objectives

Know the working principle of different metal casting processes and gating system. Classify the welding processes, working of different types of welding processes and welding defects. Know the nature of plastic deformation, cold and hot working process, working of a rolling mill and types, extrusion processes. Understand the principles of forging, tools and dies, working of forging processes. Know about the Additive manufacturing.

Course Outcomes

After completion of this course, the learners will be able to

CO1	Design the patterns and core boxes for metal casting processes
CO2	Understand the different welding processes
CO3	Demonstrate the different types of bulk forming processes
CO4	Understand sheet metal forming processes
CO5	Learn about the different types of additive manufacturing processes

Unit-1: Casting CO1 11L

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-2: Welding CO2 10L

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-3: Bulk Forming CO3 10L

Bulk Forming

Plastic deformation in metals and alloys-recovery, recrystallization and grain growth. Hot working and Cold working-Strain hardening and Annealing. 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-4: Sheet Metal Forming and High energy rate forming processes CO4 10L

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-5: Additive manufacturing CO5 10L

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

Textbook(s)

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

Reference book(s)

1. R.K. Jain, Production Technology, Khanna Publishers, 2022.
2. Sharma P.C., A Text book of Production Technology, 8/e, S Chand Publishing, 2014.
3. A.Ghosh & A.K.Malik, Manufacturing Science, East West Press Pvt. Ltd, 2010.
4. Lindberg and Roy, Processes and materials of manufacture, 4/e, Prentice Hall India Learning Private Limited, 1990.
5. H.S. Shaun, Manufacturing Processes, 1/e, Pearson Publishers, 2012.
6. WAJ Chapman , Workshop Technology, 5/e, 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, 2/e, Springer, 2015.

Web reference(s)

1. https://www.edx.org/learn/manufacturing/massachusetts-institute-of-technologyfundamentals-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-formingtechnology/?v=c86ee0d9d7ed

Fluid Mechanics & Hydraulic Machines

Regulation GE24	GIET Engineering College (Autonomous)	I B. Tech. II Sem. (4th Semester)			
Course Code	**Fluid Mechanics & Hydraulic Machines** (Mechanical Engineering)	L	T	P	C
Prerequisites	Engineering Mechanics	3	0	0	3

Course Objectives

The students completing this course are expected to

- Understand the properties of fluids, manometer, hydrostatic forces acting on different surfaces
- Understand the kinematic and dynamic behaviour through various laws of fluids like Continuity, Euler's, Bernoulli's equations, energy and momentum equations.
- Understand the theory of boundary layer, working and performance characteristics of various hydraulic machines like pumps and turbines.

Course Outcomes

After completion of this course, the learners will be able to

CO1	Understand the basic concepts of fluid properties.
CO2	Estimate the mechanics of fluids in static and dynamic conditions.
CO3	Apply the Boundary layer theory, flow separation and dimensional analysis.
CO4	Estimate the hydro dynamic forces of jet on vanes indifferent positions.
CO5	Understand the working Principles and performance evaluation of hydraulic pump and turbines.

Unit-1: Fluid statics ,Buoyancy and Floatation CO1 9L

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, Measurement of pressure – Manometers - Piezometer, U-tube, inverted and differential manometers. Pascal's & hydrostatic laws.

Buoyancy and floatation

Meta center, stability of floating body. Submerged bodies. Calculation of metacentre height. Stability analysis and applications.

Unit-2: Fluid Kinematics, Fluid dynamics and Closed conduit flow: CO2 9L

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 irrotational flow, flownet, source and sink, double tand 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.

Closed conduit flow
Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel total energy line hydraulic gradient line.

Unit-3: Boundary Layer Theory and Dimensional Analysis CO3 12L

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.

Dimensional Analysis
Dimensions and Units, Dimensional Homogeneity, Non dimensionalization of equations, Method of repeating variables and Buckingham Pi Theorem.

Unit-4: Basics of turbo machinery and Hydraulic Turbines CO4 10L

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-5: Performance of hydraulic turbines , Centrifugal pumps and Reciprocating pumps CO5 10L

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.

Textbook(s)

1. P N Modi and S M Seth, Hydraulics & Fluid Mechanics including Hydraulics Machines, Standard Book House, 2017.
2. RK Bansal, Fluid Mechanics and Hydraulic Machines, 10/e, Laxmi Publications (P)Ltd, 2019.

Reference book(s)

1. Rajput, Fluid Mechanics and Hydraulic Machines, S Chand & Company, 2016.
2. D.S. Kumar, Fluid Mechanics and Fluid Power Engineering, S K Kataria &Sons, 2013.

Web reference(s)

1. https://www.edx.org/learn/fluid-mechanics
2. www.coursera.org/learn/fluid-powerera

Theory of Machines

Regulation GE24	GIET Engineering College (Autonomous)	II B. Tech. II Sem. (4th Semester)			
Course Code	**Theory of Machines** (Mechanical Engineering)	L	T	P	C
Prerequisites	Nil	3	0	0	3

Course Objectives

To provide students with a foundational understanding of basic mechanisms and their applications, emphasizing the importance of degrees of freedom, velocity and acceleration in mechanisms, cams and follower motions, gyroscopic couples, and the equation of motion for single degree of freedom systems.

Course Outcomes

After completion of this course, the learners will be able to

CO1	Understand different mechanisms and their inversions.
CO2	Calculate velocity and acceleration of different links in a mechanism
CO3	Apply the effects of gyroscopic couple in ships, aero planes and road vehicles.
CO4	Evaluate unbalance mass in rotating machines.
CO5	Analyze free and forced vibrations of single degree freedom systems.

Unit-1: Simple Mechanisms CO1 12L

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 – UniversalJoint – Rocker mechanisms.

Unit-2: Plane and Motion analysis CO1 12L

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-3: Gyroscope and Gear Profile CO2 12L

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-4: Balancing of Rotating masses and Cams CO4 10L

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-5: Vibrations & Turning Moment Diagrams and Flywheels CO5 10L

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.

Textbook(s)

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

Reference book(s)

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

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Fluid Mechanics & Hydraulic Machines Lab

Regulation GE24	GIET Engineering College (Autonomous)	II B. Tech. II Sem. (4th Semester)			
Course Code	**Fluid Mechanics & Hydraulic Machines Lab** (Mechanical Engineering)	L	T	P	C
Prerequisites	Engineering Mechanics	0	0	3	1.5

Course Objectives

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

Course Outcomes

After completion of this course, the learners will be able to

CO1	Demonstrate the devices used for measuring flow.
CO2	Compute major losses in pipes.
CO3	Illustrate the operating parameters of turbines.
CO4	Explain the working of different types of pumps.
CO5	Explain the devices used for measuring flow.

List of Experiment(s)

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.

Textbook(s)

1. P N Modi and S M Seth, Hydraulics & Fluid Mechanics including Hydraulics Machines, Standard Book House, 2017.
2. RK Bansal, Fluid Mechanics and Hydraulic Machines, 10/e, Laxmi Publications (P)Ltd, 2019.

Reference book(s)

1. Rajput, Fluid Mechanics and Hydraulic Machines, S Chand & Company, 2016.
2. D.S. Kumar, Fluid Mechanics and Fluid Power Engineering, S K Kataria &Sons, 2013.

Web Resource(s)

1. https://me.iitp.ac.in/Virtual-Fluid-Laboratory/index.html
2. https://fmc-nitk.vlabs.ac.in/List%20of%20experiments.html

Manufacturing Processes Lab

Regulation GE24	GIET Engineering College (Autonomous)	II B. Tech. II Sem. (4th Semester)			
Course Code	**Manufacturing Processes Lab** (Mechanical Engineering)	L	T	P	C
Prerequisites	Nil	0	0	3	1.5

Course Objectives

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

Course Outcomes

After completion of this course, the learners will be able to

CO1	Make moulds for sand casting.
CO2	Fabricate different types of components using various manufacturing techniques.
CO3	Adapt unconventional manufacturing methods.
CO4	Develop Different Weld joints.
CO5	Explain different types of 3d Printing techniques.

List of Experiment(s)

1. Design and make a
   i. Single piece pattern and
   ii. Split pattern
2. Sand Properties testing of
   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.

Reference(s)

1. R.K. Jain, Production Technology, Khanna Publishers, 2022.
2. Sharma P.C., A Text book of Production Technology, 8/e, S Chand Publishing, 2014.

Web Resource(s)

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

Soft Skilla

Regulation GE24	GIET Engineering College (Autonomous)	II B. Tech. II Sem. (4th Semester)			
Course Code	**Soft Skills**	L	T	P	C
Prerequisites	Nil	3	0	0	3

Course Objectives

To equip students with comprehensive life skills, encompassing intra-personal, inter-personal, verbal, and non-verbal communication, and interview techniques, thereby bridging the gap between academic knowledge and industry requirements, and fostering holistic personality development.

Course Outcomes

After completion of this course, the learners will be able to

CO1	Assimilate and understood the meaning and importance of soft skills and learn how to develop them.
CO2	Understand the significance of soft skills in the working environment for professional excellence.
CO3	Prepare to undergo the placement process with confidence and clarity.
CO4	Ready to face any situation in life and equip themselves to handle them effectively.
CO5	Understand and learn the importance of etiquette in both professional and personal life

Unit-1: Introduction CO1 11L

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-2: Intra- Personal CO2 10L

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

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Unit-3: Inter-Personal CO3 10L

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

Unit-4: Verbal Skills CO4 10L

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-5: Non-Verbal Skills and Body Skills CO5 10L

Definition and Meaning – Importance- Facial Expressions- Eye Contact – Proxemics-Haptics -Posture, cross cultural body language, body language in 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.

Textbook(s)

1. Sherfield, M. Robert at al, Cornerstone Developing Soft Skills, 4/e, Pearson Publication, New Delhi, 2014.
2. Alka Wadkar, Life Skills for Success, 1/e, Sage Publications India Private Limited, 2016.

Reference book(s)

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, 4/e, S. Chand Publication, New Delhi, 2014.
6. Stephen Covey, Seven Habits of Highly Effective People, JMD Book, 2013.

Web reference(s)

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

Engineering Physics

Regulation GE24	GIET Engineering College (Autonomous)	II B. Tech. II Sem. (4th Semester)			
Course Code	**Design Thinking & Innovation** (Common for all branches of Engineering)	L	T	P	C
Prerequisites	Nil	1	0	2	2

Course Objectives

Bring awareness on innovative design and new product development. Explain the basics of design thinking. Familiarize the role of reverse engineering in product development. Train how to identify the needs of society and convert into demand. Introduce product planning and product development process.

Course Outcomes

After completion of this course, the learners will be able to

CO1	Define the concepts related to design thinking.
CO2	Explain the fundamentals of Design Thinking and innovation.
CO3	Apply the design thinking techniques for solving problems in various sectors
CO4	Analyse to work in a multidisciplinary environment.
CO5	Evaluate the value of creativity.

Unit-1: Introduction to Design Thinking CO1 9L

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-2: Design Thinking Process CO2 9L

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, brainstorming, 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-3: Innovation CO3 12L

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-4: Product Design CO4 10L

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-5: Design Thinking in Business Processes CO5 10L

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 Start-ups. Defining and testing Business Models and Business Cases. Developing & testing prototypes.

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

Textbook(s)

1. Tim Brown, Change by design, 1/e, Harper Bollins, 2009. .
2. Idris Mootee, Design Thinking for Strategic Innovation, 1/e, Adams Media, 2014.

Reference book(s)

1. David Lee, Design Thinking in the Classroom, Ulysses press, 2018.
2. Shrrutin N Shetty, Design the Future, 1/e, Norton Press, 2018.
3. William lidwell, Kritinaholden, &Jill butter, Universal principles of design, 2/e, Rockport Publishers, 2010.
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Web reference(s)

1. https://onlinecourses.nptel.ac.in/noc22_de16/preview.
2. https://nptel.ac.in/courses/109/104/109104109/