KNOWLEDGE INSTITUTE OF TECHNOLOGY, SALEM

(An Autonomous Institution)

Approved by AICTE, Affiliated to Anna University, Chennai.
Accredited by NBA (CSE, ECE, EEE & MECH), Accredited by NAAC with 'A' Grade

KIOT Campus, Kakapalayam – 637 504. Salem Dt., Tamil Nadu, India.

B.E. / B.Tech. Regulations 2023

B.E. - Mechanical Engineering

Curriculum and Syllabi

(For the Students Admitted from the Academic Year 2023 – 2024 onwards)

VERSION : 1.0	**06.07.2024**

	KNOWLEDGE INSTITUTE OF TECHNOLOGY(AUTONOMOUS), SALEM
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	website: www.kiot.ac.in

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Board of Studies
Faculty of Mechanical Engineering
Knowledge Institute of Technology
KIOT Campus, Kakapalayam.

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	website: www.kiot.ac.in

B.E. / B.Tech. REGULATIONS 2023 (R 2023)

CHOICE BASED CREDIT SYSTEM AND OUTCOME BASED EDUCATION

B.E. - MECHANICAL ENGINEERING

VISION OF THE INSTITUTE
To be a world class institution to impart value and need based professional education to the aspiring youth and carving them into disciplined world class professional who have the questfor excellence, achievement orientation and social responsibilities.

MISSION OF THE INSTITUTE	
A	To promote academic growth by offering state-of-art undergraduate, postgraduate and doctoral programs and to generate new knowledge by engaging in cutting – edge research
B	To nurture talent, innovation, entrepreneurship, all-round personality and value system among the students and to foster competitiveness among students
C	To undertake collaborative projects which offer opportunities for long-term interaction with academia and industry
D	To pursue global standards of excellence in all our endeavors namely teaching, research, consultancy, continuing education and support functions

VISION OF THE DEPARTMENT
To create competent and industry relevant Mechanical Engineers with professional and social values to meet global challenges.

MISSION OF THE DEPARTMENT	
M1	Enabling environment for effective teaching –learning and research to meet global challenges.
M2	Motivating students to pursue higher education and to excel in competitive examinations and entrepreneurship.
M3	Establish a continuous Industry Institute Interaction to make the students employable.
M4	Inculcate the students leadership quality with ethical values and spirit of team work.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)	
PEO 1	Graduates will apply the knowledge of Mechanical Engineering to solve real world Engineering problems.
PEO 2	Graduates will have the required attributes to pursue advanced education in Engineeringand Technology.
PEO 3	Graduates will have the leadership skills with ethical values and team spirit.

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PROGRAM OUTCOMES (POs)	
Engineering Graduates will be able to:	
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)	
After the successful completion of B.E. Programme in Mechanical Engineering, the graduates will able to	
PSO 1	Apply the knowledge of Computer Aided Design and Computer Aided Engineering tools to design and analyze the products and process related to Mechanical Engineering systems.
PSO 2	Develop the knowledge and skill relevant to Heating, Ventilation and Air-Conditioning industries.
PSO 3	Exhibit the ability to make a product related to Mechanical Engineering and allied engineering fields.

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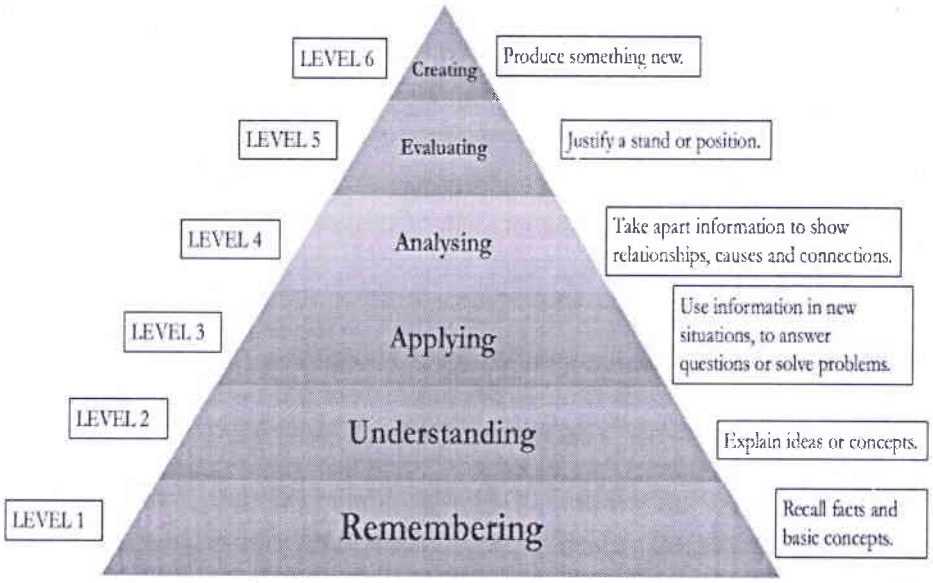
Bloom's Taxonomy Levels(BTL)

Bloom's Taxonomy(BT) is based on the belief that learners must begin by learning basic, foundational knowledge about a given subject before they can progress to more complex types of thinking such as analysis and evaluation. Bloom's Taxonomy can be useful for course design because the levels can help faculty to teach students through the process of learning, from the most fundamental remembering and understanding to the more complex evaluating and creating.



At KIOT, the Curriculum Design, Delivery and Assessment (CDDA) are carried out based on the Blooms' Taxonomy Levels (BTL). Its organized set of objectives helps teachers to plan and deliver appropriate instruction, design valid assessment tasks & schemes. It also helps to ensure that instruction and assessment are aligned with the objectives.

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KNOWLEDGE INSTITUTE OF TECHNOLOGY (AUTONOMOUS), SALEM - 637504												
B.E. MECHANICAL ENGINEERING											Version : 1.1	
Courses of Study and Scheme of Assessment (Regulations 2023)											Date : 06.07.24	
Sl. No.	Course Code	Course Title	Periods / Week						Maximum Marks			
			CAT	CP	L	T	P	C	IA	ESE	Total	
SEMESTER I												
-	-	Induction Programme	-	-	-	-	-	-	-	-	-	
	THEORY											
1	BE23EN101	Communicative English-I	HS	2	1	1	0	2	40	60	100	
2	BE23MA201	Calculus for Engineers	BS	3	2	1	0	3	40	60	100	
3	BE23PH202	Physics for Mechanical Engineers	BS	3	3	0	0	3	40	60	100	
4	BE23CY201	Engineering Chemistry	BS	3	3	0	0	3	40	60	100	
5	BE23GE301	Overview of Engineering and Technology	ES	3	3	0	0	3	40	60	100	
6	BE23MC901	Heritage of Tamils	MC	1	1	0	0	1	40	60	100	
	THEORY CUM PRACTICAL											
7	BE23GE306	Problem solving and C Programming	ES	5	3	0	2	4	50	50	100	
	PRACTICAL											
8	BE23BS201	Physics and Chemistry Laboratory	BS	4	0	0	4	2	60	40	100	
9	BE23GE305	Engineering Practices Laboratory	ES	4	0	0	4	2	60	40	100	
	EMPLOYABILITY ENHANCEMENT											
10	BE23PT801	Human Excellence and Value Education -I	EEC	2	1	0	1	NC	100	-	100	
Total				30	17	2	11	23	510	490	1000	
SEMESTER II												
	THEORY											
1	BE23EN102	Communicative English-II	HS	2	1	1	0	2	40	60	100	
2	BE23MA202	Vector Calculus and Numerical Methods	BS	3	2	1	0	3	40	60	100	
3	BE23GE302	Engineering Graphics and Building Drawings	ES	5	1	0	4	3	40	60	100	
4	BE23ME401	Engineering Mechanics	PC	3	2	1	0	3	40	60	100	
5	BE23MC902	Tamils and Technology	MC	1	1	0	0	1	40	60	100	
6	BE23MC903	Universal Human Values and Ethics	MC	3	2	1	0	3	40	60	100	
	THEORY CUM PRACTICAL											
7	BE23GE308	Programming in Python	ES	5	3	0	2	4	50	50	100	
8	BE23EE311	Electrical Machines and Controls	ES	5	3	0	2	4	50	50	100	
	EMPLOYABILITY ENHANCEMENT											
9	BE23PT802	Human Excellence and Value Education -II	EEC	2	1	0	1	NC	100	-	100	
10	BE23PT804	Engineering Clinic-I	EEC	2	0	0	2	1	100	-	100	
11	BE23PT806	Aptitude Skills-I	EEC	1	0	0	1	0.5	100	-	100	
Total				32	16	4	12	24.5	640	460	1100	

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B.E. MECHANICAL ENGINEERING											
Courses of Study and Scheme of Assessment (Regulations 2023)											
Sl. No.	Course Code	Course Title	Periods / Week						Maximum Marks		
			CAT	CP	L	T	P	C	IA	ESE	Total
SEMESTER III											
	THEORY										
1	BE23MA204	Transforms and Partial Differential Equations	BS	3	2	1	0	3	40	60	100
2	BE23ME402	Thermodynamics	PC	3	2	1	0	3	40	60	100
3	BE23ME403	Materials Science and Metallurgy	PC	3	2.5	0.5	0	3	40	60	100
4	BE23ME404	Production Technology	PC	3	2.5	0.5	0	3	40	60	100
	THEORY CUM PRACTICAL										
5	BE23CS310	Fundamentals of Data Structures and Database	ES	5	2	1	2	4	50	50	100
6	BE23ME405	Fluid Mechanics and Machinery	PC	5	2	1	2	4	50	50	100
	PRACTICAL										
7	BE23EN103	Professional Communication Laboratory-I	HS	2	0	0	2	1	60	40	100
8	BE23ME406	Production Technology and Quality Control Laboratory	PC	4	0	0	4	2	60	40	100
	EMPLOYABILITY ENHANCEMENT										
9	BE23PT805	Engineering Clinic-II	EEC	2	0	0	2	1	100	-	100
10	BE23PT807	Aptitude Skills-II	EEC	1	0	0	1	0.5	100	-	100
		Total		**31**	**13**	**5**	**13**	**24.5**	**580**	**420**	**1000**

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SYLLABUS

SEMESTER – III

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BE23MA204	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	CP	L	T	P	C
		3	2	1	0	3
Programme & Branch	Common to B.E.(MECH) and B.E.(CIVIL)	Version 1.0				

Use of Calculator - fx991ms is Permitted

Course Objectives

1.	To familiarize individuals with the core concepts of Partial Differential Equations and facilitate the resolution of standard partial differential equations.
2.	To study the concepts of Fourier series and Boundary conditions, which will help them to model and analyze the physical attributes.
3.	To acquaint students with Fourier Series techniques for solving heat flow problems in various situations.
4.	To understand the methodologies involved in Fourier Transform.
5.	To learn the concepts of Z- transform and inverse Z-transform.

INTRODUCTION (Not for Examination) — 2

Importance:

PDEs involve partial derivatives with respect to multiple variables and can describe physical phenomena such as heat conduction, fluid flow, and wave propagation. Fourier transforms are fundamental in signal processing, as they convert signals between the time and frequency domains.

Real-life Example:

Fluid Dynamics-Heat Transfer – Structural Mechanics- Optimize the control of dynamic systems.

Linkages:

Pre-requisite: Calculus for Engineers.

Future courses: Heat and Mass Transfer, Engineering Thermodynamics, Fluid Mechanics, Structural Dynamics, Strength of Materials.

UNIT–I	PARTIAL DIFFERENTIAL EQUATIONS	6+3

Formation of Partial Differential Equations (L2) – Solutions of Standard Types of First Order Partial Differential Equations (F(p,q)=0 & Clairaut's Form) (L3) – Lagrange's Linear Equation (L3) – Linear Partial Differential Equations of Second and Higher order With Constant Coefficients of Homogeneous Types (L3).

UNIT–II	FOURIER SERIES	6+3

Dirichlet's Conditions (L1) – General Fourier Series (L3) – Odd and Even Functions (L3) – Half Range Sine Series and Cosine Series (L3) – Root Mean Square Value (L2) – Parseval's Identity (L3) – Harmonic Analysis(L3).

UNIT– III	APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS	6+3

Classification of PDE (L2) – Fourier Series Solution of One-Dimensional Wave Equation (L3) – One Dimensional Equation of Heat Conduction (L3).

UNIT – IV	FOURIER TRANSFORMS	6+3

Statement of Fourier Integral Theorem (L1) – Fourier Transform Pair (L2) – Fourier Sine and Cosine Transforms (L3) – Properties (L2) –Transforms of Simple Functions (L3) – Convolution Theorem(L3) – Parseval's Identity (L3).

UNIT–V	Z - TRANSFORMS AND DIFFERENCE EQUATIONS	6+3

Z-Transforms(L1) – Elementary Properties (L2) – Initial and Final Value Theorems (L3) – Inverse Z Transform Using Partial Fraction (L3) - Convolution Theorem (L3) – Formation of Difference Equations(L2) – Solution of Difference Equations Using Z Transforms (L3).

Total: 47 Periods

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	OPEN-ENDED PROBLEMS / QUESTIONS	
Course specific Open Ended Problems will be solved during the classroom teaching. Such problems can be given as Assignments and evaluated as Internal Assessment only and not for the End semester Examinations.		
Course Outcomes: Upon completion of this course, the students will be able to		**BLOOM'S Taxonomy**
CO1	Solve the Partial Differential Equations in Engineering Problems.	L3 – Apply
CO2	Apply Fourier Series analysis to solve the Differential Equations, given its significant importance in Engineering Applications.	L3 - Apply
CO3	Utilizing Fourier series approaches in the solution of one-dimensional wave equations.	L3 - Apply
CO4	Utilize the Mathematical concepts of Fourier Transform to address Engineering Challenges.	L3 - Apply
CO5	Apply the Z Transforms to resolve Difference Equations that occur within Discrete Time Systems.	L3 - Apply

TEXTBOOKS:

1.	R.K. Jain, S.R.K. Iyengar, "Advanced Engineering Mathematics", Fifth Edition, Narosa Publishing House, New Delhi, 2020.
2.	Kreyzig E., "Advanced Engineering Mathematics", Tenth Edition, John Wiley and sons, 2020.

REFERENCE BOOKS:

1.	Srimanta pal, Subodh Chandra Bhunia., "Engineering Mathematics", First Edition, Oxford University Press, 2015.
2.	T. Veerarajan, "Transforms and Partial Differential Equations", Third Edition, McGraw hill Education, New Delhi, 2016.
3.	Glyn James, "Advanced Engineering Mathematics", Fourth Edition, Pearson Education, 2010.

WEB REFERENCES:

	Publisher	Website link	Type of Content
1.	IJAERS	https://www.researchgate.net/publication/350973707_A_study_about_Fourier_series_Mathematical_and_graphical_models_and_application_in_electric_current_and_square_Oscillations.	Journal
2.	IJACSA	https://www.researchgate.net/publication/339020331_Towards_an_Improvement_of_Fourier_Transform.	Journal

VIDEO REFERENCES

	Video Details	Name of the Expert	Type of Content	Video Link
1.	NPTEL	Dr. Srinivasa Rao Manam, Department of Mathematics, IIT Madras	Lecture	https://onlinecourses.nptel.ac.in/noc24_ma85/preview
2.	NPTEL	G.K. Srinivasan, Department of Mathematics, IIT Bombay	Lecture	https://onlinecourses.nptel.ac.in/noc23_ma22/preview

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Mapping of COs with POs and PSOs															
COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1												
CO2	3	2		1											
CO3	3	2		1											
CO4	3	2			1										
CO5	3	2			1										
Avg.	**3**	**2**	1	1	1										
1-Low, 2 -Medium, 3-High.															

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BE23ME402	THERMODYNAMICS	CP	L	T	P	C
		3	2	1	0	3
Programme & Branch	B.E. - MECHANICAL ENGINEERING	Version: 1.0				

Use of the Steam Table, Psychrometric Chart and Mollier Chart is permitted.

Course Objectives:

1.	To learn the concept of a thermodynamic system, the basic terms and definitions.
2.	To apply the concept of the first law of thermodynamics to closed systems and open systems.
3.	To determine principles of heat engines, refrigerators, heat pumps and entropy.
4.	To apply the properties of pure substances to analyze steam power cycles.
5.	To calculate the properties of air-vapor mixtures using psychometric chart.

INTRODUCTION: (Not for Examination)	**2**

Importance:

- Energy in Stored and Transient, Available forms Vs. Required forms - Need for Energy Conversion (one form to other) - Efficiency and Conversion- High grade and Low grade Energy Forms - Renewable and Non-Renewable - Sustainable and Eco-Friendly Energy Forms.
- Available Energy Forms – Energy Scenario (World, India, TN State) – 1900s, Present and Future Trends - Emissions or its impacts on World Environment.
- To convert disorganized form of energy (heat) into organized form of energy (work).

Real Life Examples:

- Air (Ideal gas) as Working fluid-based system: I.C Engines, Gas Turbine, Car, Bus, Aeroplane.
- Steam (Pure substance) as Working fluid-based system: Steam power plant, Nuclear power plant.
- Renewable energy-based systems: Hydroelectric power plant, Wind power plant, Solar (PV), Solar (Thermal), Geothermal, Wave, Tidal.
- Refrigeration & Air-Conditioning, Heat pumping with work input.

Linkages:

- **Pre-requisite:** Calculus for Engineers, Physics for Mechanical Engineers and Engineering Chemistry.
- **Future Courses:** Thermal Engineering, Heat and Mass Transfer, Renewable Energy Technologies, Power Plant Engineering, Energy Conversion System, Advanced I.C Engines, Refrigeration and Air Conditioning and Automobile Engineering.

UNIT–I	**BASIC CONCEPT OF THERMODYNAMICS**	**6+3**

Macroscopic Vs. Microscopic approach (L2) - SI units system (L2) – System concept - 3 types of equilibrium and Thermodynamic equilibrium (L2) - Properties, Property classification (L2) - Measured Vs. Derived, Intrinsic Vs. Extrinsic - Property diagram , Minimum No. of properties required to define state, Path, Process, Point function and Path function (L2) - Quasi-State process (L2)- Reversible and Irreversible Process (L2)- Thermodynamic cycle, need for Thermodynamic cycle (L2) - Concept of Heat and Thermodynamic work: Problem on displacement work and work forms(L3) - Heat and Work are not properties of system (L2) - Zeroth Law of Thermodynamics (L2) - Temperature and Temperature measurement (L2)- Temperature scales (Centigrade and Fahrenheit), Absolute Temperature scale (Kelvin and Rankine) (L2)- Working Fluid models: Ideal gas and Real gas (L2) - Internal energy, Specific heat (Cv and Cp) and enthalpy of ideal gas (L2)- Equation of state and law of corresponding

state (L2)- Thermodynamic properties of mixtures and Thermodynamics relations (concept only) (L1) - Thermodynamic properties of mixtures Problems (L3).

(Experiential Learning: Present the learning of any two-wheeler bike engine parts and specifications details).*

UNIT–II	FIRST LAW OF THERMODYNAMICS	6+3

First Law of Thermodynamics (L2) - Ideal gas as Working Fluid (L2) - Application of First Law to a closed system, Cycle and Process (L2) - ΔE as a property (Proof) (L2) - Basic Definition of Entropy (L1) - Application of First Law of Thermodynamics for a closed system (with ideal gas as working fluid) (L2)- Five basic processes: Constant Volume (V=C), Constant Pressure (P=C), Constant Temperature (T=C), Adiabatic Process ($Pv^{\gamma}=C$) and Polytropic Process ($Pv^{n}=C$) for each process (Definition, Process on pV, Ts, pVT relation, Index n =? , ΔU,ΔH,W,Q and ΔS) Derivations and Problems (L3)- Open System: Steady Flow Energy Equation (SFEE) Applications: Nozzle, Heat Exchanger, Pump, Turbine and Boiler Derivation and Problem (L3) – Throttling process and Free expansion (L1) - Unsteady Flow Process (L2).

UNIT–III	SECOND LAW OF THERMODYNAMICS AND ENTROPY	6+3

Limitations of First Law (L1) – Kelvin-Plank and Clausius statement (L1) – Heat Engines (L2) - Refrigerators (L2) - Heat Pumps (L2) - Efficiency and COP (L2) - Problems on Heat Engine and Heat Pump (L3) - Carnot cycle derivation and problems (L3) - Clausius Inequality (L3) – Entropy as properties of a system (L2) - Entropy change in reversible process (L2) - Principle of increase in entropy (L2) - Reversibility and Irreversibility (L2) – Applications: Mixing and Quenching operation Problems only (L3)- Concept of available energy and unavailable energy (L2).

UNIT–IV	PROPERTIES OF STEAM AND VAPOUR POWER CYCLE	6+3

Properties of pure substance (L2) - Solid(S) , Liquid(L) and Vapour(V) regions , Major operation in L , L+V , V regions (L2) - Tabulated properties of pure substance (Steam and Refrigerant) (L2) - Ps, Ts, hf, hg, hfg, sf, sg, cpl, cpv (L2) - Calculations of properties at five states: Sub cooled liquid, Saturated liquid, Wet vapour, Saturated vapour, Superheated vapour (L3)- Diagrams of p-v, p-T, T-v, h-s , pvT surfaces (L2) - Ideal and Actual Rankine cycles (L2) - Cycle improvements methods (L2) - Reheat and Regenerative cycles Problems (L3) - Comparison between Rankine and Carnot cycle (L2).

UNIT–V	PSYCHROMETRY	6+3

Psychrometry (L1) - Psychrometric properties (L1) - Psychrometric chart (L2) - Property calculations of air - water vapour mixtures by using chart and expressions(L3) - Psychrometric processes : Adiabatic saturation, Sensible heating and cooling, Humidification, Dehumidification, Evaporative cooling and Adiabatic mixing (L3) - Simple AC system layout (L2) - Concept of SHL, RHL, SHF and BF (L2) - Simple Psychrometric Application Problems (L3).

(Experiential Learning: Explore how hands-on experience in maintaining and repairing air conditioning systems enhances the development of technical skills).*

	OPEN ENDED PROBLEMS / QUESTIONS	

Course specific Open Ended Problems will be solved during the class room teaching. Such problems can be given as assignments and evaluated as Internal Assessment only and not for the End Semester Examinations.

Total: 47 Periods

**Experiential learning part is not considered for Internal Assessment Tests (IATs) and End Semester Examinations (ESEs).*

Course Outcomes: Upon completion of this course the students will be able to:		BLOOM'S Taxonomy
CO1	Understand the thermodynamic properties of the system and the concepts of ideal and real gas.	L2 - Understand
CO2	Apply the first law of thermodynamics to closed systems and open systems.	L3 - Apply
CO3	Apply the second law of thermodynamics and the entropy principle to thermodynamic processes and Heat engines, Heat pumps and refrigerators.	L3 - Apply
CO4	Determine the thermodynamic properties of pure substances in the analysis of steam power cycles.	L3 - Apply
CO5	Apply their knowledge of psychrometry to solve simple application problems involving the calculation of psychrometric properties and the analysis of psychrometric processes.	L3 - Apply

TEXTBOOKS:

1.	R.K. Rajput, "A Text Book of Engineering Thermodynamics ", 6th Edition Laxmi Publications Pvt., Ltd., 2023.
2.	P.Chattopadhya, "Engineering Thermodynamics", Oxford university press, New Delhi, 2016.

REFERENCE BOOKS:

1.	Yunus a. Cengel & Michael a. Boles, "Thermodynamics", 9th edition , Tata McGraw-Hill, New Delhi, 2019.
2.	Holman.J. P, "Thermodynamics", 10th Edition, Tata McGraw-Hill, New Delhi, 2017.
3.	Nag.P. K, "Engineering Thermodynamics", 6th Edition, Tata McGraw-Hill, New Delhi, 2017.

WEB REFERENCES:

	Publisher	Website link	Type of Content
1.	DerğiPark	https://dergipark.org.tr/en/pub/ijot	International Journal.
2.	NSIT – National Institute of Science and Technology.	https://www.nist.gov/thermodynamics	NSIT – National Institute of Science and Technology. USA.
3.	PennState Extension	https://extension.psu.edu/psychrometric-chart-use	Psychrometric Chart Use.

VIDEO REFERENCES:

	Video Details	Name of the Expert	Type of Content	Video link
1.	Basic of Thermodynamics	Prof.S.K. Som, Department of Mechanical Engineering, IIT Kharagpur	Online course	https://onlinecourses.nptel.ac.in/noc20_ae09/preview
2.	Mechanical - Basic Thermodynamics	Prof.S.K. Som, Department of Mechanical Engineering, IIT Kharagpur	Lecture Series	https://www.youtube.com/watch?v=9GMBpZZtjXM&list=PLD8E646BAB3366BC8
3.	Introduction to Thermodynamics	Roger Rangel, Ph.D. University of California.	Lecture Series	https://www.youtube.com/watch?v=rvZZYeouz_I

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Mapping of COs with POs and PSOs															
COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1										1	2
CO2	3	3	2	1					1	1	1	1		1	2
CO3	3	3	2	1										1	2
CO4	3	3	2	1		1	1		1	1	1	1		1	2
CO5	3	3	2	1		1	1		1	1	1	1		1	2
Average	3	3	2	1		1	1		1	1	1	1		1	2
1–Low, 2 –Medium, 3–High															

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BE23ME403	MATERIALS SCIENCE AND METALLURGY	CP	L	T	P	C
		3	2.5	0.5	0	3
Programme & Branch	B.E.- MECHANICAL ENGINEERING	Version: 1.0				

Course Objectives:

1.	To develop an understanding of the relationships between the structure and properties of materials for engineering applications.
2.	To explore new and advanced materials.
3.	To learn the material selection, principles and techniques of material testing methods.
4.	To understand the various types of heat treatment processes.
5.	To identify strategies for effective reuse and recycling.

INTRODUCTION (Not for Examination)	2

Importance:

- Mechanical Engineering - Engineering Design - Various Courses - Significance of Materials Science and Metallurgy.
- Overview of Materials Science and Metallurgy. Materials used in Automotive Industry – Materials used for making car parts - Main factors for selecting the materials – Recycling and Reuse.

Real Life Examples:

- Aerospace Industry- Automobile Industry -Electronics-Energy Sector- Consumer Goods.
- Medical Implants- Construction - Military and Defense.

Linkages:

- **Pre-requisite :** Physics for Mechanical Engineers
- **Future courses:** Production Technology- Strength of Materials for Mechanical Engineers- Finite Element Analysis- Sustainability Engineering- Automotive Materials and Additive Manufacturing.

UNIT–I	STRUCTURE AND PROPERTIES OF MATERIALS	8+2

Atomic Structure and Crystallography: Atomic structure and Bonding in materials (L1) - Crystal structures and Crystallography (L2) - Defects in crystals and their impact on properties (L2) - Phase diagrams and Phase transformations (L2).

Mechanical properties: Stress-Strain relationships (L2), Elasticity (L1), Plasticity (L1)- Thermal properties: Heat capacity (L1), Thermal expansion (L1), Conductivity (L1) - Electrical and Magnetic properties (L2)- Optical properties of materials (L2).

*(Experiential Learning: Analyze material behavior and properties using Ansys software)**

UNIT–II	ENGINEERING AND ADVANCED MATERIALS	7+2

Ferrous and Non-Ferrous Materials: Classifications, Properties and Applications of Steel, Cast iron, Aluminium and Magnesium alloys (L2) **- Polymers and Ceramics:** Structure, Properties and Applications (L2) **- Composite Materials:** Fabrication, Properties and Applications (L3).

Introduction to Emerging Materials: Structure, Properties and Applications of Nanomaterial, Smart Materials and Sustainable Materials (L2) (Aerospace, Automotive and Biomedical Fields).

*(Experiential Learning: Relate the usage of different materials in day to day applications)**

UNIT–III	MATERIAL SELECTION AND TESTING METHODS	8+1

Material Selection: Criteria for selecting materials for engineering applications (L2)- Considerations of Cost, Weight, Strength and Sustainability (L2) - Trade off analysis (L2) - Failure analysis: Modes of failure (L2) (Brittle, Fatigue and Creep), Techniques for analyzing material failures (L2)- case studies for Material failures in engineering projects (L3) - ASTM standards (L1).

Material Testing Methods: Tensile test (L2), Compressive test (L2), Hardness test (L2), Impact Test (L2) and Fatigue test (L2) - Nondestructive Testing(NDT) techniques (L2) (Ultrasonic and Radiography) - Corrosion and Oxidation: Types, Effects and Prevention methods (L2).

(*Experiential Learning: Test various materials using tensile test, hardness test and impact test using Strength of Materials laboratory)**

UNIT–IV	BEHAVIORS OF MATERIALS AND LIFE CYCLE ANALYSIS	8+1

The Effects of Casting, Welding, Forming (L2) (Rolling, Forging and Extrusion), Powder Metallurgy processes (L2) and Heat Treatment (Annealing, Normalizing, Quenching and Tempering) on behavior of materials (L2). Introduction to Life Cycle Analysis (LCA) (L2) - LCA tools and software (L2) - Standards and Guidelines for LCA (L2) - case studies and Industrial applications (L3).

UNIT–V	MATERIALS REUSE AND RECYCLING	7+1

Overview of the importance of reuse and recycling (L2) - Methods of recycling metals (Aluminum, Steel and Copper) (L2) - Challenges in metal recycling (L2) - Legal and Regulatory frameworks for recycling (L2) - Innovations and New Trends in recycling technology (L2) - Applications of recycled materials (L2) - case studies (L3).

TOTAL: 47 PERIODS

**Experiential learning part is not considered for Internal Assessment Tests (IATs) and End Semester Examinations (ESEs).*

OPEN ENDED PROBLEMS / QUESTIONS

Course specific Open Ended Problems will be solved during the class room teaching. Such problems can be given as assignments and evaluated as Internal Assessment only and not for the End Semester Examinations.

Course Outcomes: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Comprehend the atomic structure, phase diagrams and mechanical properties of materials.	L2 - Understand
CO2	Explain the properties and applications of advanced engineering materials.	L2 - Understand
CO3	Identify the key factors influencing material selection and testing.	L2 - Understand
CO4	Apply knowledge of material behaviour and life cycle analysis to real world engineering applications.	L3 - Apply
CO5	Apply the understanding of recycling principles and technologies to solve practical engineering problems.	L3 - Apply

TEXTBOOKS:

1.	Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", 9th edition, Prentice Hall of India Private Limited, 2018.
2.	William D. Callister, "Materials Science and Engineering an Introduction", 10th edition, Jr, John Wiley & Sons, Inc. 2018.

REFERENCE BOOKS:	
1.	Gorge E. Dieter, "Mechanical Metallurgy", 3rd edition, McGraw-Hill, 2017.
2.	Sydney H.Avner, "Introduction to Physical Metallurgy", McGraw Hill Book Company, 1997
3.	Michael F. Ashby, "Materials Selection in Mechanical Design", 5th edition, Elsevier Ltd, 2017.

WEB REFERENCES:

	Publisher	Website link	Type of Content
1.	COURSERA	https://www.coursera.org/courses?query=material%20science	Course
2.	TMS Career Resource Center	http://www.istl.org/02-spring/internet.html#polymers	Web Content
3.	CORVUS FERRUM	https://www.dierk-raabe.com/useful-links/	Web Content

VIDEO REFERENCES:

	Video Details	Name of the Expert	Type of Content	Video link
1.	NPTEL	Prof.Rajesh Prasad Department of Applied Mechanics, IIT,Delhi.	Real -time applications	https://www.youtube.com/watch?v=KMcsjCXfLQw&list=PLyAZSyX8Qy5Am_2StOOQ5vCUE3VIcAenE
2.	YouTube	UBC Engineering	Real -time applications	https://youtu.be/aBSam0Jjrx0
3.	YouTube	Zach Star	Overview of Materials Science	https://youtu.be/x5OD2KZXd54

Mapping of COs with POs and PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2				1		1	1		2			
CO2	3	2	2	1		1	1	1				2	1		1
CO3	3	2	2	2	2	1	1		1	1		2			1
CO4	3	2	2	2	2	1	2	1	1	1		2			1
CO5	3	2	2	2	2	2	2	1	1	1		2			-
Average	3	2	2	1.8	2	1.3	1.4	1	1	1		2	1		1

1–Low, 2 –Medium, 3–High

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BE23ME404	PRODUCTION TECHNOLOGY	CP	L	T	P	C
		3	2.5	0.5	0	3
Programme & Branch	B.E. - MECHANICAL ENGINEERING	Version: 1.0				

Course Objectives:

1.	To illustrate the working principles of various metal casting processes and forming processes.
2.	To learn the working principles of various metal joining processes.
3.	To learn the basics of machine tools with reciprocating and rotating motions.
4.	To develop CNC codes for simple components.
5.	To classify Non-Traditional machining processes and describe Mechanical and Electrical Energy.

INTRODUCTION: (Not for Examination) — **2**

Importance:

- Mechanical Engineering – Production Technology - Various Courses – Significance of Production Technology.
- Overview of Production Technology – Understanding manufacturing processes - Efficiency improvement – Quality assurance – Safety and Sustainability – Career opportunities.

Real Life Examples:

- Automotive Industries - Aerospace Industries - Ship Building - Railway Industry- Energy Sector - Tool and Die Making - Robotics and Automation.
- Electronics Industry - Medical Industry.

Linkages:

Future courses: Industrial Engineering- Additive Manufacturing- Industry 4.0- Robotics and Automation.

UNIT–I | **METAL CASTING AND FORMING PROCESSES** | **7+2**

Introduction to metal casting (L1) – Types of casting processes (L1) – Pattern**:** Types of pattern and allowances (L2) - Moulding sand properties (L2) –Sand casting defects (L2) Special casting processes: CO_2 and Shell moulding (L2) - Investment casting(L2) - Die casting(L2) - Inspection and Casting defects(L2) – Industrial applications of metal casting(L2) – Introduction to metal forming (L1) - Classification of Forging and Rolling operations (L1) - Open Die Forging and Closed Die Forging (L2) - Hot Rolling and Cold Rolling (L2) - Defects in Rolled and Forged components (L2) - Extrusion process (L2) - Classification of Wire and Tube Drawing processes (L2) - Industrial applications of metal forming (L2) – case studies (L3).

*(Experiential Learning: Make sand moulding using simple pattern)**

UNIT–II | **WELDING PROCESSES** | **5+2**

Introduction (L1) - Types of welding (L2) - Gas welding (L2) - Arc welding (L2) - Shielded Metal Arc Welding (GTAW – GMAW) (L2) – Resistance welding (L2) - Thermit welding (L2) - Safety aspects in welding (L2) - Electron Beam and Laser Beam welding (L2) - Plasma Arc welding (L2) - Friction welding (L2) - Ultrasonic welding (L2) - Underwater welding (L2) - Welding of plastics (L2) - Welding Robots (L2) - Industrial applications (L2) - case studies (L3).

UNIT–III | **MACHINING OPERATIONS AND MACHINE TOOLS** | **7+2**

Introduction (L1) -Types of surfaces (L1) – Degrees of freedom of machines (L2) - Lathe machine and operations (L2) - Taper turning methods (L2) - Single point cutting tool nomenclature (L2) - Shaper machine and operations (L2) - Planer machine and operations (L2) - Drilling machine and operations (L2) - Machine tool characteristics (L2) – Forces acting on machine tools (L2) - Cutting tool materials (L1) - Cutting tool wear (L2) - Cutting tool life problems (L3) - applications (L2) - case studies(L3).

*(Experiential Learning: Make simple component covering different operation using lathe)**

UNIT–IV	CNC PROGRAMMING AND SMART MANUFACTURING	9+2
Introduction (L1) - Different types of CNC machines (L2) - Constructional features (L2) - Drives and Control systems (L2) – accessories (L1) – feedback devices (L2) - Manual part programming (L3) - Special functions (L2) - Canned cycles (L2) - Intelligent Manufacturing (Industry 4.0) (L2) - Cyber Physical Systems (CPS) (L2) - case studies (L2). *(Experiential Learning: Make simple component covering different operation using CNC machine)**		
UNIT–V	**UNCONVENTIONAL MACHINING PROCESSES**	**7+2**
Mechanical Energy (L1) – Abrasive Jet Machining (AJM) (L2) - Electrical Energy (L2) – Electrical Discharge Machining (EDM) (L2) - Laser Beam Machining (LBM) (L2) - 3D Printing (L2) – Stereolithography (SLA) (L2) - Selective Laser Sintering (SLS) (L2) - Fused Deposition Modeling (FDM) (L2) - Process parameters and application considerations (L2) - Industrial applications (L2) - case studies (L3). *(Experiential Learning: Demonstrate 3D printing models)**		
		Total: 47 PERIODS
**Experiential learning part is not considered for Internal Assessment Tests (IATs) and End Semester Examinations (ESEs).*		
	OPEN ENDED PROBLEMS / QUESTIONS	
Course specific Open Ended Problems will be solved during the class room teaching. Such problems can be given as assignments and evaluated as Internal Assessment only and not for the End Semester Examinations.		

Course Outcomes: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Explain the working principles of casting and forming processes.	L2 – Understand
CO2	Understand the principles of various welding process in industry.	L2 – Understand
CO3	Understand the various machine operations and machine tools.	L2 – Understand
CO4	Apply manual part programming skills to create simple program for CNC Machines.	L3- Apply
CO5	Apply the advanced manufacturing processes for the industry.	L3- Apply
TEXTBOOKS:		
1.	Kalpakjian. S, "Manufacturing Engineering and Technology", 7th edition, Pearson Education India,2023.	
2.	Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd., 2021.	
REFERENCE BOOKS:		
1.	Roy. A. Lindberg, "Processes and materials of manufacture", PHI / Pearson education, 2006.	
2.	M. C. Shaw, "Metal Cutting Principles", 2nd edition, Oxford University Press, 2005.	
3.	M. P. Groover, "Fundamentals of Modern Manufacturing, Materials, Processes and Systems" ,2nd edition, Wiley India, Reprint 2007.	

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WEB REFERENCES:

	Publisher	Website link	Type of Content
1.	CRC Press – Taylor and Francis Group	https://www.routledge.com/production-Technology/book-series/CRCADVMATSCI	Miniaturized Testing of Engineering Materials
2.	efunda – engineering fundementals	https://www.efunda.com/processes/processes_home/process .cfm	Forming, Moulding, Casing,CNC

VIDEO REFERENCES:

	Video Details	Name of the Expert	Type of Content	Video link
1.	NPTEL Video Course: Fundamentals of Manufacturing Process	Prof.D.K. Dwivedi, Department of Mechanical Engineering, IIT Roorkee	Online Course	https://archive.nptel.ac.in/courses/112/107/112107219/
2.	Principles of Casting Technology	Prof.Pradeep K. Jha Department of Mechanical Engineering, IIT Roorkee	Online Course	https://archive.nptel.ac.in/courses/112/107/112107215/
3.	Scope, Challenges, Focus and History of Casting Process	Dr. D. B. Karunakar, Dr. Pradeep Kumar Department of Mechanical Engineering, IIT Roorkee	Online Course	https://nptel.ac.in/courses/112107084

Mapping of COs with POs and PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	1	1			1	1		1			2
CO2	3	1	1	1	1	1			1	2	2	1			2
CO3	3	1			1	1	1					1			3
CO4	3	2			2	2	1	1		1		1	2		2
CO5	3	1			2	1		1	1			1	2		2
Average	**3**	**1.2**	**1**	**1.5**	**1.5**	**1.2**	**1**	**1**	**1**	**1.3**	**2**	**1**	**2**		**2.2**

1–Low, 2 –Medium, 3–High

BE23CS310	FUNDAMENTALS OF DATA STRUCTURES AND DATABASE	CP	L	T	P	C
		5	2	1	2	4
Programme & Branch	Common to B.E.(EEE, ECE, MECH and CIVIL)	Version: 1.0				

Course Objectives:

1.	To understand the concepts of ADTs and to learn linear data structure - list ADT.
2.	To learn linear data structures - stacks, and queues.
3.	To understand nonlinear data structures - trees and graphs.
4.	To learn the fundamentals of database system, relational database and ER Model.
5.	To understand the basic concepts of SQL database, SQL comments and normalizations.

INTRODUCTION (Not for Examination) — 2

Importance of Data Structures:

Efficiency in Data Management - Performance Optimization - Real World Applications - Competitive Programming and Contest and Problem-Solving Skills.

Importance of Database:

Databases are the technique of storing, maintaining and accessing any sort of data. They collect information on people, places or things. It provides organizations a complete, clear view into the way data is shared and ensuring there aren't unnecessary copies of data.

Real-life Examples:

Arrays: Online Shopping Carts - Linked Lists: Music Playlists - Stacks: Web Browser History - Queues: Customer Service Systems - Trees: File Systems - Graphs: Social Networks and Google Map - Mark sheet generation – EB bill - Library Management System – Banking System.

Linkages:

Pre-requisite: Problem Solving using C Programming.

Future courses: Coding Skills – I, Coding Skills – II.

UNIT–I	DATA STRUCTURES TYPES AND LIST ADT	6+3

Data Structure – Types(L1), Abstract Data Types (ADTs)(L1) - **List ADT:** Array implementation of List ADT and Linked List implementation of List ADT(L3) - Singly linked lists(L3) - Circularly Singly linked lists(L3) - Doubly linked lists(L3).

UNIT–II	LINEAR DATA STRUCTURES (STACK AND QUEUE)	6+3

Stack ADT: Operations - Array and Linked List implementation(L2) - **Applications:** Expression Evaluation - Infix to Postfix conversion(L3) - Evaluation of Postfix Expression(L3) - **Queue ADT:** Operations - Array and Linked List implementation(L3) - Circular Queue(L2).

UNIT– III	NON LINEAR DATA STRUCTURES (TREES AND GRAPHS)	6+3

Tree ADT: Tree Definition(L1) - Tree terminologies(L2), General tree and Binary Tree(L2) - Tree traversal(L3) - Expression tree(L3) - Binary Search Tree(L3) - **Graph ADT:** Graph Definition(L1) - Graph terminologies(L2), Representation of Graphs(L2) - Graph traversal(L3) - **Shortest Path algorithms:** Dijkstra's algorithms(L3) - **Minimum Spanning Tree:** Prim's and Kruskal's algorithms(L3).

UNIT – IV	INTRODUCTION TO DATABASE SYSTEM	4+3

Database System: Definition and Purpose of Database System(L2) - Views of data(L2) - Data Models(L2) - Database System Architecture(L2) - **Introduction to relational databases:** Relational Model(L2) - Relational Algebra(L3) - **Entity Relationship model:** ER Diagrams(L3).

UNIT–V	FUNDAMENTALS OF MySQL and SQL	8+3

MySQL: Introduction to MySQL(L2) - Environmental Setup(L2) **SQL:** Introduction to SQL(L2) - Process of SQL(L2) - Advantages and Disadvantages of SQL(L2) - SQL Syntax(L2) - SQL Data

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Types(L2) - SQL Operators(L2) – Keys(L2) **SQL Commands:** DDL(L3), DML(L3), DCL(L3), TCL(L3), DQL(L3) - Normalizations(L3) - Joins(L3) - Sub queries(L3) - Aggregate Functions(L3).	
	Total (LT) : 47 Periods
LIST OF EXPERIMENTS/EXERCISES:	
1.	Implement array and pointer based list.
2.	Implement array and pointer based stack.
3.	Implement array and pointer based queue.
4.	Implement binary tree traversals.
5.	Implement Shortest path and Minimum Spanning Tree algorithm.
6.	Implementation of DDL commands of SQL for the following operations. • Create table • Alter table • Drop Table
7.	Implementation of DML commands of SQL for the following operations. • Insert • Update • Delete
8.	Implementation of different types of operators in SQL. • Arithmetic Operators • Logical Operators • Comparison Operator • Special Operator • Set Operation
	Total (P) : 30 Periods
	Total (LT+P) : 77 Periods

	OPEN-ENDED PROBLEMS / QUESTIONS	
Course specific Open Ended Problems will be solved during the classroom teaching. Such problems can be given as Assignments and evaluated as Internal Assessment only and not for the End semester Examinations.		
Course Outcomes: **Upon completion of this course, the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Implement linear data structure operations using List.	**L3 - Apply**
CO2	Use stack and queue data structure operations for solving a given problem.	**L3 - Apply**
CO3	Use appropriate non-linear data structure operations for solving a given problem.	**L3 - Apply**
CO4	Construct queries using relational algebra.	**L3 - Apply**
CO5	Apply SQL queries to handle SQL database.	**L3 - Apply**

TEXTBOOKS:	
1.	Reema Thareja, "Data Structures Using C", Third Edition, Oxford University Press, 2023.
2.	Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", 9th Edition, McGraw Hill, 2022.

REFERENCE BOOKS:	
1.	Ritika Mehra, "Data Structures using C", 1st Edition, Pearson Education, 2021.
2.	Langsam, Augenstein and Tanenbaum, "Data Structures Using C and C++", 4th Edition, Pearson Education, 2022.
3.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Fourth Edition, Mcgraw Hill/ MIT Press, 2022.
4.	Alfred V. Aho, Jeffrey D. Ullman,John E. Hopcroft, "Data Structures and Algorithms", 4th edition, Pearson, 2020.
5.	Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", 8th Edition, Pearson Education, 2020.

WEB REFERENCES:

	Publisher	Website link	Type of Content
1.	Tutorialspoint	https://www.tutorialspoint.com/dsa_using_c/dsa_using_c_useful_resources.htm	Online Course
2.	Hackerrank	https://www.hackerrank.com/domains/datastructures	Online Course
3.	Geeksforgeeks	https://www.geeksforgeeks.org/introductionofdbmsdatabasemanagementsystemset1/	Online Course

VIDEO REFERENCES:

	Video Details	Name of the Expert	Type of Content	Video Link
1.	YouTube	K.Ravikumar	Lecture	https://www.youtube.com/@reachtutorravi3115
2.	YouTube	Jenny's Lectures	Lecture	https://www.mygreatlearning.com/academy/learnforfree/courses/datastructures inc
3.	NPTEL	Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay	Lecture	https://onlinecourses.nptel.ac.in/noc22_cs91/preview

Mapping of COs with POs and PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1				1			2	3	1	1
CO2	3	2	2	1	1				1			2	3	1	1
CO3	3	2	2	1	1	1			1			2	3	1	1
CO4	2	2	2	1	2	1						1	1		
CO5	2	2	2	1	2	1						1			
Avg.	**2.6**	**2.0**	**2.0**	**1.0**	**1.4**	**1.0**			**1.0**			**1.6**	**2.5**	**1.0**	**1.0**

1–Low, 2 –Medium, 3–High.

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BE23ME405	FLUID MECHANICS AND MACHINERY	CP	L	T	P	C
		5	2	1	2	4
Programme & Branch	B.E.- MECHANICAL ENGINEERING	Version: 1.0				

Course Objectives:

1.	To understand basic properties of fluids and to learn fluid statics.
2.	To learn fluid kinematics and dynamics.
3.	To study about the importance of boundary layer and to understand losses in flow.
4.	To use dimensional analysis to facilitate the conversion of units.
5.	To explain the fundamental concepts, an operation of fluid machines.

INTRODUCTION (Not for Examination) — **2**

Importance:

- Fluid Physics - Units and Dimensions- Natural source of energy- Environmental energy conservation-Concepts of Newton Law of viscosity- Hydrostatic Law- Head loss.
- Boundary layer concepts-Prototypes and Similitude - Principles of Turbo machinery.

Real Life Examples:

- Power Plant: Power generation in hydropower plants.
- Aerospace: Calculating forces and movements on aircraft.
- Architecture: Force calculation for wind resistance in building design.
- Oil Refinery: Determining the friction losses and Mass flow rate of gasoline through pipelines.
- Industrial Pump: Calculating discharge of water.

Linkages:

- **Pre-requisite :** Engineering calculus and differential equations
- **Future Courses :** Thermal Engineering-Heat and Mass Transfer-Fluid Power System-Power Plant Engineering-Renewable Energy Engineering-Computational Fluid Dynamics.

UNIT–I	INTRODUCTORY CONCEPTS OF FLUID PROPERTIES	6+3

Density(L1)-Pressure(L1)-Thermodynamics variables(L1)-Newton Law of viscosity(L1)- Viscosity(L2) - Water as reference fluid(L1)– Compressibility(L1)- Surface tension(L3)– Capillarity(L3)- Vapor pressure(L1)-Pascal's Law (L1)-Hydro Static Law (L1) - Single tube manometer (L3)-U Tube manometer (L3)-Differential manometer(L3)- Buoyancy(L2).

UNIT – II	FLUID KINEMATICS AND DYNAMICS	6+3

Fluid flow (L1) - Types of fluid flow(L1) - Continuity equation-Euler's equation of motion(L3)-Bernoulli's equation (L3)- and its applications (L1)- Flow through confined passage(L1) - Navier Stroke equation of motion (L2)- Energy equation(L2).

UNIT–III	BOUNDARY LAYER AND FLOW THROUGH PIPES	6+3

Boundary Layer development (L1) - Lift (L1) – Drag (L1)-Flow over a flat plate (L2) - Flow over circular cylinder-(L2) Flow over an Aero foil (L1)-Friction loss (L3)-Minor losses (L3) - Energy Gradient Line (L2) - Hydraulic Gradient Line (L2) - Pipe in series and parallel (L3).

*(Experiential learning: Apply Computational Fluid Dynamics (CFD) software to simulate the behavior of fluid flow in different boundary conditions.)**

UNIT – IV	DIMENSION ANALYSIS AND SIMILITUDE	6+3
Introduction (L1)-Dimensions of physical quantities (L1)-Dimensional homogeneity (L2)-Buckingham's Π theorem (L3)-Importance of dimensionless number (L1) – Applications of dimensional method (L1)-Similitude (L3) - Distorted and Undistorted Models (L1).		
UNIT–V	**FLUID MACHINES**	**6+3**
Classifications on the general features(L1)-Specific speed(L1)-Energy transfer (L1) - Impulse and Reaction principle(L1)- Centrifugal pump(L3)- Efficiency(L1)-Performance(L2)- Reciprocating pump(L3) - Classification (L1)- Working principles(L2) - Indicator Diagram(L2)-Impulse turbine (L1) -Pelton wheel (L3) - Reaction turbine (L1) - Francis (L3) - Kaplan turbine (L3) - Draft tube (L1)- Cavitation phenomena(L1).		
TOTAL(LT): 47 PERIODS		
**Experiential learning part is not considered for Internal Assessment Tests (IATs) and End Semester Examinations (ESEs).*		

LIST OF EXPERIMENTS/EXCERCISES:	
1.	To determine the metacentric height of a floating body.
2.	To calibrate a flow measurement of discharge, venturi meter, nozzle or orifice meter.
3.	To determine the head losses in pipe transition in relation to the velocity head of the fluid.
4.	To determine the performance characteristics of a centrifugal pump.
5.	To determine the performance characteristics of reaction turbine.
	Total(P): 30 PERIODS
	TOTAL(LT+P): 77 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS
Course specific Open Ended Problems will be solved during the class room teaching. Such problems can be given as assignments and evaluated as Internal Assessment only and not for the End Semester Examinations.

Course Outcomes: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Understand the properties and behaviors of fluid in static condition.	L2 - Understand
CO2	Calculate the discharge of fluid flow by using a Venturi Meter, Nozzle and Orifice Meter as measurement tools.	L3 - Apply
CO3	Calculate major losses and minor losses of fluids in flow through pipes.	L3 - Apply
CO4	Apply the Buckingham Π Theorem for problem-solving in engineering applications involving fluid phenomena.	L3 - Apply
CO5	Design appropriate centrifugal pumps and turbines for specific applications.	L3 - Apply

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TEXTBOOKS:	
1.	Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House (p) Ltd. New Delhi, 2016.
2.	R.K.Bansal., "Fluid Mechanics and Hydraulic Machines", Laxmi Publication (p) Ltd, 2019.
REFERENCE BOOKS:	
1.	Cengel Y A and Cimbala J M, "Fluid Mechanics", McGraw Hill Education Pvt. Ltd., 2014.
2.	S K Som; Gautam Biswas and S Chakraborty,"Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill Education Pvt. Ltd., 2012.
3.	Pani B S, "Fluid Mechanics: A Concise Introduction", Prentice Hall of India Private Ltd, 2016.

WEB REFERENCES:

	Publisher	Website link	Type of Content
1.	Jousef Murad	https://www.coursera.org/projects/computational-fluid-mechanics-airflow-around-a-spoiler-uktyf	Computational Fluid Mechanics Airflow Around a Spoiler.
2.	Gaikwad Shraddhey	https://medium.com/@shraddhey.gaikwad21/fluid-mechanics-in-everyday-life-73ce45c09875	Fluid Mechanics in Everyday Life.
3.	Xavier Amandolese	https://www.coursera.org/learn/fluid-solid-interaction	Fundamentals of Fluid-Solid Interactions.

VIDEO REFERENCES:

	Video Details	Name of the Expert	Type of Content	Video link
1.	NPTEL	Prof. Shamit Bakshi Prof. Dhiman Chatterjee	Lecture	https://archive.nptel.ac.in/courses/112/104/112104118/
2.	NPTEL	Prof.Chak	Lecture	https://archive.nptel.ac.in/courses/112/105/112105269/
3.	NPTEL	Prof.S.K.Som	Lecture	https://archive.nptel.ac.in/courses/112/105/112105171/

Mapping of COs with POs and PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3		2	2	1			3	3		2	2		
CO2	3	3	2	2		1			3	3		2			
CO3	3	3	2	2	2	1			3	3		2	2	1	1
CO4	3	3	2	2		1	1		3	3	1	2			
CO5	3	3	2	2	1	2	2	1	3	3	2	2	1	2	1
AVG	**3**	**3**	**2**	**2**	**1.6**	**1.2**	**1.5**	**1**	**3**	**3**	**1.5**	**2**	**1.6**	**1.5**	**1**

1–Low, 2 –Medium, 3–High.

BE23EN103	PROFESSIONAL COMMUNICATION LABORATORY - I	CP	L	T	P	C
		2	0	0	2	1
Programme & Branch	(COMMON TO ALL BRANCHES EXCEPT B.Tech CSBS)	Version : 1.0				

Course Objectives:

1.	To use language for employment and social interaction.
2.	To help learners frame sentences in the correct context.
3.	To develop learners' confidence for presentation.
4.	To strengthen learners' communication in formal contexts.
5.	To participate confidently and appropriately in team conversations.

INTRODUCTION (Not for Examination)

Importance:

- The course provides a platform for students to enhance their language competence.
- It helps learners acquire career skills sought by industries for campus recruitment.
- It improves communication skills in formal and informal situations.

Real-life Example(s):

Writing letters - drafting e-mails - blog writing - writing abstracts - public speaking- presentation

Linkages:

Pre-requisite: Communicative English - I, Communicative English - II.

LIST OF EXPERIMENTS

1.	Listening & Reading Comprehension (L2)
2.	Root words & Sentence formation (L3)
3.	Expressing oneself in an everyday situation (L3)
4.	Conversation and Just a minute talk (L3)
5.	Oral presentation – Long turn (L3)
6.	Group Discussion (L3)
7.	Creative writing (L3)
8.	Business Letter writing (L3)
9.	Giving constructive feedback and offering suggestions (L3)
10.	E-mail writing (L3)

Total: 30 Periods

Course Outcomes: Upon completion of this course, the students will be able to:		**BLOOM'S Taxonomy**
CO1	Use language effectively for employment.	L3 - Apply
CO2	Enhance writing skills for better communication.	L3 - Apply
CO3	Present ideas in public forum.	L3 - Apply
CO4	Write business letters in a comprehensive manner.	L3 - Apply
CO5	Express opinions assertively in group discussions.	L3 - Apply

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TEXTBOOKS:	
1.	Richardson, Mathew. Advanced Communication Skills. Charlie Creative Lab, 2020.
2.	Rizvi, Ashrif. Effective Technical Communication, Tata Mc Grahill, 2011.

REFERENCE BOOKS:	
1.	Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English.Cambridge University Press, Cambridge: Reprint 2011
2.	Terk, Natasha. Reports, Proposals and Procedures: A write it well guide. Gildan Media, 2015.
3.	Carnegie, Dale. The Art of Public Speaking. Prabhat Prakashan Pvt. Ltd. 1st Edition: New Delhi, 2016

WEB REFERENCES:

	Publisher	Website link	Type of Content
1.	Leverageedu	https://leverageedu.com/blog/group-discussion-topics/	others
2.	Forbes	https://www.forbes.com/advisor/in/business/business-letter-format/	others

VIDEO REFERENCES:

	Video Details	Name of the Expert	Type of Content	Video Link
1.	NPTEL	Dr.T.Ravichandran IIT, Kanpur	Lecture	https://nptel.ac.in/courses/109104031
2.	NPTEL	Dr.Binod Mishra IIT, Roorkee	Lecture	https://onlinecourses.nptel.ac.in/noc21_hs76/preview

Mapping of COs with POs and PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									1	3		1			
CO2									1	3		1			
CO3									1	3		1			
CO4									1	3		1			
CO5									1	3		1			
Avg.									**1**	**3**		**1**			

1–Low, 2 –Medium, 3–High.

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BE23ME406	PRODUCTION TECHNOLOGY AND QUALITY CONTROL LABORATORY	CP	L	T	P	C
		4	0	0	4	2
Programme & Branch	B.E.- MECHANICAL ENGINEERING	Version: 1.0				

Course Objectives:

1.	To select appropriate tools, equipment and machines to complete a given job.
2.	To develop the fundamentals of GD&T and surface metrology.
3.	To develop a part programming for various operations.

List of Experiments / Exercises:

1.	Performing a Taper turning and Drilling operations in Lathe (L3).
2.	Knurling, External and Internal thread cutting on circular parts using lathe machine (L3).
3.	Design a 3D model and Fabricate using 3D Printer (L3).
4.	Linear Measurements using vernier caliper, Height gauge, Bore gauge (L3).
5.	Measurement of angles using Bevel protractor (L3).
6.	Measurement of angles using Sine bar (L3).
7.	Measurement of Surface finish in components manufactured using various processes (Turning, Milling, Grinding, etc.) (L3).
8.	Develop and execute part programming for any specific operation (L3).
	Total: 60 PERIODS

Course Outcomes: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
1.	Select appropriate tools, equipment and machines to complete the given job.	L3 – Apply
2.	Demonstrate the fundamentals of GD&T and surface metrology.	L2 – Understand
3.	Develop part programming knowledge for various operations	L3 – Apply

TEXTBOOKS:

1.	Dotson Connie, "Dimensional Metrology", 1st edition, Cengage Learning, 2012.
2.	Kalpakjian. S, "Manufacturing Engineering and Technology", 7th Edition, Pearson Education India, 2018.
3.	Michael Fitzpatrick, "Machining and CNC Technology", 4th, McGraw-Hill Education, 2018.

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Mapping of COs with POs and PSOs															
COs	POs												PSOs		
	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3		3				3	1			3		3
CO2	3	2	3		3				3	1			3		3
CO3	3	1	3		3				3	1			3		3
Average	3	1.4	3		3				3	1			3		3
1–Low, 2 –Medium, 3–High															

BE23PT805	ENGINEERING CLINIC - II	CP	L	T	P	C
		2	0	0	2	1
	(COMMON TO ALL BRANCHES)					
Programme & Branch	B.E.- MECHANICAL ENGINEERING	Version: 1.0				

Course Objectives:

1	To provide a platform for hands-on learning experiences in order to build relevant engineering skills.
2	To enable students to learn and develop skills on designing of new product for real world application using 3D Printer and IoT.
3	To take entrepreneurship, product development, startup-related activities and problem-solving skills in higher semesters and final semester project work.

A. CONCEPT

Engineering Clinic laboratory provides hands-on training for students to develop certain simple real-world products or applications with the help of faculty. It is a team activity consisting of maximum 3 students per team. A list of products or applications will be given. Engineering Clinic - II focus on product development involving interdisciplinary Engineering courses. Each team can choose one or more products for a given application. The students have to design, fabricate and demonstrate the working of the product.

B. EXECUTION

Day	Session	Course content / Activity	No. of Periods
1	S 1	Introduction to Embedded Systems and IoT.	2
	S 2	Hands-on Training to write a code for IoT Circuit design using open-source software.	4
	S 3	Demonstration and explanation of real-time IoT application circuits in various sectors.	6
2	S 4	Introduction to 3D Printing Technology.	2
	S 5	Hands-on Training to design 3D Printing model using open-source software.	4
	S 6	Fabrication of 3D Printing Models.	6
3	S 7	Demonstration of Sublimation and Vinyl cutter Machine.	3
	S 8	Demonstration of Wood router Machine.	3
		Total	**30 Periods**

A list of sample applications/products is attached.

C. ASSESSMENT

i. Assessment is done by internal mode only and there is no End Semester Examination.
ii. Sessions (S7 & S8) are intended for demonstration purposes only, not for assessment.
iii. Marks distribution for Infernal Assessment is,

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Method	Review I	Review II	Review III	Review IV
Details	System description and Circuit design.	Testing, Validation and Demonstration.	Design and Fabrication of 3D Printing Models.	Final Product Demonstration / Presentation.
Marks	25	25	25	25

For Product/Application the student team can choose themselves.

Total: 30 PERIODS

Course Outcomes: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Understand the Basics of IoT components.	L2- Understand
CO2	Design and Demonstrate the prototype of expedient product using 3D Printer.	L4 -Analyze
CO3	Practice the culture of Innovation and Product Development towards Start-ups in an Institution.	L4 - Analyze

Mapping of COs with POs and PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	2	1	2	2	2	2	2	2	3
CO2	3	3	3	2	2	2	2	1	2	2	3	2	2	2	3
CO3	3	3	3	2	2	2	2	1	2	3	3	2	2	2	3
Average	3	3	3	2	2	2	2	1	2	2.3	2.6	2	2	2	3

1–Low, 2 –Medium, 3–High.

List of sample Applications / Products for Engineering Clinic II

1. Automated Irrigation System
2. Smart Home Automation
3. AI based Image Capturing Robot
4. Vehicle Tracking System
5. IoT based Smart Traffic Management
6. IoT based Smart Hybrid Energy Management System
7. IoT based Garbage Monitoring System
8. Miniature of Home / Buildings / Bridges
9. Miniature of Robot /Quad copter/Motor and Drives
10. Development of Wood Wall Art/logo pendant /Door design.

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BE23PT807	APTITUDE SKILLS - II	CP	L	T	P	C
		1	0	0	1	0.5
Programme & Branch	Common to all B.E. / B.Tech. Courses	Version: 1.0				

Course Objectives:

1.	To develop foundational knowledge and skills in averages, percentages, problems on ages, ratios and proportions
2.	To enhance logical reasoning skills from Venn diagrams, cubes and cuboids charts, tables and graphs

INTRODUCTION (Not for Examination)	01

Importance:

Problem-solving skills, analytical skills and logical reasoning are crucial in various aspects of an engineering education, career, and professional development. Hence, aptitude skills are needed for engineers in the following areas:

1. Engineering Design and Analysis
2. Innovation and Research
3. Project Management
4. Competitive Exams and Career Advancement

Real-Life Example(s):

a. **Budgeting and Financial Planning**: Managing personal or business finances involves calculating expenses, savings, investments, and returns. For instance, creating a monthly budget requires understanding percentages and basic arithmetic to allocate funds appropriately.

b. **Productivity:** A manager in a factory calculates the average number of units produced by employees to gauge overall productivity.

c. **Data Analysis:** In various professions, analyzing data to make informed decisions is crucial. For example, a marketing analyst uses quantitative skills to interpret sales data and forecast future trends.

d. **Shopping and Discounts**: While doing shopping, calculating discounts and comparing prices involves quantitative skills.

Linkages:

Previous Courses: Aptitude Skills I
Future Courses: Aptitude Skills III and Aptitude Skills IV

UNIT–I	Quantitative Aptitude	08

Number system(L3): Remainder Theorem - Unit digits - Factor and Factorial Theorem - Divisibility Rule

Averages(L3): Basic Concepts of Averages - Properties of Averages- Weighted Averages - Problems on Averages - Averages of Averages

Percentage(L3): Basic Concepts of Percentages - Percentage Increase and Decrease - Finding Percentages - Percentage Change - Successive Percentage Changes - Percentage Comparisons

Profit and Loss(L3): Basic Concepts of Profit and Loss - Profit and Loss Percentages - Selling Price and Cost Price Calculations - Mark Price and Discount - Successive Selling and Buying - Overheads and Additional Costs - Markup and Margin - Cost Variations and Impact on Profit/Loss - Application of Profit and Loss in Business Scenarios

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Problems on Ages(L3): Basic Concepts of Age Problems - Formulating Equations Based on Age Statements - Solving Single-variable Age Problems - Solving Multi-variable Age Problems - Age Differences - Sum of Ages - Average Age - Age Ratios - Age Problems Involving Future and Past Scenarios - Age Problems in Competitive Exams - Age Puzzles and Riddles

Ratios & Proportions(L3): Basic Concepts of Ratios - Comparing Ratios - Proportions - Direct Proportion - Inverse Proportion - Compound Ratios - Ratio and Proportion in Real-life Applications - Ratio of Increase and Decrease - Advanced Problems on Ratios and Proportions

UNIT–II	Logical Reasoning	06

Venn Diagrams(L3): Basic Concepts of Venn Diagrams - Types of Venn Diagrams - Union and Intersecti... of Sets - Difference of Sets - Complement of a Set - Cardinality of Sets - Subset and Superset Relationships - Using Venn Diagrams for Logical Reasoning - Diagrammatic Representation of Data - Real-life Applications

Cubes & Cuboids(L3) : Basic Concepts and Definitions - Surface Area of Cubes and Cuboids - Volume of Cubes and Cuboids - Diagonal of Cubes and Cuboids - Face Diagonal of Cubes and Cuboids - Relationship Between Edge Lengths and Dimensions - Construction of Cubes and Cuboids - Applications in Real-life Scenarios

Data-Interpretation and Data-Sufficiency(L3): Introduction to Data Interpretation - Types of Charts and Graphs - Calculations and Approximations - Percentage Calculations - Comparison and Analysis – Problem Solving Techniques

TOTAL: 15 PERIODS

Course Outcomes: **Upon completion of this course the students will be able to:**		**Bloom's Taxonomy**
CO1	solve quantitative problems, including averages, percentages, problems on ages, ratios and proportions	L3 – Apply
CO2	apply logical reasoning and draw conclusions from Venn diagrams, cubes and cuboids, charts, tables and graphs	L3 – Apply

TEXTBOOKS:

1.	Dr. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examinations", S.Chand and Company Ltd., 2022
2.	Dr. R.S. Aggarwal, "A Modern Approach to Logical Reasoning", S.Chand and Company Ltd., 20...
3.	FACE, "Aptipedia: Aptitude Encyclopedia", 2nd edition, Wiley India Pvt. Ltd., 2017

REFERENCE BOOKS:

1.	Arun Sharma, "Quantitative Aptitude for the CAT" 10th edition, McGraw-Hill Publishing, 2022
2.	Praveen R. V., "Quantitative Aptitude and Reasoning", 3rd edition, PHI Learning Pvt. Ltd., 2016

WEB REFERENCES:

	Publisher	Website link	Type of Content
1.	Indiabix	https://www.indiabix.com/online-test/aptitude-t...	...s for Practice

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2.	Placement preparation	https://www.placementpreparation.io/quantitative-aptitude/	Tests for Practice
3.	Geeks for geeks	https://www.geeksforgeeks.org/aptitude-for-placements/	Learning Resources and Tests for Practice

VIDEO REFERENCES:

	Video Details	Name of the Expert	Type of Content	Video link
1.	YouTube	CareerRide	Video Lectures	https://www.youtube.com/playlist?list=PLpyc33gOcbVA4qXMoQ5vmhefTruk5t9lt
2.	YouTube	Freshersworld.com	Video Lectures	https://www.youtube.com/playlist?list=PLjLhUHPsqNYkcq6YOfiywbTfnvf_TN7i9

Mapping of COs with POs and PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2													
CO2	3	2													
Avg.	3	2													

1–Low, 2 –Medium, 3–High.

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