NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA, GAUTAM BUDDH NAGAR
(An Autonomous Institute)

Affiliated to

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, UTTAR PRADESH LUCKNOW

Evaluation Scheme & Syllabus

For

B. Tech Working Professional in Mechanical Engineering (ME-WP)

Second Year

(Effective from the Session: 2026-27)

NOIDA INSTITUTE OF ENGINEERING & TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute)
B. Tech in Mechanical Engineering (ME-WP)

Evaluation Scheme
SEMESTER III

Sl. No.	Subject Codes	Subject Name	Types of Subjects	Periods			Evaluation Schemes				End Semester		Total	Credit
				L	T	P	CT	TA	TOTAL	PS	TE	PE		
1	CCSCC0301	Employability Skill Development - I	Mandatory	2	0	0	60	40	100				100	2
2	CASL0301	Technical Communication	Mandatory	2	0	0	30	20	50		50		100	2
3	CME0301	Engineering Mechanics & Strength of Materials	Mandatory	3	0	0	30	20	50		100		150	3
4	CME0302	Material Science	Mandatory	3	0	0	30	20	50		100		150	3
5	CME0304	Thermodynamics and Heat Transfer	Mandatory	3	0	0	30	20	50		100		150	3
6	CME0303	Manufacturing Science & Technology	Mandatory	3	0	0	30	20	50		100		150	3
7	CME0354	Thermodynamics and Heat Transfer Lab	Mandatory	0	0	2				25		25	50	1
8	CME0356	Computer Aided Modelling Lab	Mandatory	0	0	2				25		25	50	1
9	CME0351	Strength of Materials & Material Characterization Lab	Mandatory	0	0	2				25		25	50	1
10	CME0355	Computer Aided Manufacturing	Mandatory	0	0	6				50		100	150	3
11	CME0359	Internship - I	Mandatory	0	0	2				50			50	1
12	CNC0301/ CNC0302	Artificial Intelligence and Cyber Ethics / Environmental Science	Compulsory Audit	2	0	0	30	20	50				50	NA
13		*Massive Open Online Courses (For B.Tech. Hons. Degree)	*MOOCs											
		TOTAL		**18**	**0**	**14**	**210**	**140**	**350**	**175**	**450**	**175**	**1150**	**23**

*** List of MOOCs (Infosys Springboard) Based Recommended Courses for Second year B. Tech Students**

S. No.	Subject Code	Course Name	University/ Industry Partner Name	N. of Hours	Credits
1.	CMC0024	A Complete Beginner's Guide to Industry 4.0	Infosys Wingspan (Infosys Springboard)	30h 34m	2.5
2.	CMC0025	Cyber Security Foundation	Infosys Wingspan (Infosys Springboard)	11h 5 m	0.5
3.	CMC0026	Programming Fundamentals using Python - Part 1	Infosys Wingspan (Infosys Springboard)	43 h 25 m	3.5

PLEASE NOTE: -

- **A 3-4 weeks Internship shall be conducted during summer break after semester-II and will be assessed during semester-III**
- **Compulsory Audit (CA) Courses (Non-Credit - CNC0301/CNC0302)**
  - All Compulsory Audit Courses (a qualifying exam) do not require any credit.
  - The total and obtained marks are not added in the grand total.

Abbreviation Used:

L: Lecture, T: Tutorial, P: Practical, CT: Class Test, TA: Teacher Assessment, PS: Practical Sessional, TE: Theory End Semester Exam., CE: Core Elective, OE: Open Elective, DE: Departmental Elective, PE: Practical End Semester Exam, CA: Compulsory Audit, MOOCs: Massive Open Online Courses.

NOIDA INSTITUTE OF ENGINEERING & TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute)
B. Tech in Mechanical Engineering (ME-WP)

Evaluation Scheme
SEMESTER IV

Sl. No.	Subject Codes	Subject Name	Types of Subjects	Periods			Evaluation Schemes				End Semester		Total	Credit
				L	T	P	CT	TA	TOTAL	PS	TE	PE		
1	CASCC0401	Employability Skill Development - II	Mandatory	2	0	0	60	40	100				100	2
2	CME0403	Measurement and Metrology	Mandatory	3	0	0	30	20	50		100		150	3
3	CME0401	Computer Integrated Manufacturing	Mandatory	3	0	0	30	20	50		100		150	3
4	CME0402	Fluid Mechanics & Machines	Mandatory	3	0	0	30	20	50		100		150	3
5		Department Elective - I	Departmental Elective	3	0	0	30	20	50		100		150	3
6	CAS0402	Probability, Statistics and Complex Analysis	Mandatory	3	1	0	30	20	50		100		150	4
7	CME0453	Measurement and Metrology Lab	Mandatory	0	0	2				25		25	50	1
8	CME0452	Fluid Mechanics & Machines Lab	Mandatory	0	0	2				25		25	50	1
9	CME0455	Machine Design and Application of FEA	Mandatory	0	0	6				50		100	150	3
10	CME0459	Mini Project	Mandatory	0	0	2				50			50	1
11	CCS0452	Problem Solving Approaches	Mandatory	0	0	2				50			50	1
12	CNC0402/ CNC0401	Environmental Science / Artificial Intelligence and Cyber Ethics	Compulsory Audit	2	0	0	30	20	50				50	NA
13		*Massive Open Online Courses (For B.Tech. Hons. Degree)	*MOOCs											
		TOTAL		**19**	**1**	**14**	**210**	**140**	**350**	**200**	**500**	**150**	**1200**	**25**

*** List of MOOCs (Infosys Springboard) Based Recommended Courses for Second year B. Tech Students**

S. No.	Subject Code	Course Name	University/ Industry Partner Name	N. of Hours	Credits
1.	CMC0046	Introduction to AI	Infosys Wingspan (Infosys Springboard)	6h 18m	0.5
2.	CMC0047	Finite Elements Analysis	Infosys Wingspan (Infosys Springboard)	9 h 52 m	0.5
3.	CMC0048	CATIA V5 - Computer Aided Design (CAD)	Infosys Wingspan (Infosys Springboard)	42h 30m	3.5

PLEASE NOTE: -

- **A 3-4 weeks Internship shall be conducted during summer break after semester-IV and will be assessed during Semester-V**
- **Compulsory Audit (CA) Courses (Non-Credit - CNC0401/CNC0402)**
  - All Compulsory Audit Courses (a qualifying exam) do not require any credit.
  - The Total and obtained marks are not added in the Grand Total.

Abbreviation Used:

L: Lecture, T: Tutorial, P: Practical, CT: Class Test, TA: Teacher Assessment, PS: Practical Sessional, TE: Theory End Semester Exam., CE: Core Elective, OE: Open Elective, DE: Departmental Elective, PE: Practical End Semester Exam, CA: Compulsory Audit, MOOCs: Massive Open Online Courses.

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List of Department Elective (if any): -

S. No.	Subject Code	Subject Name	Bucket Name	Semester
1	CME0412	Factory Automation	Industry 4.0 (Robotics and Automation)	4
2	CME0411	Automotive Engines	Automotive Engineering	4
3	CME0413	Operations Management	Supply Chain Management	4

NOIDA INSTITUTE OF ENGINEERING & TECHNOLOGY, GREATER NOIDA
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AICTE Guidelines in Model Curriculum:

A student will be eligible to get Under Graduate degree with Honours only, if he/she completes the additional MOOCs courses such as Infosys Springboard/NASSCOM/CISCO (as applicable) certifications, or any other online courses recommended by the Institute (Equivalent to 20 credits). During Complete B.Tech. Program Guidelines for credit calculations are as follows.

1. For 6 to 12 Hours =0.5 Credit
2. For 13 to18 =1 Credit
3. For 19 to 24 =1.5 Credit
4. For 25 to 30 =2 Credit
5. For 31 to 35 =2.5 Credit
6. For 36 to 41 =3 Credit
7. For 42 to 47 =3.5 Credit
8. For 48 and above =4 Credit

For registration to MOOCs Courses, the students shall follow Infosys Springboard/NASSCOM/CISCO (as applicable) registration details as per the assigned login and password by the Institute these courses may be cleared during the B. Tech degree program (as per the list provided). After successful completion of these MOOCs courses, the students shall provide their successful completion status/certificates to the Controller of Examination (COE) of the Institute through their coordinators/Mentors only.

The students shall be awarded Honours Degree as per following criterion.

i. If he / she secures 7.50 as above CGPA.
ii. Passed each subject of that degree program in the single attempt without any grace.
iii. Successful completion of MOOCs based 20 credits

Course Code: CCSCC00301	Course Name: Employability Skill Development - I	L	T	P	C
Course Offered in: ME		2	0	0	2

Pre-requisite: Reasoning and Basic Programming

Course Objectives:

Section A: Develop understanding of computer systems, mathematical foundations, and programming concepts while applying structured problem-solving techniques to design logical solutions effectively.
Section B: Enhance numerical ability and logical reasoning skills through speed mathematics, number systems, and analytical problem-solving techniques for competitive aptitude development.
Section C: To develop the ability to communicate effectively and empathetically in workplace situations while strengthening active listening, adaptability, and cross-cultural awareness for navigating complex professional environments.

Course Outcome:		Bloom's Level
CO1	Apply fundamental concepts of computer systems, mathematical foundations, and programming constructs to analyze and solve basic computational problems.	K3
CO2	Design and develop structured solutions for problem statements by applying SDLC principles, logical thinking, and flowchart/pseudocode techniques.	K6
CO3	Apply fundamental number theory concepts such as divisibility, HCF & LCM, remainder theorem, and cyclicity to solve quantitative problems efficiently	K3
CO4	Solve problems involving logical reasoning and analytical thinking, including direction sense, blood relations, series patterns, and time-based puzzles like clocks and calendars.	K3

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	-	2	3	1	-	3	2	2	2	-	-	-
CO2	3	3	3	3	3	2	1	3	2	2	2	-	-	-
CO3	3	3	2	1	-	-	-	1	2	2	2	-	-	-
CO4	-	-	-	-	1	2	-	3	2	2	-	-	-	-

Course Contents / Syllabus

Section-A

Unit 1	Foundations of Computer Systems and Mathematical Concepts	8 hours

Computer System Fundamentals: Introduction to Assembler, Compiler, Interpreter, Role of Loader and Linker in program execution. **Mathematical Foundations for Computing:** Sets, Relations, and Functions: definitions and applications, Principle of Mathematical Induction and its use in proofs.
Basic Concepts of Programming Language: Memory model of C/C++ Program, Activation Record of a function, L-Value/ R-Value concept. Operators, Precedence, Order of Evaluation and Associativity. Pointers and Dynamics Memory Concept, Functions (argument passing, concept of scope), Understanding Recursion, Bitwise Operations.

Unit 2	Design and develop structured solutions for problem statements	8 hours

Introduction to Software Development Life Cycle, Step-by-step solution to simple problems, Developing logic/flowchart/pseudocode. Step-wise refinement and Procedural Abstraction.
Case Study*: Understand the problem statement, identify a feasible solution, and develop the logic along with a flowchart for the proposed solution.

Section-B

Unit 3:	Speed Math and Number System	8 hours

Classification of number, Divisibility Rule, Factorization, HCF & LCM, It's Application, Unit digit (Cyclicity), Last two-digit, Remainder theorem, Factorial and Number of zeroes, Highest power		
Unit 4	**Analytical and Logical Reasoning**	**6 hours**
Direction and Sense, Blood Relation, Number Series and Letter Series, Coding Decoding.		
		Total Lectures: 30 hours

**A list of problem statements will be provided by the mentor; you may choose any one.*
***Note:** Students may choose an alternative problem statement with prior approval from the mentor.*

Reference Books:

S. No	Book Title	Author
1.	A Project-Based Introduction to Programming	Access Point Publishing
2.	Programming: Principles and Practice Using C++	Bjarne Stroustrup
3.	Effective Modern C++	Scott Meyers
4.	Quantitative Aptitude	R S Aggarwal
5.	Verbal & Non-Verbal Reasoning	R S Aggarwal

Mode of Evaluation

CIE							ESE	Total
ST1	ST2	ST3	TA1 10	TA2 10	TA3 10	Attendance 10		
60			40					100

Course Code: CASL0401	Course Name: Technical Communication	L	T	P	C
Course Offered in: B. Tech. All Computing branches (except CSBS)		**2**	**0**	**0**	**2**

Pre-requisite: Intermediate level (CEFR) and above

Course Objectives:

Demonstrate effective verbal and non-verbal communication skills in diverse professional settings, including meetings, presentations, and interpersonal interactions. Develop and apply clear, concise, and audience-appropriate written communication, such as emails, letters, memos, resume', using correct grammar, tone, and format. Adapt communication style based on cultural, organizational, and situational contexts to foster inclusive and respectful professional relationships. Employ digital communication tools and platforms (e.g., video conferencing, business messaging apps) responsibly and effectively in remote or hybrid work environments.

Course Outcome: After completion of the course, the student will be able to		**Bloom's Knowledge Level (KL)**
CO1	Comprehend the principles and functions of technical communication.	K2
CO2	Write for specific audience and purpose to fulfil the provided brief	K3
CO3	Recognize and produce different kinds of technical documents.	K3
CO4	Apply effective speaking skills to efficiently carry out official discourses.	K3
CO5	Demonstrate their understanding of communication through digital media.	K3

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	2	1	2	3	1	1	-	-	-
CO2	1	1	1	1	1	1	1	2	3	1	1	1	-	1
CO3	1	1	1	1	1	1	1	2	3	1	1	2	1	2
CO4	1	1	1	1	1	1	1	2	3	1	1	1	1	2
CO5	1	1	1	1	1	1	1	2	3	1	1	1	1	1

Course Contents / Syllabus

Unit 1	**Introduction to Technical Communication**	**4 hours**

Technical Communication: Definition, Process, Types, Levels, and Flow; Barriers to Technical Communication: emphasis on gender neutral language and cultural sensitivity; Significance of audience in technical communication

Unit 2	**Technical Writing 1**	**5 hours**

Technical writing skill: characteristics, examples; Business letters/emails: Content organization, Tone and intent; Agenda & Minutes of Meetings

Unit 3	**Technical Writing 2**	**5 hours**

Job application, Resume'; Report, proposal; Technical paper: Abstract; Ethical Writing: Copy Editing, Referencing and Plagiarism

Unit 4	**Public Speaking**	**6 hours**

Components of effective speaking: Simplicity, order, balance in arranging ideas. Importance of *KOPPACT;* Appearing for a job interview: FAQs; Telephonic & Online Interviews

Unit 5	**Virtual/Remote Communication**	**4 hours**

Remote work: online platforms; Video conferencing; Virtual etiquette: email ids, usernames; Writing Blogs & creating Vlogs

	Total Lecture Hours	**24 hours**

Textbook:

SNO	Books Title	Author
1	Technical Communication – Principles and Practices, 4th Edition , Oxford Univ. Press, 2022, New Delhi.	Meenakshi Raman & Sangeeta Sharma

Reference Books:

S.NO	Books Title	Author
1	Technical Communication, 15th Edition , Pearson, 2021	John M. Lannon & Laura J. Gurak

2	Spoken English- A Manual of Speech and Phonetics (5th Edition) by , 2024, New Delhi.	R K Bansal & J B Harrison, Orient Blackswan
3	Business Correspondence and Report Writing (6 Edition), Tata McGraw Hill & Co. Ltd., 2020, New Delhi.	Prof. R C Sharma, Krishna Mohan, and Virendra Singh Nirban
4	Intercultural Communication in Virtual Exchange , Cambridge Univ. Press, 2024.	Francesca Helm
Self-Study Content Links:		**Duration (in Hrs)**
MOOCs	https://onlinecourses.nptel.ac.in/noc24_ge37/preview https://archive.nptel.ac.in/courses/109/106/109106094/	4 weeks
Video Lectures	https://www.youtube.com/watch?v=kOJlwMJxEG0&t=8s https://www.youtube.com/watch?v=Sg7Q_dC_fWU&list=PLPuC5CMHiqmuzq_KQ4aw0V9Q7xJY6aezb https://www.youtube.com/watch?v=ymLFJDpjgCk&list=PLPuC5CMHiqmuzq_KQ4aw0V9Q7xJY6aezb&index=6	2.5 hours
Web References	Technical Communication And Soft Skills For Engineers	

Course Code: CME0301	Course Name: Engineering Mechanics & Strength of Materials	L	T	P	C
Course Offered in: ME		**3**	**0**	**0**	**3**

Pre-requisite: Engineering Mathematics and Physics.

Course Objectives:

This course aims to provide a foundational understanding of the mechanics of deformable bodies. It introduces the analysis of force systems and equilibrium in two dimensions, followed by the study of stress-strain relationships under various loading conditions. The course focuses on the analysis of beams for shear force, bending moment, slope, and deflection, and extends to torsion in circular shafts and buckling of columns. It also covers the behavior of thin and thick-walled cylinders under internal and external pressures, enabling students to apply mechanical principles to practical engineering problems.

Course Outcome: After completion of the course, the student will be able to

1.	Apply the equilibrium conditions of force system to solve the problems and find the unknown forces	K3
2.	Analyze the behavior of stresses and strains, including principal stresses and strains, under different loading conditions for engineering applications	K4
3.	Analyze the beams and determine stresses, slope, and deflection of the transversely loaded members.	K4
4.	Analyze the behavior of shafts subjected to torsion and evaluate stresses, strains, and buckling effects in columns under different loading conditions .	K4
5.	Analyze the behavior of thin and thick cylinders and evaluate stresses and strains for solving engineering problems related to pressure vessels.	K4

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**3**	**1**	1
CO2	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**		**3**	**1**	1
CO3	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**3**	**2**	1
CO4	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**3**	**2**	1
CO5	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**		**3**	**2**	1

Course Contents / Syllabus

Unit 1	Introduction	10 hours

Overview of force system: Review of two-dimensional force systems, free body diagram, laws of friction, and equilibrium analysis of simple systems involving friction.
Trusses: Introduction, simple truss and solution of simple truss, methods of joints, and methods of sections.

Unit 2	Simple, Compound, and Principal Stresses and strains	08 hours

Simple stress and strains: Introduction to simple stress, strain, shear stress, hooks law, elastic constants, numerical problems on hooks law, thermal stresses, strain energy.
Principle stress and strain stress on inclines sections, state of plane stress, principal stress and strain, maximum shear stress, Mohr's circle
for plane stress.

Unit 3	Beams	10 hours

Beam: Introduction, shear force and bending moment, different equations of equilibrium, shear force and bending moment diagram for statically determined beams.

Bending of beams: Theory of Pure Bending, normal stresses in beams, shear stresses in beams due to transverse and axial loads, composite beams. Deflection of beams: Differential equation of the elastic curve, cantilever and simply supported beams, Macaulay's method, area moment method, fixed and continuous beams.

Unit 4	**Torsion and Column analysis**	**9 hours**

Torsion: combined bending and torsion of solid and hollow shafts, torsion of thin-walled tubes.

Stability of columns: Buckling and stability, slenderness ratio, combined bending, and direct stress, middle third and middle quarter rules, struts with different end conditions, Euler's theory for pin-ended columns, effect of end conditions on column buckling, Ranking Gordon formulae.

Unit 5	**Cylinders & Spheres**	**8 hours**

Thin cylinders & spheres: Introduction, difference between thin-walled and thick-walled pressure vessels, thin-walled spheres and cylinders, hoop and axial stresses and strain, and volumetric strain.

Thick cylinders: Radial, axial, and circumferential stresses in thick cylinders subjected to internal or external pressures.

	Total Lecture Hours	**45 hours**

Textbook:

1. Engineering Mechanics BY S.S Bhavikatti

2. Strength of Materials By R.K. Bansal

Reference Books:

1. Engineering Mechanics by A. Nelson
2. Introduction to Solid Mechanics by Shames.
3. Mechanics of Materials by Beer, Johnston

Self-Study Content Links:		Duration (in Hrs)
MOOCs	NPTEL :: Mechanical Engineering - NOC:Engineering Mechanics	60
Video Lectures	NPTEL :: Mechanical Engineering - Strength of Materials	50
Web References	https://www.iitg.ac.in/rkbc/me101/Presentation/L01-03.pdf	30

Note: Self-study material may include assignments, seminars, micro projects, industrial visits, any other student activities, etc.

Course Code: CME0302	Course Name: Material Science	L	T	P	C
Course Offered in: ME		3	0	0	3

Pre-requisite:

Course Objectives: The student covers various aspects of advanced engineering materials.

To develop students' understanding of phase diagrams, strengthening mechanisms, heat treatment processes, advanced and composite materials, and material characterization techniques, including metallography, for analyzing the structure–property relationships and applications of engineering materials.

Course Outcome: After completion of the course, the student will be able to

1. Analyze the concept of phase & phase diagram & also understand the basic terminologies associated with metallurgy.	K4
2. Understand and apply heat treatment techniques, TTT diagrams, and diffusion principles for material properties.	K3
3. Interpret features, classification, applications of newer class materials like smart materials, piezoelectric materials, biomaterials, and composite materials.	K3
4. Understand the fundamentals of composites and their applications.	K2
5. Interpret Materials characterization and Metallographic techniques such as X-Ray diffraction, scanning electron microscopy.	K2

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	1	3	-	1
CO2	3	3	2	2	2	-	-	-	-	-	2	3	2	1
CO3	2	1	2	-	2	1	2	-	-	-	2	2	3	3
CO4	2	1	3	-	2	1	2	-	-	-	2	2	2	2
CO5	3	2	-	3	3	-	-	-	-	-	2	3	3	2

Course Contents / Syllabus

Unit 1	Properties of Materials & Phase Diagram	10 hours

Mechanical Properties: Stress-strain response of metallic, ceramic, and polymer materials, yield strength, tensile strength, and modulus of elasticity, toughness, plastic deformation, hardenability, fatigue, creep, and fracture,

Phase Diagram: Solid solutions, Solubility limit, Gibbs' phase rule, binary phase diagrams, intermetallic compounds, iron-carbon phase diagram, cold and hot working of metals, recrystallization, and grain growth. Microstructure, properties, and applications of ferrous and nonferrous alloys.

Unit 2	Heat Treatment and Diffusion	10 hours

Heat treatment: Various types of heat treatments such as Annealing, Normalizing, Quenching, Tempering (Aus-tempering, Martempering), and various case hardening processes. Time-Temperature-Transformation (TTT) diagram.

Diffusion: Introduction to Diffusion, Types of diffusion, Fick's laws, Factors Affecting Diffusion, Diffusion in Sintering, Doping of semiconductors, Diffusion-based surface treatments.

Unit 3	Smart and Advanced Materials	09 hours
Smart materials: classification, piezo electric materials, Rheological materials, chromic materials, thermo-responsive materials, magnetostrictive materials, Electrostrictive materials, Nanomaterials, Biomaterials and applications, super-alloys, shape memory alloys, exhibiting ferroelectric, opto-electric, semi-conductive, photoconductive, and superconductive properties, and applications.		
Unit 4	**Composite Materials**	**08 hours**
Composite: Introduction to Composite, classification of composites, Application of composite, Types of matrix and reinforcements, Fabrication methods of composite materials: Polymer Matrix Composites (PMCs):- Hand Lay-up, Vacuum Bagging. Liquid Composite Molding:-Resin Transfer Molding, Metal Matrix Composites:-Stir Casting, Powder Metallurgy.		
Unit 5	**Material characterization and Metallography**	**08 hours**
Materials characterization and Metallographic techniques: X-Ray diffraction, scanning electron microscopy, transmission electron microscopy, atomic force microscopy, scanning tunnelling microscopy, atomic absorption spectroscopy, and differential scanning calorimetry. Introduction to NDT and various NDT Techniques.		
	Total Lecture Hours	**45 hours**

Textbook:

1. Materials Science and Engineering by William D., Jr. Callister and David G. Rethwisch

2. A Textbook of Material Science by R. K. Rajput

3. Introduction to Material Science for Engineers by F. Shackelford

Reference Books:

4. Experiments in Materials Science and Engineering by Tariq A. Khraishi and Marwan S. Al-Haik
5. Materials Science and Engineering: A First Course by V. Raghavan
6. Fundamentals of Metal Cutting and Machine Tools by B. L. Juneja Sekhon

Self-Study Content Links:		Duration (in Hrs)
MOOCs	nptel.ac.in/courses/113107078	18
Video Lectures	The Science, Engineering and Technology of Materials An Introduction - I (Series) by Dr. Ravindra Gettu IIT Madras	18
Web References	Materials Project OQMD	10

Note: Self-study material may include assignments, seminars, micro projects, industrial visits, any other student activities, etc.

Course Code: CME0304	Course Name: Thermodynamics and Heat transfer	L	T	P	C
Course Offered in: ME		3	0	0	3

Pre-requisite: Engineering Physics (CAS0101A) and Calculus and Linear Algebra (CAS0103)

Course Objectives:

To provide students with a comprehensive understanding of the principles and laws of thermodynamics and their applications in engineering and Learn the concept of heat transfer in different fields of engineering. Learn about the application of Fin in Automobile and other electrical equipment. Learn about free and forced convection. Learn about radiation and how to minimize the effect of radiation. Learn about the application of heat exchanger in industry.

Course Outcome: After completion of the course, the student will be able to

1. Analyze thermodynamic systems, processes, properties, Zeroth, 1st, and 2nd laws of thermodynamics	K4
2. Analyze laws of thermodynamics with principles of entropy, availability and properties of pure substances.	K4
3. Analyze the modes of heat transfer, steady and unsteady heat transfer with its industrial applications.	K4
4. Analyze the theoretical and numerical approach of free, forced convection and radiation heat transfer with its application to industry.	K4
5. Design and analyze heat exchangers and different industrial applications of thermodynamics	K5

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	1	1	1	2	1	1	2	2	2
CO2	3	3	2	2	1	1	1	1	2	1	1	2	2	2
CO3	3	3	2	2	1	1	1	1	2	1	1	2	2	2
CO4	3	3	2	2	1	1	1	1	2	1	1	2	2	2
CO5	3	3	2	2	1	1	1	1	2	1	1	2	2	2

Course Contents / Syllabus

Unit 1	Basic Concepts and laws of thermodynamics	10 hours

Basic Concepts: Concept of System and Surrounding, State, Property, Process. Zeroth law of thermodynamics: Concept of equality of Temperature First law of thermodynamics: Concept of Heat and Work

First law analysis for open and closed system, Limitations of first law of thermodynamics, PMM -I. SFEE and its applications

Second law of thermodynamics: Concept of Heat engines, Heat pump and Refrigerator, Kelvin Planck and Clausius statement of second law of thermodynamics, Carnot cycle, Carnot theorem

Unit 2	Principles of entropy and properties of pure substances	09 hours

Entropy: Clausius inequality, Concept of Entropy, Entropy change of pure substance in different thermodynamic processes. Properties of steam and Rankine cycle: Property of Pure Substance(steam), Saturation states, Sub - cooled liquid state, Superheated vapour state, Phase transformation process of water, Steam -Tables & Mollier chart

Unit 3	Steady and unsteady State Conduction	10 hours

Modes of Heat Transfer: Conduction, convection and radiation. Conduction: General differential heat conduction equation in the rectangular, cylindrical coordinate systems Steady State One-dimensional Heat conduction: Simple and Composite Systems in rectangular, cylindrical coordinate. Thermal resistance, Critical radius of insulation Transient Conduction: Transient heat conduction; Lumped capacitance method; Unsteady state heat conduction in one dimension only. Fins of uniform cross-sectional area;

Unit 4	Convection and Radiation heat transfer	08 hours

Forced Convection: Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer;

Natural Convection: Physical mechanism of natural convection; Buoyant force. Dimensionless numbers and its physical significance.

Basic radiation concepts; Radiation properties of surfaces; Black body radiation. Radiation exchange between diffuse nonblack bodies in an enclosure; Radiation shields; Solar radiation ,Condensation and Boiling.

Unit 5	Heat Exchangers and Steam Turbines	08 hours

Heat Exchangers: Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness-NTU method; Boilers: Classifications and working of boilers, boilers mountings and accessories. Condenser: Classification of condenser, air leakage. Steam and Gas Nozzles, Steam Turbines: Classification of steam turbine.

	Total Lecture Hours	45 hours

Textbook:

1. Engineering Thermodynamics, 6th Edition, Tata McGraw Hill Publication by P.K. Nag
2. Thermodynamics: An Engineering Approach, 9th Edition Tata McGraw Hill publication by Michael A. Boles and Yunus A Çengel
3. Heat and Mass Transfer, 6th Edition, McGraw Hill Publication By Yunus A Çengel
4. A Textbook on Heat Transfer, University press publication, by S.P. Sukhatme
5. Heat and Mass Transfer, S. Chand publication by R K Rajput

Reference Books:

1. Fundamentals of Engineering Thermodynamics, 8th Edition, Wiley publication by Moran M. J. & Shapiro H.N
2. Fundamentals of Heat and Mass Transfer,5th Edition, John Wiley & Sons by J.P. Holman
3. Heat Transfer by J.P. Holman, 6th Edition , McGraw Hill Publication by Incroperra & DeWitt

Self-Study Content Links:		Duration (in Hrs)
MOOCs	https://www.my-mooc.com/en/mooc/introthermodynamics-812d23a2-240e-46fe-a1a1-42091415f2cc	15
Video Lectures	https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_me171	20
Web References	https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_me76	10

Note: Self-study material may include assignments, seminars, micro projects, industrial visits, any other student activities, etc.

Course Code: CME0303	Course Name: Manufacturing Science & Technology	L	T	P	C
Course Offered in: ME		3	0	0	3

Pre-requisite: Digital Manufacturing

Course Objectives:

To provide students with a comprehensive understanding of manufacturing processes, including casting, metal forming, machining, welding, CNC machining, and non-traditional manufacturing methods, enabling them to analyze process principles, equipment, tooling, and applications for the effective production of engineering components.

Course Outcome: After completion of the course, the student will be able to

1. Understand the concept of manufacturing processes, solve the problems based on casting.	K3
2. Analyze & solve the problems based on Metal forming processes & understand the concept of powder metallurgy.	K4
3. Understand the concept of metal joining processes.	K2
4. Analyze the conventional machining processes.	K3
5. To analyze the non-traditional machining process & the Abrasive finishing processes.	K3

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	1	1	1	1	1	2	3	2	2
CO2	3	3	2	2	3	1	1	2	1	2	2	3	2	2
CO3	2	2	1	1	3	1	1	1	1	1	3	3	2	2
CO4	3	3	2	2	3	1	1	1	1	1	2	3	2	2
CO5	3	3	2	3	3	1	1	2	2	2	3	3	2	3

Course Contents / Syllabus

Unit 1	Casting & Special Casting Processes	10 hours

Gating and Riser Design for Casting: Elements of Gating System, Types of Gates and gating systems. Pouring time calculations, Top Gating, Bottom Gating and Relation (condition) to Avoid Aspiration Effect Design of Risers: Types of Risers, Directional Solidification, Chvorinov's Rule and Caine's method.
Special Casting Processes: CO2 Moulding, Shell Moulding, Investment Casting, Die Casting, Hot and Cold Chamber Processes; Centrifugal casting; Continuous Casting Defects – Types, Causes and Remedies.

Unit 2	Metal Forming Processes & Sheet Metal Forming	10 hours

Forging: Analysis of forging process. Rolling: Types of Rolling mills and Defects in Rolling. Flat Rolling and Terminology. **Analysis of rolling process Extrusion:** Direct and Indirect Extrusion, Impact Extrusion, Hydrostatic Extrusion, analysis of extrusion process, **Defects in Extruded Products. Drawing:** Wire drawing, Rod and Tube Drawing. **Sheet Metal Forming:** Classification of press tool operations; Punch and Die Clearances, Ironing, Coining and Embossing, Lancing, Twisting, Spinning, Stretch forming.
Sheet Metal Drawing: Drawing, Cupping and Deep drawing Draw Die Design. Defects in drawing.
Sheet Metal Dies: Progressive, Compound and Combination Dies. Bending and Bending Allowance, Rubber Forming.

Unit 3	Metal Joining Processes	09 hours

Electric Arc Welding: Introduction, Characteristic curves of constant-current and constant voltage, arc welding transformer; Electrodes; consumable and non-consumable electrodes, Functions of coatings on the electrodes, Arc blow. Arc Welding Processes; Shielded metal arc welding (SMAW), Inert Gas Arc Welding; Tungsten Inert Gas (TIG) welding and Metal Inert Gas (MIG) arc welding, Submerged arc welding (SAW), Resistance welding: Principle and types of resistance welding.
Metallurgy of Arc welding: Principal zones in the joint and typical grain structure, Welding defects. Terminology. Welding Symbols, WPS (Welding Procedure Specifications), PQR (Procedure Qualification Record).

Unit 4	Mechanics of Metal Cutting	08 hours

Tool Engineering: Cutting Tool geometry and definition of principles tool angles of single point cutting tools

Mechanics of Metal Cutting: Features of machining processes, mechanism of chip formation, chip reduction coefficient, force analysis, Merchants circle of cutting forces, expression for shear plane angle and coefficient of friction in terms of cutting forces and tool angles, Merchants theory-original and modified, effect of various parameters on cutting forces, Different types of dynamometers and their operations, Tool life definition, mechanism of tool wear and measurement, preliminary and ultimate feature, factors influencing tool life such as speed, feed, depth of cut, tool material, cutting fluids etc., Machinability, factors affecting surface finish.

Unit 5	Unconventional Machining	08 hours

Introduction and Classification of Un-Conventional Machining, Analysis of Un-Conventional Machining: ECM, EDM, USM, LBM and Water and Abrasive Jet Machining.

	Total Lecture Hours	45 hours

Textbook:

1. A Textbook of Manufacturing Technology by R. K. Rajput
2. A Textbook of Production Technology by P.C. Sharma
3. Manufacturing Technology by D. K. Singh
4. Manufacturing Technology - I by Anup Goel

Reference Books:

1. Manufacturing Technology: Materials, Processes, and Equipment by Helmi A. Youssef, Hassan A. El- Hofy, Mahmoud H. Ahmed

2. Advanced Manufacturing Technologies by Stephen F. Krar, Arthur Gill

· 3. Manufacturing Technology II by Dr. R. Kesavan, B. Vijaya Ramnath

4. Manufacturing Science by Ghosh, A. K. Mallik

Self-Study Content Links:		Duration (in Hrs)
MOOCs	https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_me28	20
Video Lectures	https://nptel.ac.in/courses/112104028	15
Web References	https://me.gecgudlavalleru.ac.in/images/admin/pdf/1594616577_II-II-Manufacturing-Processes.pdf	10

Note: Self-study material may include assignments, seminars, micro projects, industrial visits, any other student activities, etc.

Course Code: CME0354	LAB Course Name: Thermodynamics and Heat Transfer lab	L	T	P	C
Course Offered in: ME		0	0	2	2

Pre-requisite: NA

Course Objectives:

To provide practical experience in measuring and analyzing thermal properties, heat transfer processes, and fluid flow. Students will conduct experiments, interpret data, and apply theoretical concepts to enhance their understanding of thermodynamic systems and heat transfer mechanisms in real-world applications

Course Outcome: After completion of the course, the student will be able to

1. Calculate the heat transfer rate through conduction and convection heat transfer.	K4
2. Calculate the heat transfer rate through radiation, and heat exchanger units.	K4
3. Understand the petrol and diesel engine of 2stroke and 4 stroke.	K3

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**3**	3	2	2
CO2	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**3**	3	3	2
CO3	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	3	2	2

List Of Practicals (Indicative & Not Limited To)	**CO**
a. 1. To Determine net heat transfer rate and thermal resistance of composite wall.	**CO1**
b. 2. To Determine net heat transfer rate and thermal conductivity of Composite cylinder wall	**CO1**
c. To Determine Biot number and find out lumped body in Transient heat conduction	**CO1**
d. To calculate Thermal conductivity of insulating slab	**CO1**
e. To Determine the Thermal conductivity of insulating powder	**CO1**
f. To analyze the heat transfer capability in Heat Pipe experiment.	**CO2**
g. To Determine the Stefan–Boltzmann constant	**CO2**
h. To do the Performance analysis of Parallel and Counter flow heat exchanger.	**CO2**
i. To Study of two stroke Petrol Engine and Diesel Engine	**CO3**
j. To Study of four stroke Petrol Engine and Diesel Engine	**CO3**
Additional List of Practical	
a. To determine the heat transfer through Pin fin	**CO1**
b. To do Performance analysis of Plate type heat exchanger.	**CO2**

c. Radiation- Determination of Emissivity of a plate	**CO2**
d. Experiment on Newton's law of cooling by virtual simulator	**CO1**
e. Experiment on Natural convection by virtual simulator	**CO1**
f .Experiment on conduction by virtual simulator	**CO1**
g. Experiment on phase change by virtual simulator	**CO2**
Total Hours: 30 hrs.	

Course Code: CME0356	LAB Course Name: Computer Aided Modelling Lab	L	T	P	C
Course Offered in: ME		**0**	**0**	**2**	**1**

Pre-requisite: NA

Course Objectives:

The objective is to equip students with practical skills in using AutoCAD software to create, Analyze, and modify 3D models. Students will learn to design complex geometries, perform simulations, and generate technical drawings, preparing them for real world engineering and design challenges.

Course Outcome: After completion of the course, the student will be able to

1. Apply basic concepts and methods from design engineering to explore creative solutions of real-world problems.	K3
2. Create parts, assemblies, flexible & sheet metal modelling, diagram complex systems and detailed engineering concept drawings.	K4
3. Apply industry standards in the sketching, 3D modelling, validation and visualization of the products & assemblies.	K4

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	3	2	2	1	2	1	2	2		2	2	1
CO2	2	2	3	2	3	1	1	1	2	2		2	2	2
CO3	2	2	3	2	3	2	1	1	2	2		2	2	2

List of Practicals **Mandatory Experiments**	**CO**
1. 1. Introduction to CREO Parametric, its UI, and various design tools.	**CO1**
2. Develop proficiency in drawing and editing polygons using design tools.	**CO1**
3. Spatial Visualization of Three-Dimensional Solids through Isometric Representation (Isometric projections of solids).	**CO1**
4. Modeling of basic machine components, including bracket, flange, nuts, and bolts.	**CO2**
5. Designing of Carburetor parts, including carburetor body and throttle plate.	**CO2**
6. Design of Carburetor parts like shaft, arm, and cover.	**CO2**
7. Structural Design and Modeling of I.C. Engine Components, including Connecting Rod and Cylinder Block.	**CO2**
8. Modelling and Design of I.C. engine components II: piston and crankshaft.	**CO3**
9. Assembly and Constraint Application in Carburetor Components.	**CO3**
10. Integrated Modeling and Assembly of Mechanical Systems Using CAD Tools.	**CO3**
Suggestive Experiments: 1. Introduction to Rendering and visualization techniques.	**CO1**
2. Perform basic FEA on Engine components.	**CO2**
3. Force simulation of a structural component	**CO3**
4. Flow simulation of a fan	**CO3**
5. Creating multi-view drawings of 3D models	**CO3**

Total Hours: 30 hrs.

Course Code: CME0351	LAB Course Name: Strength of Materials & Material Characterization Lab	L	T	P	C
Course Offered in: ME		0	0	2	1

Pre-requisite: NA

Course Objectives:

The course aims to provide students with practical experience that complements the theoretical aspects of the course by providing with hands-on experience. It allows them to validate theoretical concepts, apply their knowledge to real-world scenarios, develop proficiency in instrumentation and measurements, analyses experimental data, and enhance their technical reporting and communication skills. Ultimately, the practical/lab component prepares students for practical engineering applications and equips them with the necessary skills for success in the field of strength of materials.

Course Outcome: After completion of the course, the student will be able to

1. Evaluate the Mechanical properties of metallic materials through standard mechanical testing methods.	K4
2. Observe the effect of heat treatment effect on mechanical properties of metallic specimens.	K2
3. Analyze the microstructures of different materials through metallographic examination.	K3

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	2	1	-	-	-	-	2	3	2	1
CO2	3	3	2	2	2	2	-	-	-	-	2	3	2	1
CO3	3	3	3	3	3	2	-	2	2	2	2	3	2	2

List of Practicals (Indicative & Not Limited To)	CO
1. To determine the tensile strength of metallic specimen on universal testing machine.	CO1
2. To determine the compressive strength of metallic specimen on universal testing machine.	CO1
3. To determine the shear strength of metallic specimen on universal testing machine.	CO1
4. To determine the flexural strength (3-point bending) of metallic specimen on universal testing machine.	CO1
5. To determine of torsional strength of a metallic specimen using the torsion testing machine.	CO1
6. To determine the Brinell hardness / Rockwell hardness of materials using hardness testing machine.	CO1
7. To Determine the Impact strength of materials using Izod and Charpy impact testing machine..	CO1
8. To study heat treatment processes such as annealing, normalizing, quenching, and comparison of properties before and after heat treatment.	CO2
9. To determine the microstructures of a prepared specimen using optical microscope.	CO3
10. Comparative study of microstructures of different specimens of different materials (mild steel, Gray C.I., brass, copper etc.)	CO3

Total Hours: 30 hrs.

Course Code: CME0355	LAB Course Name: Computer Aided Manufacturing	L	T	P	C
Course Offered in: ME		0	0	6	3

Pre-requisite: NA Basics of CAD & Digital Manufacturing

Course Objectives:

To develop students' knowledge and practical skills in conventional, CNC, and advanced manufacturing processes, including casting, forming, machining, welding, additive manufacturing, and non-traditional machining, while fostering safety awareness, precision, and problem-solving abilities for the fabrication and production of engineering components.

Course Outcome: After completion of the course, the student will be able to

1. Demonstrate different Casting and forming operations and make components.	K2
2. Demonstrate welding processes to make a component as per the drawing.	K2
3. Demonstrate traditional and computer-controlled machining processes to make a component as per the drawing.	K2
4. Demonstrate 3D printing and ECM processes and make components as per the drawing.	K2
5. Demonstrate modern manufacturing processes and make a component as per drawing.	K2

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	1	1	2	2	1	2	3	1	3
CO2	3	2	2	2	3	1	1	2	2	2	3	3	1	2
CO3	3	2	2	2	3	1	2	2	2	1	2	3	1	3
CO4	3	2	2	2	3	1	1	2	2	1	2	3	1	2
CO5	3	3	3	2	3	2	1	2	2	2	3	3	1	3

List Of Practical's (Indicative & Not Limited To)	CO
1. a. Pattern Making by wood working lathe. b. Gating System: - Mold making, Position of riser, runner. c. Casting: - Melting of metal in furnace, pouring of molten metal. d. To make a component using Injection Moulding.	CO1
2. a. Flattening: Use a mallet or a hammer to flatten a sheet metal surface that has become warped or distorted. b. Make a nail using forging process.	CO2

c. Make a ring using forging process. d. Stamping and Embossing: Use stamping and embossing dies or stamps to stamp letters, numbers and create raised designs or patterns on a sheet metal surface. e. Piercing: Use a hole punch or drill to create holes of various sizes and shapes in a sheet metal panel.	
3. a. To make Butt, Lap, T Joint by using gas and arc welding Processes. b. To make a component by using spot welding. c. To make a component by using TIG or MIG welding. d. Polishing: Use abrasive compounds or polishing wheels to achieve a smooth and reflective surface finish on a workpiece. e. To make a single point cutting tool on tool grinder.	**CO3**
4. a. To Perform Plane Turning, Taper Turning, Threading, Grooving, Knurling Chamfering and make a component. b. Make a hole at different locations using radial drill machine. c. Cut gear teeth on horizontal milling machine through plane indexing method. d. Cut a keyway on vertical milling machine. e. To write a part program for Perform Plane facing, Turning, Taper Turning and Threading operations and make a Component f. V-Carving: Use a CNC Router with a V-bit to create decorative V-shaped grooves or carvings on a material. g. Engraving: Use a CNC router to engrave text or designs onto a surface, such as wood or acrylic. h. Drilling: Use a CNC machine to drill precise holes in a material at specific locations and depths. i. Keychain or Key Holder: Design and print a personalized keychain or key holder to showcase the capabilities of 3D printing	**CO4**
5. a. LASER Machining: - Making a hole in non-conducting materials. b. ECM Hole Making: Explore the capabilities of ECM for cutting tapered features or Workpieces.	**CO5**
Total Hours: 120 hrs.	

Course Code: CNC0302	Course Name: Environmental Science	L	T	P	C
Course Offered in: M E		2	0	0	NA

Pre-requisite: Basic knowledge of biology, chemistry, ecology, geology, mathematics, and understanding of human impacts on natural systems.

Course Objectives:

To help the students in realizing the inter-relationship between man and environment and help the students in acquiring basic knowledge about environment.

Course Outcome: After completion of the course, the student will be able to		**Bloom's Knowledge Level (KL)**
CO1	Understand the basic principles of ecology and the environment. Ecosystem: Basic concepts, components of ecosystems, food chains and food webs. Ecological pyramids	**K2**
CO2	Understand the different types of natural recourses like food, forest, Minerals and energy and their conservation	**K2**
CO3	Understand the different types of pollution, pollutants, their sources, effects, and their control methods.	**K2**
CO4	Understand the basic concepts of sustainable development, Environmental Impact Assessment (EIA) and different acts related to environment	**K2**

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO MAPPING	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	-	3	3	2	2	-	2	2	2
CO2	3	3	2	2	-	3	3	2	2	-	2	2	2
CO3	3	3	2	2	-	3	3	2	2	-	2	2	2
CO4	3	3	2	2	-	3	3	3	2	-	2	2	2

Course Contents / Syllabus

UNIT 1	**Basic Principle of Ecology and Biodiversity**	**5 HOURS**

Definition, Scope and basic principles of ecology and environment. Ecosystem: Basic concepts, components of ecosystem. Food chains and food. Webs. Ecological pyramids, Energy flow in ecological systems, Characteristics of different ecosystems. Biogeochemical Cycles: Importance, gaseous and sedimentary cycles. Carbon, Nitrogen, Phosphorus and Sulphur Cycles. Biodiversity and their importance, Threats to biodiversity, major causes, extinction's, vulnerability of species to extinction, IUCN threa t categories, Red data book. Strategies for biodiversity conservation, principles of biodiversity conservation in-situ and ex-situ conservation strategies Mega diversity zones and Hot spots, concepts, distribution and importance.

UNIT 2	**Natural Resources and Ecological succession**	**5 HOURS**

Natural resources and associated problems. Forest resources: Use and over- exploitation, deforestation. Timber extraction, mining, dams and their effects on forest and tribal people. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. Food resources: World food problems, changes caused by agriculture and over- grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, and salinity. Land resources: Land as a resource, land degradation, man induced landslides. Equitable use of resources for sustainable lifestyles. Non-Renewable Energy Resources: Fossil fuels and their reserves, Nuclear energy, types, uses and effects, Renewable Energy Resources: hydropower, Solar energy, geothermal, tidal and wind energy, Biomass energy, biogas and its advantages. Ecological succession-Types, stages, examples of ecological succession

UNIT 3	**Pollution and Waste Management**	**5 HOURS**

Air pollution: sources of air pollution, Primary and secondary air pollutants. Origin and effects of SOX, NOX, Cox, CFC, Hydrocarbon, control of air pollution. Water pollution: sources and types of water pollution, Effects of water pollution, Eutrophication, Soil pollution: Causes of soil pollution, Effects of soil pollution, Major sources of and effects of noise pollution on health, Ra dioactive and thermal pollution sources and their effects on surrounding environment. Solid waste disposal and its effects on surrounding environment, Introduction to E- Waste, Types and classification of E- Waste, Impacts of E- Waste on environment and human health, E-Waste management and recycling., Climate change, global warming, acid rain, ozone layer depletion.

UNIT 4	**Environmental Assessment and Legislation**	**5 HOURS**

Women education, Role of NGOs regarding environmental protection, Bio indicators and their role, Natural disasters and disasters management, Aims and objectives of Environmental Impact Assessment (EIA). Salient features of following Acts: Environmental Protection Act, 1986, Wildlife (Protection) Act, 1972.Water (Prevention and control of pollution) Act, 1974. Forest (Conserving) Act, 1980. Definition and concept of sustainability, impacted areas of sustainable development, Global initiative, and issues on sustainable development UN SDGs, System Thinking and Sustainability.

	Total Lecture Hours	**20 HOURS**

Textbook:

S.No	**Book Title with publication agency & year**	**Author**
1	Brady, N.C. 1990. The nature and properties of Soils, Tenth Edition. Mac Millan Publishing Co., New York	Brady, N.C
2	Sodhi G.S. 2005, Fundamentals of Environmental Chemistry: Narosa Publishing House, New Delhi.	Sodhi G.S
3	Dash, M.C. (1994), Fundamentals of Ecology, Tata Mc Graw Hill, New Delhi.	Dash, M.C
Reference Books:		
1	Rao M.N. and H.V.N. Rao, 1989 : Air Pollution, Tata McGraw Hill Publishing Co. Ltd., New Delhi	Rao M.N. and H.V.N. Rao
2	A Text Book of environmental Science By Shashi Chawla	Shashi Chawla
Self-Study Content Links:		
MOOC'S		
VIDEO LECTURES	https://www.youtube.com/watch?v=T21OO0sBBfc https://www.youtube.com/watch?v=qt8AMjKKPDo https://www.youtube.com/watch?v=brF0RWJyx9w https://www.youtube.com/watch?v=GK_vRtHJZu4	**7 min 42 sec** **15 min** **3 min 25 sec** **4 min 25 sec**
WEB REFERENCES	https://www.youtube.com/watch?v=yqev1G2iy20, https://www.youtube.com/watch?v=_74S3z3IO_I, https://www.youtube.com/watch?v=jXVw6M6m2g0	**28 min** **31 min 35 sec** **11 min**

Course Code: CASCC0401	Course Name: Employability Skill Development - II	L	T	P	C
Course Offered in: B. Tech ECE / EE (VLSI)		**2**	**0**	**0**	**2**

Pre-requisite: Basic Reasoning and Basic Programming Skill

Course Objectives:

Section-A: Develop proficiency in C++ programming, data management, and project development by applying concepts, teamwork, and problem-solving to build practical applications.

Section-B: Enhance quantitative aptitude skills through business mathematics concepts, enabling accurate problem-solving in financial calculations, ratios, and real-world numerical applications.

Course Outcome: After completion of the course, the student will be able to		**Bloom's Level**
CO1	Apply C++ programming concepts, file handling, and STL techniques to develop efficient programs for data storage and manipulation.	**K3**
CO2	Design and implement a C++ -based project by applying planning, teamwork, and problem-solving skills.	**K6**
CO3	Solve real-life business math problems involving percentages, profit and loss, discounts, interest average calculations and using appropriate mathematical methods	**K3**
CO4	Solve real-life business math problems involving averages, mixtures, and ratios using appropriate mathematical methods	**K3**

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	-	2	3	1	-	3	2	2	2			
CO2	3	3	3	3	3	2	1	3	2	2	2			
CO3	3	3	2	1	-	-	-	1	2	2	2			
CO4	-	-	-	-	1	2	-	3	2	2	-			

Course Contents / Syllabus

Section-A

Unit 1:	**Foundations of C++ Programming and Data Management Techniques**	**8 hours**

Core Fundamentals of C++, Functions & Program Structure, Arrays & Strings, **File Handling:** File streams (ifstream, ofstream, fstream), Reading/writing text files , Saving user data (scores, records, logs) **STL Basics:** vector, array, map, unordered_map set Algorithms (sort, find)

Unit 2	**Project/Game Development**	**8 hours**

Project Planning & Development (Teams, roles, idea pitching and Implement in C++), Mini Project, Project Demonstration and Review

Section-B

Unit 3	**Business Math I**	**8 hours**

Percentage, Profit and Loss, Discount, Simple Interest and Compound Interest, Average

Unit 4	**Business Math II**	**6 hours**

Ratio & Proportion, Partnership, Mixture & Allegation, Clock , Calendar

Total Lectures: 30 hours

Reference Books:

S. No	Book Title	Author
1.	A Project-Based Introduction to Programming	Access Point Publishing
2.	Programming: Principles and Practice Using C++	Bjarne Stroustrup
3.	Effective Modern C++	Scott Meyers
4.	Quantitative Aptitude	R S Aggarwal
5.	Verbal & Non-Verbal Reasoning	R S Aggarwal

Mode of Evaluation

CIE							ESE	Total
ST1	ST2	ST3	TA1 10	TA2 10	TA3 10	Attendance 10		
60			40					100

Course Code: CME0403	Course Name: Measurement and Metrology	L	T	P	C
Course Offered in: ME		3	0	0	3

Pre-requisite: NA

Course Objectives:

The objective of this course is to bridge the gap between theoretical physics and practical engineering inspection. It aims to equip undergraduate mechanical engineering students with the skills to establish measurement traceability, design standard-limit gauges, operate advanced coordinate measuring systems, and integrate high-precision optical technologies into modern, automated manufacturing environments.

Course Outcome: After completion of the course, the student will be able to

1. Understand the measurement systems to evaluate calibration principles, error sources, and experimental uncertainty	K2
2. Design limits, fits, and manufacturing gauges based on Taylor's principle and tolerance analysis	K3
3. Understand and apply contact or non-contact equipment to inspect component form, surface roughness, and tool wear.	K3
4. Analyze geometric errors in screw threads and gears using specialized probing and CMM configurations.	K3
5. Understand the non-contact optical and laser systems for real-time, high-precision in-process inspection.	K2

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	-	2	-	-	-	-	-	-	1	3	-	1
CO2	3	2	3	-	-	1	-	-	-	-		3	2	1
CO3	3	1	-	2	2	-	-	-	-	-	2	2	3	3
CO4	2	2	-	1	3	-	-	-	-	-	-	2	2	2
CO5	2	-	2	-	3	2	-	-	-	-	-	3	3	2

Course Contents / Syllabus

Unit 1	Foundations of Metrology & Linear Measurement	10 hours

Parameters – geometry (straightness, flatness, roundness, etc.), displacement, force, speed, torque, flow, level, pressure, temperature, acceleration;
Definitions: Accuracy, precision, range, resolution, uncertainty, and error sources; Regression analysis.
Calibration principles; Linear and angular measurements; Comparators; Gauge design; Interferometry.

Unit 2	Inspection	10 hours

Definitions: Tolerance zone and grades, Hole and shaft system, Geometric tolerances, Taylor's principle of gauging, Design of tolerances for various applications.
Tolerance analysis in manufacturing and assembly; Role of metrology in the design of Manufacturing.

Unit 3	Mechanical Measurements and Equipment	09 hours

Dimensional metrology - Vernier, micrometers, LVDT;
Form metrology - form tester, surface profiler, CMM, 3D scanning;
Surface metrology - optical microscopes, Laser scanning microscopes, electron microscopy (SEM/TEM), x ray microscopy, Raman spectroscopy;
Tool wear, workpiece quality, and process metrology.

Unit 4	**Specialized Mechanical Metrology**	**08 hours**

Screw Thread Metrology -Terminology and Specific Measurement Techniques.
Gear Measurement- Gear types, terminology, spur gear errors, and advanced measurement.
CMM - Introduction to CMM, Types of CMM Configurations, Probing Systems, CMM Software

Unit 5	**Advanced Metrology & Opto-Mechanical Systems**	**08 hours**

Non-Contact Profiling - Optical systems used for surface inspection without physical contact.

Optical Metrology - Laser vision, in-process gauging, lens/coating design, and precision assembly.

High-Precision Tech - Nanotechnology instrumentation, stage position metrology, and contact bonding.

	Total Lecture Hours	**45 hours**

Textbook:

1.E.O Doebelin and Dhanesh Manik, “Measurement Systems”, McGraw Hill, 2017

2.Bewoor & Kulkarni, “Metrology & Measurement” Tata McGraw Hill, 2009.

Reference Books:

1. D. James, and S, Meadow, “Geometric Dimensioning and Tolerancing”, Marcel Dekker, 1995

2. Madhav S. Phadke, Quality Engineering using Robust Design, Prentice Hall, 1989

Self-Study Content Links:		Duration (in Hrs)
MOOCs	nptel.ac.in/courses/112106138	15
Video Lectures	Lec 1: Introduction to measurement	15
Web References	Measurement comparisons in the CIPM MRA (March 2016) get_pdf.cfm	15

Note: Self-study material may include assignments, seminars, micro projects, industrial visits, any other student activities, etc.

Course Code: CME0401	Course Name: Computer Integrated Manufacturing	L	T	P	C
Course Offered in: ME		3	0	0	3

Pre-requisite: Manufacturing Science and Technology

Course Objectives:

This course develops a comprehensive understanding of the integration of manufacturing systems through computer technologies by introducing the fundamentals of CIM and smart manufacturing, including essential processes, data flow, subsystem integration, and the role of automation. Students will learn about computer graphics, CAD systems, and geometric transformations for design applications, along with the principles and programming of CNC machines for modern manufacturing. The course further emphasizes the application of group technology and automated material handling systems within a CIM environment. In addition, it covers process planning methodologies, including computer-aided approaches, and provides insights into flexible manufacturing systems (FMS) and their industrial applications.

Course Outcome: After completion of the course, the student will be able to

1. Understand the concept of computer integrated manufacturing including its elements, data flow, system integration, automation principles, and smart manufacturing concepts.	K2
2. Apply principles of computer graphics and geometric transformations to represent and manipulate engineering designs in CAD environments.	K3
3. Apply the working principles of CNC machines and develop part programs using G & M codes for basic manufacturing operations.	K3
4. Understand the role of group technology and automated material handling systems in improving efficiency within a CIM environment.	K2
5. Understand the process planning approaches and the design and implementation of flexible manufacturing systems for modern industrial applications.	K2

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	2	–	–	–	1	2	3	3	2
CO2	3	2	3	2	3	1	–	–	–	–	2	3	3	2
CO3	3	2	3	2	3	1	–	–	–	1	2	3	3	2
CO4	3	2	2	1	2	2	–	–	–	1	2	3	2	2
CO5	3	3	3	2	3	2	–	1	1	2	3	3	3	3

Course Contents / Syllabus

Unit 1	Introduction to CIM	8 hours

Introduction to CAD, CAM, CIM, Elements of CIM, Data flow in CIM, CIM wheel, Processes involved in CIM, CIM integration, Sub-system of CIM, Automated manufacturing system, Need of automation, Basic elements of automation, Levels of automation, Advantages & disadvantages of automation, Introduction to smart manufacturing.

Unit 2	Computer Graphics	10 hours

Principles of Computer Graphics:

Introduction to design, Computer graphics display devices, Cathode ray tube, Random & raster scan display, Colour CRT monitors, Direct view storage tubes, Flat panel display, Color models, Bresenham's line drawing algorithm and Bresenham's circle generating algorithm.

Geometric Transformations:

Coordinate systems in CAD, Transformation of geometry, 2D Geometric transformations - Translation, Rotation, Scaling, Reflection, & Shearing matrix representation, Composite transformation, 3D Geometric transformations.

Unit 3	**CNC Machines & Programming**	**11 hours**

Introduction to CNC Machines: Fundamental of Numerical Control, elements of NC/CNC/DNC machines, classification of NC/CNC machine, Advantages, limitations and application of NC/CNC system, CNC Tooling and mechanism, Adaptive control.

CNC Part Programming: G & M Codes, Manual part programming for drilling, milling, and turning, Computer assisted part programming (APT).

Unit 4	**Group Technology and Material Handling in CIM environment**	**8 hours**

Group Technology: Group technology (GT), Part family, Part classification and coding systems, Benefits of group technology, Limitations of group technology.

Material Handling in CIM environment: Material handling systems and their function, Types of material handling equipment, Automated guided vehicle systems, Automated storage/retrieval systems, Swarf handling.

Unit 5	**Process Planning and Flexible Manufacturing System**	**8 hours**

Process Planning: Process planning, Manual process planning, Computer aided process planning – Variant and Generative, Aggregate production planning, Capacity planning, Concurrent engineering, Design for manufacturing, Advanced manufacturing planning.

Flexible Manufacturing System: Flexible manufacturing system, FMC/FMS components. FMS workstations, Material handling & storage system, Computer control system, Planning for FMS, FMS layout, FMS benefits and applications, Alternative approaches to flexible manufacturing.

	Total Lecture Hours	**45 hours**

Textbook:

S. No	**Book Title**
1.	CAD/CAM/CIM - P. Radhakrishnan, S. Subramanyan, V. Raju (New Age International)
2.	Automation, Production Systems, and Computer-Integrated Manufacturing - Mikell P. Groover (Pearson Education)
3.	Computer Integrated Manufacturing – Alavudeen and Venkateshwaran (PHI Learning)
4.	CAD/CAM - P. N. Rao (Tata McGraw Hill)

Reference Books:

S. No	**Book Title**
1.	CAD/CAM Theory and Practice - Ibrahim Zeid (McGraw-Hill)
2.	CNC Machines and Automation - J.S. Narang (Dhanpat Rai)
3.	Computer Numerical Control Concepts and Programming - Warren S. Seames

Self-Study Content Links:		Duration (in Hrs)
MOOCs	https://nptel.ac.in/courses/112104289	20
Video Lectures	https://www.youtube.com/watch?v=54XQ_vw6LVI	15
Web References	https://www.google.co.in/books/edition/COMPUTER_INTEGRATED_MANUFACTURING/GlL0TO6n320C?hl=en&gbpv=1&dq=Computer+Integrated+Manufacturing+books&printsec=frontcover	10

Course Code: CME0402	Course Name: Fluid Mechanics & Machines	L	T	P	C
Course Offered in: ME		3	0	0	3

Pre-requisite: Engineering Mathematics, Engineering Mechanics

Course Objectives:

The objective of the Fluid Mechanics & Machines course is to provide students with a comprehensive understanding of fluid properties, fluid statics, and fluid dynamics principles. Students will learn to analyze and solve problems related to fluid flow in pipes, and around submerged bodies. The course will cover the principles and applications of fluid machinery, including pumps, turbines, and compressors. Through theoretical concepts and practical laboratory experiments, students will develop the skills to design, and analyze, fluid systems and machinery, preparing them for advanced studies and careers in mechanical engineering field.

Course Outcome: After completion of the course, the student will be able to

1. Apply the principles of fluid properties, pressure measurement, buoyancy, and hydrostatic force analysis to solve basic fluid mechanics engineering problems.	K3
2. Apply the principles of fluid kinematics, fluid dynamics, and flow measurement devices to analyze and solve engineering problems related to fluid flow systems..	K4
3. Analyze boundary layer behavior, pipe flow characteristics, dimensional analysis, and flow measurement techniques to evaluate fluid flow performance in engineering applications.	K4
4. Apply the principles of turbo machinery and hydraulic turbines to solve problems related to fluid power generation and turbine performance.	K3
5. Analyze the performance and operating characteristics of pumps and hydro-power systems, including efficiencies, losses, and system parameters in hydraulic applications.	K4

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	–	–	–	–	1	3	1	1
CO2	3	3	2	1	1	-	–	–	–	–	1	3	2	1
CO3	3	3	2	2	1	-	1	–	–	–	1	3	2	1
CO4	3	2	2	-	-	-	1	–	–	–	1	3	1	1
CO5	3	3	2	2	1	-	1	–	–	–	1	3	1	1

Course Contents / Syllabus

Unit 1	Fluid Statics	8 hours

Dimensions and units: physical properties of fluids- specific gravity, viscosity, and surface tension, vapor pressure and their influence on fluid motion- atmospheric, gauge and vacuum pressures.
Measurement of pressure: Piezometer, U-tube, and differential manometers, buoyancy, and hydrostatic force analysis.

Unit 2	Fluid Kinematics & Dynamics	10 hours

Fluid Kinematics: Stream line, path line and streak lines and stream tube, classification of flows-steady & unsteady, uniform, non-uniform, laminar, turbulent, rotational, and irrotational flows-equation of continuity for one dimensional (1D) & three dimensional (3D) flow, circulation and vorticity, flow net.
Fluid dynamics: Surface and body forces – Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its application on force on pipe bend. Flow measurement: Venturimeter, orifice meter, and Pitot tube.

Unit 3	Boundary Layer , Pipe Flow& dimensional analysis	10 hours

Boundary Layer Concepts: Definition, thicknesses, characteristics along thin plate, laminar and turbulent boundary layers (No derivation) boundary in transition, separation of boundary layer, submerged projects-drag and lift.
Pipe flow analysis: Reynolds's experiment –Darcy Weisbach equation – Minor losses in pipes- pipes in series and pipes in parallel-total energy line hydraulic gradient line. Measurement of flow: Pitot tube, Venturi meter and Orifice meter, Flow nozzle.
Dimensional analysis: Buckingham Pi theorem, important dimensionless numbers, and their significance.

Unit 4	Prime Movers and Thrust Analysis	9 hours

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, Head and efficiency, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine- working principles, work done, efficiencies, hydraulic design Draft tube theory and deficiency.
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.

Unit 5	Fluid Pumps and Devices	8 hours
Centrifugal pumps: classification, working, work done-barometric head – losses and efficiencies specific speed, pumps in series and parallel, performance characteristic curves, NPSH **Reciprocating pumps**: Working, Discharge, slip, Indicator Diagram Hydraulic lifts, torque convertor. **Hydro-power Systems:** Layout of hydroelectric power plants, surge tanks, and efficiency calculations..		
	Total Lecture Hours	**45 hours**

Textbook:

1. Fluid mechanics and machines by R.K Bansal.
2. Introduction to fluid mechanics and Fluid machines by S.K. Som, Gautam Biswas, S Chakraborty.

Reference Books:

7. Fluid Mechanics by Yunus Cengel.
8. Fluid Mechanics, by F.M. White.
9. Fluid mechanics by R. K. Rajput, S. Chand and Company Limited.
10. Introduction to Fluid Mechanics by R.W. Fox, A.T. McDonald and P.J. Pritchard.
11. Fluid Mechanics And Hydraulic Machines by K. Subramanya

Self-Study Content Links:		Duration (in Hrs)
MOOCs		
Video Lectures	NPTEL: Mechanical Engineering - NOC: Introduction to Fluid Mechanics	60
Video Lectures	NPTEL: Mechanical Engineering - NOC: Fluid Machines	40
Web References	https://msubbu.in/ln/fm/	20

Note: Self-study material may include assignments, seminars, micro projects, industrial visits, any other student activities, etc.

Course Code: CAS0402	Course Name: Probability, Statistics and Complex Analysis	L	T	P	C
Course Offered in: B. Tech- ME		3	1	0	4

Pre-requisite: B. Tech 1st year

Course Objectives:

The objective of this course is to familiarize the students with concepts of statistical techniques and complex variables. It aims to show case the students with standard concepts and tools from B. Tech to deal with advanced level of mathematics and applications that would be essential for their disciplines.

CO	Course Outcome: After completion of the course, the student will be able to	Bloom's Level
CO1	Apply the basic concepts of probability theory in real life problems.	K3
CO2	Apply the concept of skewness and Kurtosis in the relevant application area.	K3
CO3	Apply the concept of Random Variable and Probability Distributions in real world problems	K3
CO4	Apply the working methods of complex functions for finding analytic functions.	K3
CO5	Apply the concepts of complex functions for finding Taylor's series, Laurent's series and evaluation of definite integrals	K3

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	3	1	1	-	1	2	2	2	-	-	-
CO2	3	2	2	3	1	1	-	1	2	2	2	-	-	-
CO3	3	2	1	2	-	-	-	-	1	1	1	-	-	-
CO4	3	2	2	3	-	-	-	-	2	1	1	-	-	-
CO5	3	2	2	3	1	1	-	1	2	2	1	-	-	-

Course Contents / Syllabus

Module 1	Statistical Techniques-I	9 hours

Introduction: Measures of central tendency: Mean, Median, Mode, Standard deviation, Quartile deviation, Moments, Skewness, Kurtosis.

Module 2	Theory of Probability	9 hours

Definition of Probability, Elementary problems of probability, Addition and Multiplication theorems of probability, Conditional Probability

Module 3	Random Variables and distribution	9 hours

Random Variable: Definition of a Random Variable, Discrete Random Variable, Continuous Random Variable, Expected Value of a Random Variable, Mean, Variance, Moment Generating Function, Binomial, Poisson, Normal distribution.

Module 4	Complex Variable - Differentiation	9 hours

Limit, Continuity and differentiability, Functions of complex variable, Analytic functions, Cauchy- Riemann equations (Cartesian and Polar form), Harmonic function, Method to find Analytic functions.

Module 5	Complex Variable -Integration	9 hours

Complex integrals, Contour integrals, Cauchy-Goursat theorem (Statement), Cauchy integral formula (Statement), Taylor's series, Laurent's series, Liouvilles's theorem (Statement), Singularities, Classification of Singularities, zeros of analytic functions, Residues, Methods of finding residues, Cauchy Residue theorem(Statement).

Total Lecture Hours	45 hours

Textbook:

1. Textbook of Engineering Mathematics- IV, Bali, N.P.
2. Advanced engineering mathematics, Jain, R.K.
3. Higher engineering mathematics, Grewal, B.S.
4. Statistical methods, Gupta, S.P.

5. Advanced engineering mathematics, ZILL, DENNIS G.		
Reference Books: 1. Introduction to Probability Models, Ross, Sheldon M 2. Probability, Random Variables and Stochastic Processes, Papoulis, Athanasios 3. Advanced engineering mathematics, Kreyszig, E.		
Self-Study Content Links:		Duration (in Hrs)
MOOCs	1. https://www.coursera.org/learn/complex-analysis 2. https://www.coursera.org/learn/introductiontoprobability 3. https://www.futureskillsprime.in/course/probability-and-statistics/	10 Hrs 7 Hrs 30 Hrs
Video Lectures	https://youtu.be/xhAdXdkx4IY?si=qmeWymorZjTRP5Gb https://youtu.be/D-ugYU-5KD0?si=5GnIImQh0KZkhdng https://youtu.be/Am7Bu4aytEQ?si=tPOufctBkK0fa-41 https://youtu.be/KQkOxZSZpZw?si=HWag4HVOEnAYFEea https://youtu.be/TL7yAkOA9D0?si=Zpde-JLws0Du9UT4	27 Min 28 Min 28 Min 27 Min 29 Min
Web References	https://ocw.mit.edu/courses/18-04-complex-variables-with-applications-spring-2018/pages/syllabus/	3hrs

Course Code: CME0453	LAB Course Name: Measurement and Metrology Lab.	L	T	P	C
Course Offered in: ME		0	0	2	1

Pre-requisite: NA

Course Objectives:

The objective of this laboratory course is to enhance the students' practical understanding of industrial inspection paradigms. By bridging the gap between theoretical measurement principles and practical implementation, the lab aims to train students to confidently operate precise dimensional tools, analyze sensor signal characteristics, and appreciate the role of automated, non-contact measurement software in modern quality control departments.

Course Outcome: After completion of the course, the student will be able to

1. Measure linear dimensions and component tapers using contact-type instruments.	K 3
2. Inspect geometric form errors like roundness, cylindricity, and surface flatness.	K 4
3. Understand the working principles and operational characteristics of mechanical transducers, Coordinate Measuring Machines (CMMs), and non-contact electro-optical inspection systems	K 4

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	-	-	2	-	-	2	2	-	1	3	2	3
CO2	3	2	-	2	2	-	-	2	2	-		2	2	1
CO3	3	2	2	1	2	1	-	2	2	-	3	3	3	2

List of Practicals (Indicative & Not Limited To)	CO
1. Performance on linear measurements using Vernier Caliper and Micrometer.	CO 1
2. Performance on linear measurements using Vernier Calliper, Vernier height gauge, and Micrometer.	CO 1
3. Measurement of angle and taper of a given workpiece using a Sine Bar and Slip Gauges.	CO 1
4. Performance on surface measurements using a dial indicator.	CO 2
5. Use a Dial Test Indicator and a V-block to check the Roundness and Cylindricity of a cylindrical shaft.	CO 2
6. To study Temperature Measurement.	CO 3
7. To study Stress, Strain, and Force Measurements.	CO 3
8. To Study Torque, Speed, and acceleration measurement.	CO 3
9. To study the application of image processing and electro-optical sensors in non-contact dimensional metrology.	CO 3
10. To study the construction, working principle, and applications of a Coordinate Measuring Machine (CMM).	CO 3

Total Hours: 30 hrs.

Course Code: CME0452	LAB Course Name: Fluid Mechanics and Machines Lab	L	T	P	C
Course Offered in: ME		0	0	2	1

Pre-requisite: Basic Knowledge of Mechanics and mathematics

Course Objectives:

The objective of this laboratory course is to provide practical understanding of fluid mechanics and hydraulic machines through experiments on Bernoulli's theorem, venturi meter, orifice meter, notches, minor losses in pipes, and Reynolds number determination, along with performance analysis of hydraulic turbines such as Pelton wheel and Francis turbine, and hydraulic pumps including centrifugal and reciprocating pumps, thereby developing experimental skills, data analysis capability, and understanding of fluid flow behavior and hydraulic system performance

Course Outcome: After completion of the course, the student will be able to

1. Demonstrate performance characteristics of flow and flow measuring devices.	K3
2. Demonstrate various turbines and determine their efficiency.	K3
3. Demonstrate various pumps and determine their efficiency.	K3

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	2	-	1	-	-	-	-	1	3	2	1
CO2	3	2	2	2	-	1	-	-	-	-	1	3	1	1
CO3	3	2	2	2	-	1	-	-	-	-	1	3	2	1

List Of Practical's (Indicative & Not Limited To)	CO
1. To verify the Bernoulli's Theorem.	CO1
2. To determine the coefficient of discharge of venturi meter.	CO1
3. To determine coefficient of discharge of an orifice meter.	CO1
4. To determine the coefficient of discharge of Notch (V and Rectangular types)	CO1
5. To determine the minor losses due to sudden enlargement, sudden contraction, and bends.	CO1
6. To find critical Reynolds number for a pipe flow.	CO1
7. Experiments on performance of Pelton wheel	CO2
8. Experiments on performance of Reaction turbine (Francis Turbine)	CO2
9. Experiments on performance of Centrifugal Pump.	CO3
10. Experiments on performance of reciprocating pump	CO3

Total Hours: 30hrs.

LAB Course Code: CME0455	LAB Course Name: Machine Design and Application of FEA	L	T	P	C
Course Offered in: ME		0	0	6	3

Pre-requisite: Engineering Mechanics & Strength of Materials

Course Objectives:

To provide students with a comprehensive understanding of Finite Element Analysis (FEA), machine component design, material behavior, fatigue and failure theories, and the application of analytical, FEM-based, and optimization techniques for analyzing, evaluating, and improving the structural performance, strength, efficiency, safety, and reliability of mechanical systems under various loading conditions.

Course Outcome: After completion of the course, the student will be able to

1. Understand the fundamentals and workflow of Finite Element Analysis (FEA).	K2
2. Analyze mechanical components under static and dynamic loading conditions.	K5
3. Apply failure theories and fatigue concepts in mechanical design.	K5
4. Design and evaluate gear using analytical and FEM methods.	K5
5. Design and evaluate bearings using analytical and FEM methods.	K5

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	1	1	1	1	1	1	3	2	2
CO2	3	3	3	2	2	1	1	1	1	1	1	3	3	3
CO3	3	3	3	2	2	1	1	1	1	2	1	3	2	3
CO4	3	3	3	3	3	1	1	1	1	2	2	3	3	3
CO5	3	3	3	3	3	1	1	1	1	2	2	3	3	3

Course Contents / Syllabus

Unit 1	Introduction to FEA	05 hours

Introduction to FEA, Different modules in FEA, Different types of Elements, Material Properties, Boundary condition, Meshing, assembly, result visualization.

Unit 2	Static and Dynamic Loading	11 hours

Types of loads, Stresses due to bending and torsion, Theory of failure, Cause of failure in shafts, Materials for shaft, Design of shafts subjected to twisting moment, bending moment and combined twisting & bending moments. Analysis of shaft failure using FEM package.

Cyclic stresses, Fatigue and endurance limit, Stress concentration factor and its measures for various machine parts, Notch sensitivity, Design for finite and infinite life, Soderberg, Goodman & Gerber criteria. Analysis of component under fluctuating load using FEM package. Analysis of component under fluctuating load using FEM package.

Unit 3	Gear Design	11 hours

Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear tooth, Design of spur gear, Introduction to Helical Gear.

Worm Gear:

Types of worms, Terminology, Gear tooth proportions, Efficiency of worm gears, Heat dissipation in worm gearing, Strength and wear tooth load for worm gears, Design of worm gearing system. Analysis of Gear using FEM package.

Unit 4	Selection and Analysis of Bearing	10 hours

Types, Advantages and disadvantages, Designation of bearing, bearing life, Selection of roller bearings, Dynamic equivalent load for roller contact bearing under constant and variable loading, Reliability of Bearing, Design of roller bearing. Analysis of bearing using FEM package		
Unit 5	**Miscellaneous Elements**	**10 hours**
Design for Threaded joint and rivet joint, Design for Welded joint, Design for helical spring.		
	Total Lecture Hours	**47 hours**

Textbook:

1. Design of Machine Elements, Tata McGraw Hill Co by V. B. Bhandari

2. Textbook of Machine Design, Eurasia Publishing House by R. S. Khurmi,

Reference Books:

12. Machine Design: An Integrated Approach, Pearson Education by Robert L. Norton,
13. Mechanical Engineering Design, McGraw-Hill Education by Joseph Shigley,

Self-Study Content Links:		Duration (in Hrs)
MOOCs	Finite Element Analysis, Infosys Springboard	10
Video Lectures	Design of Machine Elements I, IIT Kharagpur, Prof. G. Chakraborty, Prof. S.K. Roychowdhury, Prof. B. Maiti, NPTEL	35
Web References	purdue.edu/freeform/me354/wp-content/uploads/sites/28/2022/06/220607_ME354_LectureNotes_BHess.pdf	35

Course Code: CME0455	LAB Course Name: Machine Design and Application of FEA	L	T	P	C
Course Offered in: ME		0	0	6	3

Pre-requisite: Engineering Mechanics & Strength of Materials

Course Objectives:

To equip students with the knowledge and skills to apply Finite Element Analysis (FEA), analytical design methods, and optimization techniques in the design and evaluation of mechanical components and systems, considering material behavior, stress, deformation, fatigue, and failure theories to ensure safe, efficient, and reliable engineering solutions.

Course Outcome: After completion of the course, the student will be able to

1. Understand the fundamentals and workflow of Finite Element Analysis (FEA).	K2
2. Analyze mechanical components under static and dynamic loading conditions.	K5
3. Apply failure theories and fatigue concepts in mechanical design.	K5
4. Design and evaluate gear using analytical and FEM methods.	K5
5. Design and evaluate bearings using analytical and FEM methods.	K5

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PPSO2
CO1	3	2	2	2	3	1	1	1	1	1	1	3	2	2
CO2	3	3	3	2	2	1	1	1	1	1	1	3	3	3
CO3	3	3	3	2	2	1	1	1	1	2	1	3	2	3
CO4	3	3	3	3	3	1	1	1	1	2	2	3	3	3
CO5	3	3	3	3	3	1	1	1	1	2	2	3	3	3

List Of Practical's (Indicative & Not Limited To)	CO
1. b. Introduction to FEA Packages.	CO1
2. a. Direct stress in uniform and non-uniform cross section rod. b. Analysis of haft under combined loading c. Analysis of plate, shaft using FEA package under fluctuating load, Visualization of stress, criterion of failure. d. Stress analysis in Threaded bolt and rivet joints using FEA Package. e. Stress analysis in different types of Welded Joints using FEA Package. f. Stress analysis in spring under different loading conditions using FEA Package.	CO2
3. a. Cyclic stresses, Fatigue and endurance limit, Stress concentration, Notch sensitivity, Design for finite and infinite life, Soderberg, Goodman & Gerber criteria. b. Design and analysis of plate having notch or circular hole FEA package under fluctuating load, Visualization of stress, criterion of failure.	CO3
4. a. Stress visualization in Spur Gears using FEA Package b. Stress visualization in Helical Gears using FEA Package c. Stress visualization in spur gears and gear shaft using FEA Package d. Stress visualization in worm gears using FEA Package e. Thermal modeling of worm gear f. Stress visualization in worm gear system using FEA Package.	CO4
5. a. Drafting of Bearing on Solid Modeling software. b. Analysis of stress concentration in Ball Bearing using FEA Package. . c. Analysis of stress concentration in Roller Bearing using FEA Package. d. Analysis of Stress concentration in Needle Bearing using FEA Package.	CO5
Total Hours: 47 hrs.	

LAB Course Code: CCSCC0452	LAB Course Name: Problem Solving Approaches	L	T	P	C
Course Offered in: B. Tech. ECE / EE (VLSI)		0	0	2	1

Pre-requisite: Programming Language C/C++ or Java or Python

Course Objectives:

Problem-solving in computer programming involves a structured approach to identifying, analyzing, and resolving coding challenges. The process typically includes thoroughly understanding the problem, decomposing it into smaller, manageable parts, designing an appropriate algorithm, implementing the solution through code, and performing testing and debugging to ensure correctness and efficiency

Course Outcome: After completion of the course, the student will be able to		Bloom's Level
CO1	Develop logic-based solutions using control statements, recursion and bit manipulation to solve basic and intermediate computational problems	K6
CO2	Implement and manipulate arrays and strings using fundamental and advanced searching sorting techniques	K3
CO3	Analyze and debug code for logical errors and improve the efficiency of the solution using appropriate data structures and algorithmic Pattern	K4

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	2	2	-	-	2	3	3	2
CO2	3	3	2	2	2	-	2	-	-	-	2	2	2	2
CO3	3	3	2	2	3	1	2	2	-	-	3	3	3	2

List Of Practical's (Indicative & Not Limited To)

Problem Statements need to be discussed in lab session: Control Statements	CO

1. Secure Password Generator

A company wants to create a secure password generator for their employees. The password must be based on specific numeric properties to enhance its complexity and security. Write a program to validate and generate a secure password according to the following rules:

1. Prime Number Validation:

- The user must input a 3-digit number. The program should first check if the number is a prime number.
- If it is not a prime number, the user should be prompted to enter another number until a valid prime number is provided**.**

2. Sum of Digits Check:

- Once a valid prime number is entered, calculate the sum of its digits. If the sum of the digits is not divisible by 3, ask the user to enter another prime number until a valid one is found.

3. Armstrong Number Check:

- Check entered prime number is Armstrong or not? If Armstrong are found, prompt the user to enter another prime number and repeat the process.

Password Generation:

Concatenate the 1 if entered prime number is Armstrong otherwise 2 with the sum of the digits of the valid prime number to form the secure password.

Example Scenario:

Sample Input

Enter a 3-digit prime number: 153 Sum of
digits of 153 = 9
The sum is divisible by 3. 153 is Armstrong number ***Sample***

Output

Secure Password: 19

2. Write a function to input electricity unit charges and calculate total electricity bill according to the given condition: For first 50 units Rs. 0.50/unit for next 100 units Rs. 0.75/unit For next 100 units Rs. 1.20/unit For unit above 250 Rs. 1.50/unit an additional surcharge of 20% is added to the bill

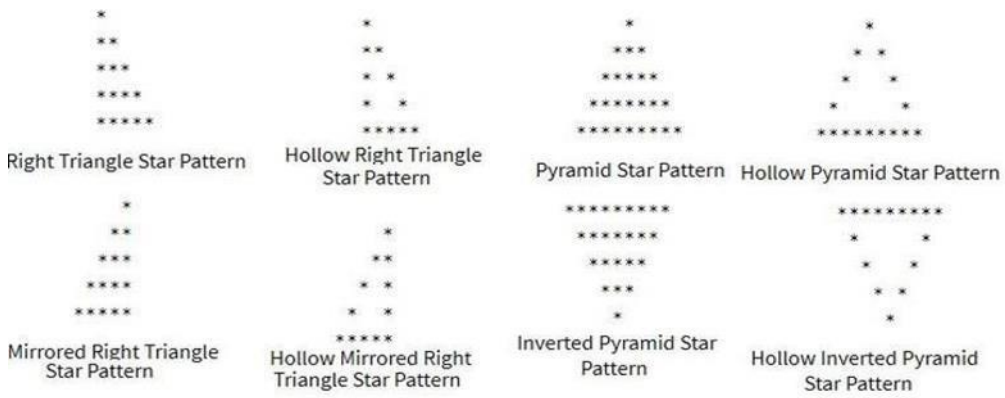
3. Write a method to generate a secure code which the sum of all possible palindrome numbers between given two numbers. For Example:

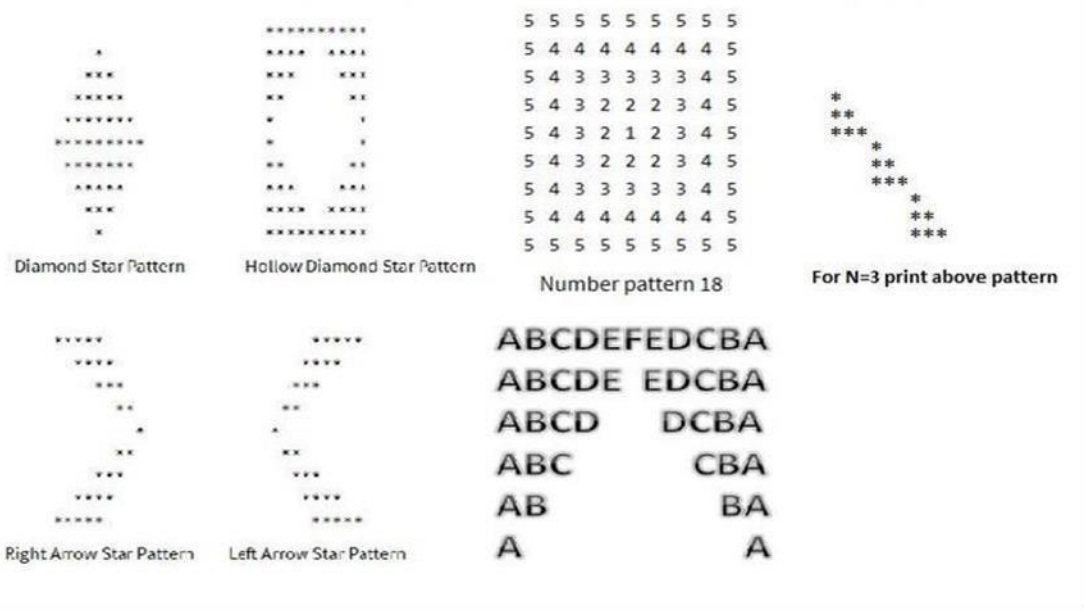
Input: 10, 80

Output: 308

Explanation: All palindrome numbers between 10 & 80 are: 11,22,33,44,55,66,77 Password=
11+22+33+44+55+66+77 = 308

4. Draw **the following Patterns for N=5**





Problem Statements need to be discussed in lab session: Recursive Approach (Basic)

1. Write a program that takes an integer n as input and prints the multiplication table of n from n * 1 to n * 10. The output should clearly show each multiplication step.
2. Write a program to calculate the sum of all integers from 1 to a given number N. The program should take N as input and output the total sum using iteration or recursion.
3. **Find the GCD of Two Numbers Using Recursion:**
   Write a recursive function to calculate the Greatest Common Divisor (GCD) of two numbers using Euclid's algorithm. The function should take two integers as input and return their GCD.
4. **Find the LCM of Two Numbers Using Recursion:**
   a. Write a program to compute the Least Common Multiple (LCM) of two numbers using recursion. You may use the relationship LCM(a, b) = |a * b| / GCD(a, b) and a recursive function for GCD.

Problem Statements need to be discussed in lab session: Bit Manipulation

1. Write a program to count the number of set bits (1s) in the binary representation of a given integer. The program should efficiently use bitwise operations to perform the task without converting the number to a string.
2. Write a program that takes a number and a bit position as input and checks whether the bit at that position is set (1) or clear (0). Use bitwise operators to perform the check
3. Given a number and a position, write a program to toggle (invert) the bit at the given position using bitwise operations. The result should reflect the updated value of the number after flipping the bit
4. Write a program to compute the XOR of all numbers from 1 to n using a mathematical pattern (not a loop). Use bitwise XOR properties to achieve an efficient solution
5. Given an array of size n-1 containing unique elements from 1 to n, find the missing number using bit manipulation (preferably XOR approach) without sorting or using extra space.

6. Given an array where all elements repeat twice except two elements that appear only once, write a program to find the two non-repeating elements using bitwise operations in linear time and constant space.
7. Write a program to check if a given number is a power of two using bit manipulation. A number is a power of two if it has exactly one set bit in its binary representation.
8. Given two integers A and B, write a program to count how many bits need to be flipped to convert A to B. Use XOR to find differing bits and count the number of set bits.
9. Write an efficient program to count the total number of set bits in binary representations of all numbers from 1 to n. Optimize the approach using bitwise logic and recursion.
10. Write a program to calculate the square of a number using only bitwise operations and addition. Do not use multiplication, division, or any power functions.
11. Write a function to add two integers using bitwise operations only. Avoid using the + or - operators. Implement logic using XOR and AND operations for binary addition.
12. Write a program to generate the power set (all subsets) of a given set using bitwise representation. Each subset can be represented by a binary number where each bit indicates inclusion of the corresponding element.

Problem Statements need to be discussed in lab session: Arrays (Try to use sliding window, prefix sum, cadence, recursion, bit manipulation, two pointer approaches)

1. Sarah is assisting the "MathMinds Club" in creating passwords for their online platform. They have a list of numbers, some stable and some unstable. Define a function that can help Sarah calculate the password according to the given scenario.

Scenario:

- There are N numbers provided.
- A number is stable if each digit appears the same number of times.
- A number is unstable if the frequency of its digits is not the same.
- The password is computed as the sum of all stable numbers minus the sum of all unstable numbers.
- Consider only those numbers in the list that have more than equal to three digits.

For example:

Input: N=5 List: 12, 1313, 122, 678, 898
Output: Password: 971

2. Given an array of integers, including possible negative values, you are allowed to modify at most one element by doubling its value. The goal is to find the maximum possible sum of any subarray after making this modification.

Input:

arr = [-2, 1, -3, 4, -1, 2, 1, -5, 4]

Expected Output:

- Original Maximum Subarray Sum: 6 (achieved from [4, -1, 2, 1])

Maximum Sum After Modification: 10(achieved from [8, -1, 2, 1], where the value 4 is doubled to 8).

3. For a given string, generate a pattern based on the following rules:

Input: A string of characters (e.g., "HAT").

Output: Generate patterns by replacing characters with the numeric value 1 and process the patterns as described below:

1. **Replace one character at a time with 1:**
    - For each character in the string, replace it with 1, keeping the other characters unchanged.
    - Example for "HAT":

1AT, H1T, HA1

2. **Replace two characters at a time with 1:**
    - Replace every combination of two characters with 1, keeping the remaining character unchanged.
    - If 1s are consecutive, replace them with their sum (e.g., 11T becomes 2T).
    - Example for "HAT":

11T → 2T, H11 → H2, 1A1

3. **Replace all characters with 1:**
    - Replace all characters in the string with 1.
    - If there are consecutive 1s, sum them up (e.g., 111 becomes 3).
    - Example for "HAT": 111

→ 3

Final Output

For the string "HAT", the output should be: 1AT, H1T, HA1, 2T, H2, 1A1, 3.

4. Given a sorted array arr [] and a target value, the task is to count triplets (i, j, k) of valid indices, such that arr[i] + arr[j] + arr[k] = target and i < j < k.

Examples:

Input: arr[] = [-3, -1, -1, 0, 1, 2], target = -2

Output: 4

5. You are given an array prices[] where prices[i] represents the price of a given stock on day i. You want to maximize your profit by choosing a single day to buy one stock and choosing a different day in the future to sell that stock. Write a program to return the maximum profit you can achieve from this transaction. If no profit is possible, return 0.

6. Find **the "Kth" max and min element of an array:**

Given k, find the k-th smallest and k-th largest element in the array. Input: arr = [7, 10, 4, 3, 20, 15], k = 3

Output: Kth Smallest: 7, Kth Largest: 10

Given k, find the k-th smallest and k-th largest element in the array. Input: arr = [7, 10, 4, 3, 20, 15], k = 3

Output: Kth Smallest: 7, Kth Largest: 10

7. Sort a binary array with value 0,1 and 2 using constant space and one pass (Dutch national Flag algorithm)

Input: [0, 2, 1, 2, 0]

Output: [0,0,1,2,2]

8. Find **longest consecutive subsequence:**

Return the length of the longest consecutive elements sequence. Input: [1, 9, 3, 10, 4, 20, 2]

Output: 4 (Sequence: 1, 2, 3, 4)

9. Given a number of bits and a number K. In one flip you can toggle exactly K consecutive bits. With only this flip operation available, convert the string into all 1. Input String: 0000110000 and K=3

Following are four flip operations by using which all bits converted into 1's. Flip1-1110110000 Flip2-1110110111

Flip3-1111000111 Flip4- 1111111111

If it is not possible to convert all bits into one's then print "IMPOSSIBLE".

10. Given a list of non-negative integers, arrange them in such a way that they form the largest possible number. Since the result can be very large, return it as a string in **O(N log N)** time complexity.

Example-1	**Example-2**
Input:	**Input**:
N = 5	N = 4
Arr[] = {3, 30, 34, 5, 9}	Arr[] = {54, 546, 548, 60}
Output: 9534330	**Output**: 6054854654

11. Given an array arr[] of size n containing distinct integers within the range [1, n+2], find the two missing numbers from the first n+2 natural numbers.

Constraints:

- The solution must run in **O(N) time** and use **O(1) extra space**.
- The array does not contain duplicate values.

Examples:

Input: arr[] = [1, 2, 4, 6, 3, 8], n = 6

Output: 5, 7

12. Given a string str of lowercase alphabets and a number k, the task is to print the minimum value of the string after removal of k characters. The value of a string is defined as the sum of squares of the count of each distinct character present in the string. Return the minimum possible required value. **Examples:**

Input: str = "abccc", k = 1

Output: 6

Input: str = "aabcbcbcabcc", k = 3

Output: 27

Expected Time Complexity: O(n+klog(p))

Note: Here n is the length of string and p is number of distinct alphabets and k number of alphabets to be removed

13. Given a non-negative integer **S** represented as a string, remove **K** digits from the number so that the new number is the smallest possible.

Note: The given *num* does not contain any leading zero.

Expected Time Complexity: O(|S|).

	Example 1: Input S=”149811, K=3 Output: 111	Example 2: Input S=”1002991, K=3 Output: 21	

14. You are given a two-dimensional grid board[][] of size n * m consisting of English letters and a string target. Your task is to determine whether the target word can be formed by sequentially connecting letters from the grid. You may move to adjacent cells **horizontally or vertically** (not diagonally), and **a cell may not be reused** once it is part of the current path.

Examples:

Input:

board[][] = [['C', 'A', 'T'], ['R', 'A', 'K'], ['T', 'O', 'N']],

target = "CART" **Output:**

true **Explanation:**

You can trace the word "CART" through the path: C → A → R → T (moving horizontally and vertically, without repeating cells).

15. Given an encoded string **s**, the task is to decode it. The encoding rule is:

- **k[encodedString],** where the **encodedString** inside the square brackets is being repeated exactly **k** times. Note that **k** is guaranteed to be a positive integer, and encoded String contains only lowercase English alphabets.

Note: The test cases are generated so that the length of the output string will never exceed 10^5.

Examples:

Input: s = "1[b]"

Output: "b"

Input: s = "3[b2[ca]]"

Output: "bcacabcacabcaca"

Competitive coding list will be shared with the students.

Total Hours: 15 hrs.

CIE						ESE	Total
PS1	**PS2**	**PS3**	**TA1** **5**	**TA2** **5**	**Attendance** **10**		
30			**20**			**50**	**100**

Course Code: CNC0401	Course Name: Artificial Intelligence and Cyber Ethics	L	T	P	C
Course Offered in: All Branches		**2**	**0**	**0**	**-**

Pre-requisite: Basic understanding of AI, Cybercrime, Computer System and Ethics

Course Objectives:

The course aims to foster critical thinking about ethical issues, promote responsible use of technology, and ensure students can identify, analyze, and address ethical dilemmas in Artificial Intelligence and cyber domains.

Course Outcome: After completion of the course, the student will be able to		**Bloom's Level**
CO1	Learn key principles of AI ethics, summarizing ethical considerations and applications in AI development and deployment.	**K2**
CO2	Apply policies and framework for Fairness in AI and Machine Learning.	**K3**
CO3	Apply privacy and security concepts, risk management and regulatory compliance in the field of AI and Cyber Security.	**K3**
CO4	Understand the nature of cybercrimes, the principles of intellectual property rights (IPR), and the legal measures necessary to address and prevent these issues.	**K2**
CO5	Describe the impact of AI in Society, employment and workforce.	**K2**

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	2
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	2

Course Contents / Syllabus

Unit 1	**An Overview to AI Ethics**	**5 hours**

Definition of AI Ethical principles in AI, Sources of AI data, Legal implications of AI Security Breaches, Privacy and AI Regulations, Key Principles of Responsible AI, Transparency and Accountability, Dual-Use Dilemma, Human-Centric Design, Introduction to Cyber Laws and Ethics, Historical Development of Cyber laws, Legal frameworks.

Unit 2	**Fairness and Favoritism in Machine Learning**	**6 hours**

Introduction to Fairness and Bias in AI, Types of Fairness and Bias, Impact of Bias and Fairness in AI, Techniques for Measuring Fairness and Bias, Techniques for Mitigating Bias, Current Policies and Frameworks for Fairness in AI, Bias in Data Collection, Fairness in Data Processing, Generative AI, Types of Bias in Generative AI.

Unit 3	**AI Ethics and Cybersecurity Principles**	**5 hours**

Importance of Privacy and Security in AI, AI specific Security Tools and Software, Privacy-Preserving Machine Learning (PPML) and Privacy-Preserving Data Mining (PPDM), Risk Management: Risk Assessment and Incident Response, Regulatory Compliance: GDPR, HIPAA, Case Studies: Implementation of AI Ethics guidelines and best practices in engineering projects

Unit 4	**Cybercrimes, IPR and Legal Measures**	**8 hours**

Types of Cybercrimes and their Impact, Legal measures for Cybercrime Prevention and Prosecution, IPR: Copyrights, Trademarks, Patents, and Trade Secrets, Ethical Implications of Intellectual Property, Cyber Security and Privacy Issues, Cyber Crime Investigations and Digital Evidence Handling, Overview of Indian Cyber Laws (IT Act 2000 and Amendments), Comparative Overview: Indian vs Global Cyber Laws, Case Study: The ATM Heist – Cosmos Bank Cyber Attack (India, 2018).		
Unit 5	**AI Contribution to Social Evolution**	**6 hours**
Positive and Negative Political impacts of AI, Role of AI in social media and Communication Platforms, AI-Generated Content and Deepfakes, Key Technical Stakeholders in AI Deployment: Developers, Researchers, Policymakers, Technical Impacts on Employment and Workforce Automation Technologies: Robotic Process Automation (RPA), Autonomous Systems.		
	Total Lecture Hours	**30 hours**

Textbook:	
	Authors Name
1. Artificial Intelligence: A Guide for Thinking Humans	Melanie Mitchell
2. Cyber Ethics: Morality and Law in Cyberspace	Richard Spinello, Jones & Bartlett Learning
Reference Books:	
	Authors Name
1. Artificial Intelligence and Ethics	S. B. Kishor, Debajit Biswas.
2. Cyber Security and Cyber Laws Cengage	Alfred Basta, Nadine Basta, Sattwik Panda

Self-Study Content Links:		**Duration (in Hrs)**
MOOCs		
Video Lectures	Unit 1: https://www.youtube.com/watch?v=VqFqWIqOB1g Unit 2: https://www.youtube.com/watch?v=hVJqHgqF59A Unit 3: https://www.youtube.com/watch?v=O5RX_T4Tg24 Unit 4: https://www.youtube.com/watch?v=RJZ0pxcZsSQ Unit 5: https://www.youtube.com/watch?v=I9FOswjTSGg	00Hrs 06Min 00Hrs 05Min 00Hrs 01Min 00Hrs 05Min 00Hrs 10Min
Web References		

Course Code: CME0412	Course Name: Factory Automation	L	T	P	C
Course Offered in: ME		3	0	0	3

Pre-requisite: Basics of Manufacturing processes

Course Objectives:

Upon completing this course, students will be able to implement, and manage automated systems in manufacturing environments, including material handling, production, quality control, and process control. They will gain a comprehensive understanding of automation technologies, including computer-based control systems, and be able to apply this knowledge to improve efficiency, productivity, and quality in industrial settings.

Course Outcome: After completion of the course, the student will be able to

1. Explain the principles and strategies of automation in production systems, including basic elements, advanced functions, and levels of automation.	**2**
2. Describe the design and components of material handling systems used in industrial applications.	**3**
3. Apply techniques to develop automated manufacturing systems.	**3**
4. Implement industrial control systems for process automation.	**3**
5. Design and develop computer-based industrial control systems for real-world applications.	**3**

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	-	-	-	-	2	3	2	3
CO2	3	3	3	3	3	2	-	-	-	-	2	3	2	3
CO3	3	3	3	3	3	2	-	-	-	-	2	3	2	3
CO4	3	3	3	3	3	2	-	-	-	-	2	3	2	3
CO5	3	3	3	3	3	2	-	-	-	-	2	3	2	3

Course Contents / Syllabus

Unit 1	Introduction to Factory Automation	10 hours
Introduction to Automation in Production Systems, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automation, Flow Lines and Transfer Mechanisms, Fundamentals of Transfer Lines.		
Unit 2	**Material Handling and Identification Technologies**	**8 hours**
Overview of Material Handling Systems, Applications of Material Handling Systems, Material Transport Systems, Storage Systems, Overview of Automatic Identification Methods.		
Unit 3	**Automated Manufacturing Systems**	**10 hours**
Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation.		
Unit 4	**Control Technologies in Automation:**	**8 hours**
Industrial Control Systems, Process Industries versus Discrete Manufacturing Industries, Continuous Versus Discrete Control, Computer Process and its Forms.		
Unit 5	**Computer Based Industrial Control:**	**9 hours**
Introduction & Automatic Process Control, Building Blocks of Automation Systems: LAN, Analog & Digital I/O Modules, SCADA Systems & RTU. Distributed Control System: Functional Requirements, Configurations.		
Total Lecture Hours		**45 hours**

Textbook:

1 Automation, Production Systems, and Computer-Integrated Manufacturing by Mikell P. Groover
2 Manufacturing Automation: Metal Cutting Mechanics, Machine Tool Vibrations, and CNC Design by Yusuf Altintas
3 Industrial Automation: Handbook of the Practical Man by Frank Lamb
4 Automated Manufacturing Systems with PLCs by Hugh Jack

Reference Books:

1 Computer Control of Machines and Processes by John G. Bollinger and Neil A. Duffie

2 Industrial Control Electronics: Applications and Design by J. Michael Jacob
3 Automation and Control Systems by Frank Petruzella

Self-Study Content Links:		Duration (in Hrs)
MOOCs	Factory Automation: Shaping the Future of Manufacturing | Coursera, Factory Automation using PLC Logics	17
Video Lectures	https://www.youtube.com/@realpars https://www.youtube.com/@Automationanywhere	15
Web References	Industrial Automation Course Free. Valid Certificate	13

Course Code: CME0411	Course Name: Automotive Engines	L	T	P	C
Course Offered in: ME		**3**	**0**	**0**	**3**

Pre-requisite: Basic knowledge of Thermodynamics, Heat Transfer, and Fluid Mechanics. An understanding of the fundamentals of internal combustion engines, as covered in the Theory of Machines and Engineering Thermodynamics courses, is also required.

Course Objectives:

To provide students with a comprehensive understanding of internal combustion engines, including their classification, construction, operating principles, fuel and ignition systems, combustion processes, performance characteristics, cooling and lubrication systems, forced induction, emissions, modern engine technologies, and testing methods for performance evaluation and improvement.

Course Outcome: After completion of the course, the student will be able to

1. Understand engine types, components, and operating principles of SI and CI engines, including cycle analysis and emissions.	K2
2. Analyse fuel delivery and ignition systems, including carburetor's, fuel injectors, nozzles, and ignition mechanisms.	K4
3. Evaluate combustion processes in SI and CI engines and identify factors affecting knocking and combustion chamber design.	K3
4. Explain engine cooling, lubrication, supercharging, turbocharging, and exhaust systems and their impact on performance.	K3
5. Conduct engine testing, measure performance parameters, and interpret results using standard testing methods.	K3

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	2	2	2	2	1	1	2	3	2
CO2	3	2	2	2	2	2	3	2	2	1	1	3	3	3
CO3	3	2	2	1	2	2	2	2	1	1	1	2	3	2
CO4	3	2	3	2	2	1	2	2	2	1	1	2	3	2
CO5	3	2	1	1	2	2	2	2	1	1	1	3	3	3

W2Course Contents / Syllabus

Unit 1	**Introduction to I.C Engines and Cycles**	**08 hours**

Introduction to I.C Engines: Principle of working, Classification, Air std. Fuel, air and actual cycles, two and four-stroke, SI and CI engines, main parts, valve and port timing diagram

Unit 2	**Combustion Phenomenon in SI engines**	**10 hours**

Combustion Phenomenon in SI engines: Principles of combustion in SI engines, effect of engines and operating variables on ignition delay & flame propagation, combustion chamber for SI engines, cycle-to-cycle variation, pre-ignition, abnormal combustion, theories of detonation, effect of engine and operating variables on detonation, surface ignition, adiabatic flame temperature, ignition systems.

Unit 3	**Combustion phenomenon in CI engines**	**10 hours**

Combustion phenomenon in CI engines: Principles of combustion in CI engine, delay period, variables affecting delay period, diesel knock, methods of controlling diesel knock, combustion process & combustion chambers for CI engines.

Unit 4	**Fuel system and Mixture requirement in SI and CI Engines**	**08 hours**

Fuel system and Mixture requirement in SI and CI Engine: Carburetion- working principles, chemically correct air-fuel ratio and load variation, compensating devices, venturi and jet dimension calculation, modern fuel induction system, multi-point fuel injection system, fuel injection: common rail direct injection.

Unit 5	**Engine Testing, Supercharging, Lubrication and Engine Cooling**	**09 hours**

Engine Testing, Supercharging, Lubrication and Engine Cooling: Engine performance and testing, measurement of power, supercharging limits of SI &CI engines, methods of supercharging, superchargers, turbo charging, lubrication principles, function of lubricating system, properties of lubricating oil, additives, cooling system, air cooling, water cooling.

Total Lecture Hours	**45 hours**

Textbook:

1. Internal Combustion Engines by John B. Heywood
2. Internal Combustion Engines by V. Ganesan

Reference Books:

14. Advanced engine technology by Heinz Heisler
15. Internal Combustion Engine analysis and Practice by Obert, E.F.

Self-Study Content Links:		Duration (in Hrs)
MOOCs	NPTEL: IC Engines & Gas Turbines Course (https://www.youtube.com/playlist?list=PLT7nZHsCM2mxVhbXn7BeHTXg4w7btBf5I) NPTEL: Engine Combustion & Emissions (https://www.youtube.com/playlist?list=PLwdnzlV3ogoXHbVNKWL1BYOo_8PpyNtnC) NPTEL Fundamentals of Combustion (https://www.youtube.com/playlist?list=PLwdnzlV3ogoXHbVNKWL1BYOo_8PpyNtnC) NPTEL IC Engines (Fuel System Lectures) (https://www.youtube.com/watch?v=ry3hnaDvW3M) NPTEL IC Engines Full Course (https://www.youtube.com/watch?v=NVYSMRU1P7M)	**15 hours**
Video Lectures	#1 course overview & classification of internal combustion engines | part 01 lec 1: introduction to engine systems and its types: a focus on ignition system lec 16: fuels and combustion (part i) noc19-ae02 lec 13 - cooling and exhaust system (lab session) ic engine- performance and testing of ic engine numerical	**15 hours**
Web References	https://nptel.ac.in/courses/112103262 https://nptel.ac.in/courses/112104033 https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_me29 https://gpahmedabad.ac.in/uploads/2/coursedetails/studymaterials/4330201_Unit3.pdf	**15 hours**

Note: Self-study material may include assignments, seminars, micro projects, industrial visits, any other student activities, etc.

Course Code: CME0413	Course Name: Operations Management	L	T	P	C
Course Offered in: ME		3	0	0	3

Pre-requisite: NA

Course Objectives:

Course Objectives: students with fundamental concepts and principles of operations management, enabling them to understand its strategic role in achieving organizational goals. Students will learn tools and techniques for designing, planning, and controlling operations, fostering problem-solving skills for both manufacturing and service sectors.

Course Outcome: After completion of the course, the student will be able to

1. Understand the fundamental concepts and strategic importance of Operations Management.	K2
2. Design products, processes, and facility layouts effectively for various production systems.	K3
3. Apply forecasting and aggregate planning techniques for efficient resource management and demand fulfillment.	K3
4. Manage inventory effectively and implement Material Requirements Planning (MRP) for dependent demand systems.	K3
5. Apply principles of Total Quality Management (TQM) and understand the fundamentals of Supply Chain Management (SCM).	K3

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	2	1	-	-	1	2	2	1	1
CO2	3	3	3	1	2	2	2	-	-	1	1	3	2	1
CO3	3	3	2	2	3	1	1	-	-	3	2	3	2	1
CO4	3	3	2	1	3	1	1	-	-	3	1	3	2	1
CO5	2	2	1	1	2	3	3	1	2	2	2	2	2	2

Course Contents / Syllabus

Unit 1	Introduction to Operations Management & Operations Strategy	8 hours

Introduction to Operations Management: Definition, scope, importance, and historical evolution of operations management. Role of operations in an organization. Manufacturing vs. Service Operations.

Operations as a System: Input-Transformation-Output model. Types of production systems (Job shop, Batch, Mass, Continuous, Project). Product-Process Matrix.

Operations Strategy: Linkage with corporate strategy. Competitive priorities (Cost, Quality, Delivery, Flexibility). Order qualifiers and order winners. Strategic choices in operations.

Productivity: Definition, measurement, and improvement strategies. Factors affecting productivity.

Unit 2	Product Design, Process Selection & Facility Layout	10 hours

Product Design and Development: Stages of product development. Design for Manufacturability (DFM) and Design for Assembly (DFA). Value Analysis/Value Engineering. Concurrent Engineering.

Process Selection: Types of processes (job shop, batch, assembly line, continuous flow). Process flow analysis and charting (flow process chart, operation process chart). Break-even analysis for process choice.

Capacity Planning: Definition, measures of capacity, determinants of effective capacity. Capacity planning strategies (leading, lagging, matching). Capacity requirements planning (CRP).

Facility Location: Factors influencing location decisions. Qualitative and quantitative methods (Load-distance method, Center of gravity method).

Facility Layout: Objectives and types of layouts (Process, Product, Cellular, Fixed Position). Principles of good layout design. Line balancing techniques.

Unit 3	Forecasting & Aggregate Planning	9 hours

Forecasting: Importance and scope of forecasting. Types of forecasts (economic, technological, demand). Steps in forecasting.

Forecasting Approaches: Qualitative methods (Delphi technique, Market surveys). Quantitative Methods: Time series analysis (Moving Averages, Exponential Smoothing, Trend Projection). Associative models (Linear Regression).

Forecast Accuracy: Measures of forecast error (MAD, MSE, MAPE).

Aggregate Planning: Objectives and strategies of aggregate planning (pure strategies: chase, level). Mixed strategies. Techniques for aggregate planning (graphical- basic introduction).

Unit 4	Inventory Management & Material Requirements Planning (MRP)	10 hours

Inventory Management: Types of inventory, functions of inventory. Inventory costs (holding, ordering, shortage).

Inventory Control Systems: Independent vs. Dependent demand. ABC analysis.

Economic Order Quantity (EOQ) Model: Assumptions, derivation, and applications. EOQ with quantity discounts.

Reorder Point (ROP): ROP with and without safety stock. Service level. Continuous and periodic review systems.

Material Requirements Planning (MRP): Introduction to MRP, benefits. MRP inputs (Master Production Schedule, Bill of

Materials, Inventory records). MRP logic and outputs (Planned order releases). Basic understanding of MRP II and ERP.		
Unit 5	**Quality Management & Supply Chain Management**	**8 hours**
Quality Management: Definition of quality, dimensions of quality. Evolution of quality management. **Total Quality Management (TQM):** Principles and elements of TQM. Quality gurus (Deming, Juran, Crosby). **Statistical Process Control (SPC):** Introduction to control charts (X-bar, R, p, c charts - basic understanding and application). Process capability (Cp, Cpk). **Quality Standards & Tools:** ISO 9000, Six Sigma (DMAIC methodology - basic concept). Quality tools (Pareto chart, Fishbone diagram, Flowcharts, Check sheets). **Supply Chain Management (SCM):** Introduction to SCM, objectives, and importance. Supply chain drivers. Recent trends in SCM (Resilience, Digitalization, Sustainability).		
	Total Lecture Hours	**45 hours**
Textbook: 1. **Operations Management: Processes and Supply Chains by Lee J. Krajewski, Manoj K. Malhotra, Larry P. Ritzman** 2. **Operations Management by Heizer, Barry Render, Chuck Munson**		
Reference Books: 1. **Production and Operations Management by S.N. Chary** 2. **Operations Management: Theory and Practice by B. Mahadevan**		

Self-Study Content Links:		Duration (in Hrs)
MOOCs	nptel.ac.in/courses/112107238	20
Video Lectures	http://www.youtube.com/watch?v=MbNmIZNy3qI	15
Web References	Lecture Notes | Operations Management | Sloan School of Management | MIT OpenCourseWare	10

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