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Web: www.mits.ac.in
DEPARTMENT OF MECHANICAL ENGINEERING

CIRCULAR

Date: 20-07-2024

It is hereby informed to all the faculty members that **Program Assessment Committee (PAC)** meeting is scheduled on 22-07-2024 at WB106 (CAD/CAM Lab II) for reviewing the course structure and syllabus for second year (I semester & II semester) R23 regulation.

Agenda:

1. Discuss the PO/PSO attainment of the 2020-24 batch.
2. Discussion on second year R-23 course structure.
3. Reviewing second year R-23 syllabus.
4. Discussion on department vision and mission.

The following PAC members are requested to attend the meeting.

Sl. No.	Name of the Member	Designation
1.	**Dr. S. Baskaran**	Assoc. Professor & Head of the Department, ME
2.	**Dr. M. Lakshmana Rao**	Professor & Workshop Superintendent, ME, MITS
3.	**Dr. I. Arun**	Professor, ME, MITS
4.	**Dr. K. V. Nagesha**	Assoc. Professor, ME, MITS
5.	**Dr. P. Sivaiah**	Assoc. Professor & Assoc. Dean R&D, ME, MITS
6.	**Dr. R. Prithivi Rajan**	Assoc. Professor & MOOCs Coordinator, ME, MITS
7.	**Dr. Kamlesh Kumar**	Assistant Professor & UGC Coordinator, ME, MITS
8.	**Dr. Anantha Raman L**	Assistant Professor & Academic / NBA Coordinator, ME, MITS
9.	**Dr. Arun Kumar.D**	Assistant Professor & IQAC Coordinator, ME, MITS
10.	**Dr. Manish Sharma**	Assistant Professor & Institute NBA Coordinator, ME, MITS
11.	**Dr. Dhrubajit Sarma**	Assistant Professor & Asst. NBA Coordinator, ME, MITS

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DEPARTMENT OF MECHANICAL ENGINEERING

12.	**Dr. Rupshree Ozah**	Assistant Professor & IMS / Timetable Coordinator, ME, MITS
13.	**Dr. Thota S S Bhaskara Rao**	Assistant Professor & Research Coordinator, ME, MITS
14.	**Dr. Khan Rehan Wasim**	Assistant Professor & GATE Coordinator, ME, MITS
15.	**Dr. G. Veeresalingam**	Assistant Professor & NIRF Coordinator, ME, MITS
16.	**Dr. Mohammed Dilawar**	Assistant Professor & APSSDC Coordinator, ME, MITS
17.	**Dr. Rajalingam. A**	Assistant Professor & AICTE 360 Coordinator, ME, MITS
18.	**Dr. Jagesh Kumar Prusty**	Assistant Professor & Placement Coordinator, ME, MITS

Dr. S. Baskaran
Assoc. Professor & Head,
Department of ME, MITS

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DEPARTMENT OF MECHANICAL ENGINEERING

Date: 21-07-2024

COMPOSITION AND APPROVAL OF PROGRAM ASSESSMENT COMMITTEE (PAC)

The following members are nominated and approved for constitution of Program Assessment Committee (PAC).

Sl. No.	Name of the Member	Designation
1.	**Dr. S. Baskaran**	Assoc. Professor & Head of the Department, ME
2.	**Dr. M. Lakshmana Rao**	Professor & Workshop Superintendent, ME, MITS
3.	**Dr. I. Arun**	Professor, ME, MITS
4.	**Dr. K. V. Nagesha**	Assoc. Professor, ME, MITS
5.	**Dr. P. Sivaiah**	Assoc. Professor & Assoc. Dean R&D, ME, MITS
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12.	**Dr. Rupshree Ozah**	Assistant Professor & IMS / Timetable Coordinator, ME, MITS
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17.	**Dr. Rajalingam. A**	Assistant Professor & AICTE 360 Coordinator, ME, MITS
18.	**Dr. Jagesh Kumar Prusty**	Assistant Professor & Placement Coordinator, ME, MITS

Responsibilities of the committee:

1. Monitors attainment of COs, POs & PSOs.
2. Evaluate program effectiveness and process necessary changes in mechanical department curriculum.

Dr. S. Baskaran
Assoc. Professor & Head,
Department of ME, MITS

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DEPARTMENT OF MECHANICAL ENGINEERING

Date: 25-07-2024

Program Assessment Committee (PAC)
Minutes of meeting held on 22-07-2024, 03:00 PM – 04:00 PM & Action taken report.
Venue: WB106 (CAD/CAM Lab II)

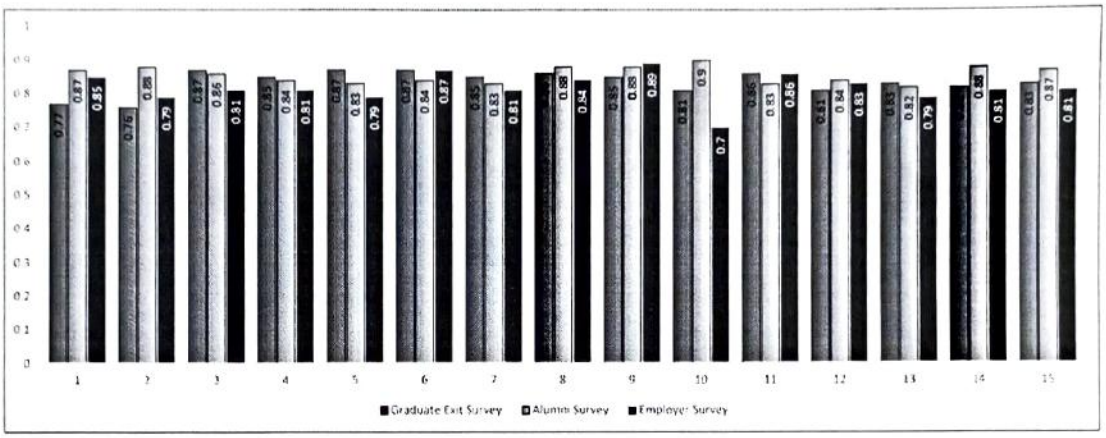
Agenda:

1. Discuss the PO/PSO attainment of the 2020-24 batch.
2. Discussion on second year R-23 course structure.
3. Reviewing second year R-23 syllabus.
4. Discussion on department vision and mission.

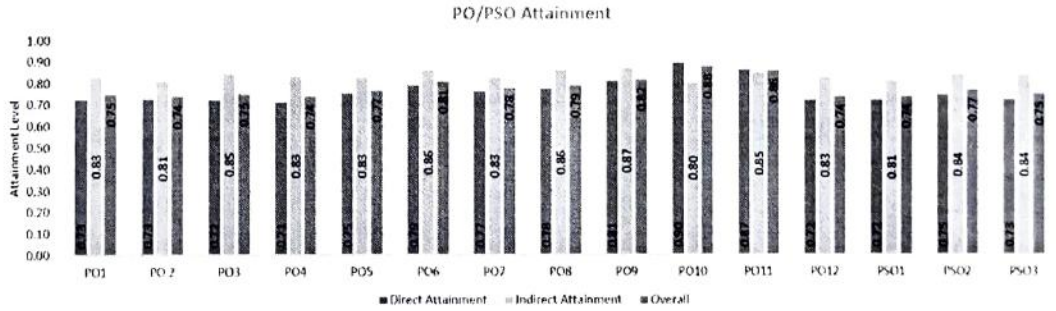
Minutes:

1. The Head of the Department, Dr. S. Baskaran welcomed all members to the PAC meeting.
2. Dr. S. Baskaran presented an overview of the institution, department, recent activities, and achievements.
3. Dr. S. Baskaran presented the agenda of the PAC meeting.
4. Dr. S. Baskaran presented the PO/PSO attainment of 2020-2024 B.Tech. Mechanical batch.
5. Dr. S. Baskaran presented the overall and course-wise PO/PSO attainment of 2020-2024 B.Tech. Mechanical batch.
6. PO6, PO10, and PO11 have attainment levels "3" and the remaining PO attainment levels were "2".
7. It has been observed that the PO/PSO attainment levels were low for PO/PSOs mapped with analytical courses with higher bloom levels.
8. The PO/PSO levels of 2017-21, 2018-22 and 2019-23 were compared.
9. The PO/PSO attainment levels for the 2020-2024 batch are mentioned below:

PO Indirect Attainment														
Graduate Exit Survey	0.77	0.76	0.87	0.85	0.87	0.87	0.85	0.86	0.85	0.81	0.86	0.81	0.83	0.82	0.83
Alumni Survey	0.87	0.88	0.86	0.84	0.83	0.84	0.83	0.88	0.88	0.9	0.83	0.84	0.82	0.88	0.87
Employer Survey	0.85	0.79	0.81	0.81	0.79	0.87	0.81	0.84	0.89	0.7	0.86	0.83	0.79	0.81	0.81
Average	0.83	0.81	0.85	0.83	0.83	0.86	0.83	0.86	0.87	0.80	0.85	0.83	0.81	0.84	0.84



Assessment Method	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Direct Attainment	0.73	0.73	0.72	0.71	0.75	0.79	0.77	0.78	0.81	0.90	0.87	0.72	0.72	0.75	0.73
Indirect Attainment	0.83	0.81	0.85	0.83	0.83	0.86	0.83	0.86	0.87	0.80	0.85	0.83	0.81	0.84	0.84
Overall	0.75	0.74	0.75	0.74	0.77	0.81	0.78	0.79	0.82	0.88	0.86	0.74	0.74	0.77	0.75
Average Attainment	2	2	2	2	2	3	2	2	3	3	3	2	2	2	2



10. Dr. S. Baskaran presented the course structure of R23 regulation to the members.
11. The course structure for 2-1 & 2-2 semesters are mentioned below:

II Year I Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	BS	23MAT105	Numerical Methods	3	0	0	3	3

2	HSMC	23HUM101	Universal Human Values	2	1	0	3	3
3	ES	**23ME103**	**Thermodynamics**	2	1	0	3	3
4	PC	**23ME104**	**Mechanics of Solids**	2	1	0	3	3
5	PC	**23ME105**	**Materials Science and Engineering**	3	0	0	3	3
6	PC	**23ME203**	**Mechanics of Solids and Materials Science Laboratory**	0	0	3	3	1.5
7	PC	**23ME204**	**Computer Aided Machine Drawing Laboratory**	0	0	3	3	1.5
8	SEC	23ENG601	Soft Skills	1	0	2	3	2
9	Audit Course	23CHE901	Environmental Science	2	0	0	2	0
Total				**15**	**3**	**8**	**26**	**20**

II Year II Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	BS	23MAT105	Probability and Statistics for Engineers	3	0	0	3	3
2	HSMC	23HUM102	Economics and Financial Accounting For Engineers	2	0	0	2	2
3	ES		Innovation and Incubation Courses (Refer ANNEXURE - I)	2	0	0	2	2
4	PC	**23ME106**	**Manufacturing Technology I**	3	0	0	3	3
5	PC	**23ME107**	**Fluid Mechanics and Hydraulic Machines**	2	1	0	3	3
6	PC	**23ME108**	**Theory of Machines**	2	1	0	3	3
7	PC	**23ME205**	**Fluid Mechanics and Hydraulic Machines Laboratory**	0	0	3	3	1.5
8	PC	**23ME206**	**Manufacturing Technology I Laboratory**	0	0	3	3	1.5
9	SEC	23CSD601	Python Programming	1	0	2	3	2
Total				**15**	**2**	**8**	**25**	**21**

12. The members approved the course structure pertaining to II-year B.Tech. Mechanical Engineering under R23 regulation.
13. Dr. S. Baskaran presented the list of INNOVATION AND INCUBATION related courses to be offered as ES course in 2-2 semester.

INNOVATION AND INCUBATION COURSES (To be offered under MOOC's Category from SWAYAM – NPTEL)		
Sl. No.	**Course Code**	**Course Title**
1	23IIC5M01	Design, Technology and Innovation
2	23IIC5M02	Introduction on Intellectual Properties to Engineers and Technologies
3	23IIC5M03	Product Engineering and Design Thinking
4	23IIC5M04	Intellectual Property and Competition Law
5	23IIC5M05	Innovation, Business Model and Entrepreneurship
6	23IIC5M06	Understanding Incubation and Entrepreneurship
Any new Innovation and Incubation Course offered by SWAYAM NPTEL can be appended in future.		

14. The members approved the above table pertaining to Innovation and Incubation courses.
15. Dr. S. Baskaran handed the session to Dr. Anantha Raman L. to give detailed presentation on second year R23 core branch courses.
16. Dr. Anantha Raman L. presented the syllabus of each course in 2-1 semester in detail.
17. 23ME103 Thermodynamics:
    - Dr. Anantha Raman L. has presented the syllabus for 23ME103 Thermodynamics.
    - All members accepted the syllabus as it is.
18. 23ME104 Mechanics of Solids:
    - Dr. Anantha Raman L. has presented the syllabus for the 23ME104 Mechanics of Solids.
    - All members accepted the syllabus as it is.
19. 23ME105 Materials Science and Engineering:
    - Dr. Anantha Raman L. has presented the syllabus for 23ME105 Materials Science and Engineering.
    - All members accepted the syllabus as it is.
20. 23ME203 Mechanics of Solids and Materials Science Laboratory:
    - Dr. Anantha Raman L. has presented the syllabus for 23ME203 Mechanics of Solids and Materials Science Laboratory.

- All members accepted the syllabus as it is.

21. 23ME204 Computer Aided Machine Drawing Laboratory:
    - Dr. Anantha Raman L. has presented the syllabus for 23ME204 Computer Aided Machine Drawing Laboratory.
    - All members accepted the syllabus as it is.
22. Dr. Anantha Raman L. presented the syllabus of each course in 2-2 semester in detail.
23. 23ME106 Manufacturing Technology I:
    - Dr. Anantha Raman L. has presented the syllabus for 23ME106 Manufacturing Technology I.
    - All members accepted the syllabus as it is.
24. 23ME107Fluid Mechanics and Hydraulic Machines:
    - Dr. Anantha Raman L. has presented the syllabus for 23ME107 Fluid Mechanics and Hydraulic Machines.
    - All members accepted the syllabus as it is.
25. 23ME108 Theory of Machines:
    - Dr. Anantha Raman L. has presented the syllabus for 23ME108 Theory of Machines.
    - All members accepted the syllabus as it is.
26. 23ME205 Fluid Mechanics and Hydraulic Machines Laboratory:
    - Dr. Anantha Raman L. has presented the syllabus for23ME205 Fluid Mechanics and Hydraulic Machines Laboratory.
    - All members accepted the syllabus as it is.
27. 23ME206 Manufacturing Technology I Laboratory:
    - Dr. Anantha Raman L. has presented the syllabus for 23ME206 Manufacturing Technology I Laboratory.
    - All members accepted the syllabus as it is.
28. Dr. Anantha Raman L. handed the session to Dr. S. Baskaran to present the department's vision and mission.
29. Dr. S. Baskaran presented the department's vision and mission.
30. Dr. S. Baskaran concluded the meeting and thanked all the members for attending and contributing to the improvement of the curriculum and syllabus.
31. The revised course-wise syllabus of all R-23 2-1 & 2-2 courses has been attached with the minutes for reference.

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Approval:

The above-mentioned meeting minutes have been approved by the following members of the Industry Alumni Advisory Board (IAAB).

Sl. No.	Member Name	Designation	Signature
1.	**Dr. S. Baskaran**	Assoc. Professor & Head of the Department, ME	
2.	**Dr. M. Lakshmana Rao**	Professor & Workshop Superintendent, ME, MITS	
3.	**Dr. I. Arun**	Professor, ME, MITS	
4.	**Dr. K. V. Nagesha**	Assoc. Professor, ME, MITS	
5.	**Dr. P. Sivaiah**	Assoc. Professor & Assoc. Dean R&D, ME, MITS	
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8.	**Dr. Anantha Raman L**	Assistant Professor & Academic / NBA Coordinator, ME, MITS	
9.	**Dr. Arun Kumar.D**	Assistant Professor & IQAC Coordinator, ME, MITS	
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11.	**Dr. Dhrubajit Sarma**	Assistant Professor & Asst. NBA Coordinator, ME, MITS	
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14.	**Dr. Khan Rehan Wasim**	Assistant Professor & GATE Coordinator, ME, MITS	
15.	**Dr. G. Veeresalingam**	Assistant Professor & NIRF Coordinator, ME, MITS	
16.	**Dr. Mohammed Dilawar**	Assistant Professor & APSSDC Coordinator, ME, MITS	

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17.	**Dr. Rajalingam. A**	Assistant Professor & AICTE 360 Coordinator, ME, MITS	
18.	**Dr. Jagesh Kumar Prusty**	Assistant Professor & Placement Coordinator, ME, MITS	

8/8/24

Dr. S. Baskaran
Assoc. Professor & Head,
Department of ME – MITS

Dr. C. Yuvaraj
Principal, MITS
Principal
Madanapalle Institute of
Technology & Science
MADANAPALLE

Copy to

- The Principal
- The Vice-Principal (Academics)
- PAC & Department file

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DEPARTMENT OF MECHANICAL ENGINEERING

Course Structure

&

Detailed Syllabi

For the students admitted to

B. Tech. Regular Four Year Degree Programme from the Academic Year 2023-24

and

B. Tech. Lateral Entry Scheme from the Academic Year 2024-25

DEPARTMENT OF MECHANICAL ENGINEERING

MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE, MADANAPALLE

B. Tech Four Year Curriculum Structure

Branch: MECHANICAL ENGINEERING

Total Credits	160 Credits for 2023(Regular) & 120 Credits 2024(Lateral Entry) Admitted Batch onwards

I. Induction Program and Holistic Development Activities

Sl.No	Title	Duration
1	Induction Program (Mandatory)	Three weeks' duration at the start of First Year

R23 - Curriculum Structure
I Year I Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	BS&H	23ENG101	Communicative English	2	0	0	2	2
2	BS&H	23MAT101	Linear Algebra and Calculus	3	0	0	3	3
3	BS&H	23CHE101	Engineering Chemistry	3	0	0	3	3
4	ESC	23CME101	Basic Civil and Mechanical Engineering	3	0	0	3	3
5	ESC	23CSE101	Introduction to Programming	3	0	0	3	3
6	BS&H	23ENG201	Communicative English Laboratory	0	0	2	2	1
7	BS&H	23CHE201	Engineering Chemistry Laboratory	0	0	2	2	1
8	ESC	23CSE201	Computer Programming Laboratory	0	0	3	3	1.5
9	ESC	23ME201	Engineering Workshop	0	0	3	3	1.5
10	BS&H	23HUM201	Health and Wellness, Yoga and Sports	-	-	1	1	0.5
Total				**14**	**0**	**11**	**25**	**19.5**

I Year II Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	BS&H	23MAT102	Differential Equations and Vector Calculus	3	0	0	3	3
2	BS&H	23PHY101	Engineering Physics	3	0	0	3	3
3	ESC	23EEE101	Basic Electrical and Electronics Engineering	3	0	0	3	3
4	ESC	23ME101	Engineering Graphics	1	0	4	5	3
5	PCC	23ME102	Engineering Mechanics	3	0	0	3	3
6	BS&H	23PHY201	Engineering Physics Laboratory	0	0	2	2	1
7	ESC	23EEE201	Electrical and Electronics Engineering Workshop	0	0	3	3	1.5
8	ESC	23CSE202	IT Workshop	0	0	2	2	1
9	PCC	23ME202	Engineering Mechanics Laboratory	0	0	3	3	1.5
10	BS&H	23HUM202	NSS / NCC / Scouts and Guides / Community Service	-	-	1	1	0.5
Total				**13**	**0**	**15**	**28**	**20.5**

(L = Lecture, T = Tutorial, P = Practical, C = Credit

R23 - Curriculum Structure
II Year I Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	BS	23MAT105	Numerical Methods	3	0	0	3	3
2	HSMC	23HUM101	Universal Human Values	2	1	0	3	3
3	ES	23ME103	Thermodynamics	2	1	0	3	3
4	PC	23ME104	Mechanics of Solids	2	1	0	3	3
5	PC	23ME105	Materials Science and Engineering	3	0	0	3	3
6	PC	23ME203	Mechanics of Solids and Materials Science Laboratory	0	0	3	3	1.5
7	PC	23ME204	Computer Aided Machine Drawing Laboratory	0	0	3	3	1.5
8	SEC	23ENG601	Soft Skills	1	0	2	3	2
9	Audit Course	23CHE901	Environmental Science	2	0	0	2	0
Total				**15**	**3**	**8**	**26**	**20**

II Year II Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	BS	23MAT105	Probability and Statistics for Engineers	3	0	0	3	3
2	HSMC	23HUM102	Economics and Financial Accounting For Engineers	2	0	0	2	2
3	ES		Innovation and Incubation Courses (Refer ANNEXURE - I)	2	0	0	2	2
4	PC	23ME106	Manufacturing Technology I	3	0	0	3	3
5	PC	23ME107	Fluid Mechanics and Hydraulic Machines	2	1	0	3	3
6	PC	23ME108	Theory of Machines	2	1	0	3	3
7	PC	23ME205	Fluid Mechanics and Hydraulic Machines Laboratory	0	0	3	3	1.5
8	PC	23ME206	Manufacturing Technology I Laboratory	0	0	3	3	1.5
9	SEC	23CSD601	Python Programming	1	0	2	3	2
Total				**15**	**2**	**8**	**25**	**21**

(L = Lecture, T = Tutorial, P = Practical, C = Credit

ANNEXURE - I

INNOVATION AND INCUBATION COURSES (To be offered under MOOC's Category from SWAYAM – NPTEL)		
Sl. No.	**Course Code**	**Course Title**
1	23IIC5M01	Design, Technology and Innovation
2	23IIC5M02	Introduction on Intellectual Properties to Engineers and Technologies
3	23IIC5M03	Product Engineering and Design Thinking
4	23IIC5M04	Intellectual Property and Competition Law
5	23IIC5M05	Innovation, Business Model and Entrepreneurship
6	23IIC5M06	Understanding Incubation and Entrepreneurship
Any new Innovation and Incubation Course offered by SWAYAM NPTEL can be appended in future.		

B.Tech. II Year I Semester

23ME103 THERMODYNAMICS

L	T	P	C
2	1	0	3

Pre-requisite: NIL

Course Description:

Thermodynamics is one of the fundamental courses in the study of mechanical engineering. The principles of thermodynamics are applicable to a wide range of problems encountered in all branches of engineering. Also, thermodynamics is an essential pre-requisite for subsequent courses in mechanical engineering like fluid mechanics, applied thermodynamics, heat transfer, gas dynamics, refrigeration and air conditioning, etc. This course is designed to equip the students with a thorough understanding of basic concepts of thermodynamics and with necessary skills and techniques to solve problems in thermodynamics through a systematic analysis using fundamental principles. The specific topics to be covered in the course include concepts of system and surroundings, energy, energy transfer by work and heat, properties of substances and property changes, first and second laws of thermodynamics.

Course Objectives:

1. To familiarize concepts of heat, work, energy and governing rules for conversion of one form to another.
2. To explain relationships between properties of matter and basic laws of thermodynamics.
3. To teach the concept of entropy for identifying the disorder and feasibility of a thermodynamic process.
4. To introduce the concept of available energy for maximum work conversion.
5. To provide fundamental concepts of Refrigeration and Psychrometry.

UNIT 1: BASIC CONCEPTS AND FIRST LAW

9 hours

Basic concepts — concept of continuum, microscopic and macroscopic approach. Path and point functions. Intensive and extensive properties, total and specific quantities. System and their types. Thermodynamic Equilibrium State, path and process. Quasi-static, reversible and irreversible processes. Heat and work transfer. Displacement work and other modes of work. P-V diagram. Zeroth law of thermodynamics — concept of temperature and thermal equilibrium– relationship between temperature scales. First law of thermodynamics – application to closed and open systems — steady and unsteady flow processes.

UNIT 2: SECOND LAW AND AVAILABILITY ANALYSIS

9 hours

Heat Reservoir, source and sink. Heat Engine, Refrigerator, Heat pump. Statements of second law and its corollaries, PMM-II. Carnot cycle, Reversed Carnot cycle, Performance. Clausius inequality. Concept of entropy, T-s diagram, Tds Equations, entropy change for — pure substance, ideal gases — different processes, principle of increase in entropy. Applications of second Law. Availability and irreversibility. Expressions for the energy of a closed system and open systems. Energy balance and entropy generation. 1st Law and 2nd Law Efficiency.

UNIT 3: PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE

9 hours
Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of I and II law for pure substances. Ideal and actual Rankine cycles, Cycle Improvement Methods — Reheat and Regenerative cycles, Economiser, preheater, Binary and Combined cycles.
UNIT 4: IDEAL AND REAL GASES, THERMODYNAMIC RELATIONS
9 hours
Properties of Ideal gas- Ideal and real gas comparison- Equations of state for ideal and real gases- Reduced properties. Compressibility factor. Principle of Corresponding states. Generalised Compressibility Chart and its use. Maxwell relations, Tds Equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Clausius Clapeyron equation, Phase Change Processes.
UNIT 5: GAS MIXTURES AND PSYCHROMETRY
9 hours
Mole and Mass fraction, Dalton's and Amagat's Law. Properties of gas mixture — Molar mass, gas constant, density, change in internal energy, enthalpy, entropy and Gibbs function. Reactive Gas Mixtures. Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process — adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Applications.
Course Outcomes:
On successful completion of the course, the student will be able to:
CO1: Understand the zeroth and first law of thermodynamics by formulating temperature scales and calculating the property changes in closed and open engineering systems. CO2: Examine the second law of thermodynamics to evaluate the efficiency of thermal devices by calculating energy and entropy. CO3: Apply the second law of thermodynamics in evaluating the various properties of steam through steam tables and Mollier chart. CO4: Evaluate the properties of pure substance in computing the macroscopic properties of ideal and real gases using gas laws and appropriate thermodynamic relations. CO5: Apply the properties of gas mixtures in calculating the properties of gas mixtures and various thermodynamic relations to calculate property changes.
Text Books:
1. PK Nag, Engineering Thermodynamics, 6th Edition, 2017, McGraw Hill Education, ISBN: 978-9352606429.
2. Çengel, Y. A., Boles, M. A., & Kanoglu, M. (2023). *Thermodynamics: An engineering approach* (10th ed.). McGraw-Hill Education. ISBN: 978-1266152115.
References:
1. J.B. Jones, and R.E. Dugan, Engineering Thermodynamics, 2/e, Prentice Hall, 1996
2. Claus Borgnakke Richard E. Sonntag, Fundamentals of Thermodynamics, 10/e, Wiley, 2022.
3. P.Chattopadhyay, Engineering Thermodynamics, 1/e, Oxford University Press, 2011.
4. CP Arora, Refrigeration and Air-conditioning, 4/e, McGraw Hill, 2021.

Online Learning Resources:
• https://www.edx.org/learn/thermodynamics. • https://archive.nptel.ac.in/courses/112/106/112106310. • https://www.youtube.com/watch?v=7NI5P4KqrAs&t=1s • https://kp.kiit.ac.in/pdf_files/02/Study-Material_3rd-Semester_Winter_2021_Mechanical-Engg.-_Thermal-Engineering-1_Abhijit-Samant.pdf • https://www.coursera.org/learn/thermodynamics-intro
Mode of Evaluation:
Assignments, Mid Term Tests, End Semester Examination

B.Tech. II Year I Semester

23ME104 MECHANICS OF SOLIDS

L	T	P	C
2	1	0	3

Pre-requisite: Engineering Mechanics

Course Description:

This course is intended to make the students learn about different types of loads acting on solid materials, thereby understanding the behaviour of the materials under such a variety of loads. This course equips the students to learn the principles and methods for analysing the stresses, strains, deformations induced in the materials under loading, and thereby to know about the failure conditions of the solid materials.

Course Objectives:

The objectives of the course are to

1. Understand the behaviour of basic structural members subjected to uni-axial and bi-axial loads. Students attain a deeper understanding of the loads, stresses, and strains acting on a structure and their relations in the elastic behaviour.
2. Students are able to analyse beams and draw complete shear and bending moment diagrams for beams.
3. Apply the concept of stress and strain to analyse and design structural members and machine parts under axial, shear and bending loads, moment and torsional moment.
4. Students will learn all the methods to analyse beams, columns, frames for normal, shear, and torsion stresses and to solve deflection problems in preparation for the design of such structural components.
5. Design and analysis of Industrial components like pressure vessels.

UNIT 1: SIMPLE STRESSES & STRAINS

Elasticity and plasticity – Types of stresses & strains–Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Bars of varying section – composite bars – Temperature stresses- Complex Stresses - Stresses on an inclined plane under different uniaxial and biaxial stress conditions - Principal planes and principal stresses - Mohr's circle - Relation between elastic constants, Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

9 hours

UNIT 2: SHEAR FORCE AND BENDING MOMENT DIAGRAMS

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

9 hours

UNIT 3: FLEXURAL STRESS & SHEAR STRESS

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

SHEAR STRESS: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I and T sections.

9 hours

UNIT 4: DEFLECTION OF BEAMS & TORSION

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

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

9 hours

UNIT 5: THICK & THIN CYLINDERS AND COLUMNS

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

COLUMNS:

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

9 hours

Course Outcomes:

On successful completion of the course, the student will be able to:

CO1: Estimate the fundamental stresses, strains, and principal stresses by analytical and Mohr's circle.

CO2: Analyze the distribution of shear force and bending moment for various types of beams under different load conditions.

CO3: Determine the flexural and shear stress and its distribution across various beams sections like rectangular, circular, triangular, I and T sections.

CO4: Evaluate bending stresses in beams and calculate the deflection and slope of beams with different types of loads.

CO5: Calculate longitudinal and circumferential stresses of pressure vessels and analyze the elastic stability of flexible columns.

Text Books:

1. Strength of Materials by R.K. Bansal, Rainbow Book Distributors, 6th Edition, 2020.
2. Strength of Materials by S. Ramamrutham, Dhanpat Rai Publishers, 16th Edition ,2020

References:

1. Mechanics of Materials by Ferdinand P. Beer and E.Russel Johnston, McGraw Hill Education (India) publicationsEdition,8e,2020
2. Mechanics of Materials by Gere and Timoshenko, C B S Publishers & Distributors, 2nd Edition, 2004.
3. Strength of Materials by R.K. Rajput, S.Chand& Company, 5th Edition,2018.
4. Strength of Materials by Dr. Sadhu Singh, Khanna Publishers, 10th Edition,2013.
5. Mechanics of solids and structures by Dr. R. Vidyanathan and Dr. P. Perumal, Laxmi Publishers.1e, 2018.

Mode of Evaluation:
Assignments, Mid Term Tests, End Semester Examination

B. Tech II Year I Semester					
23ME105 Materials Science and Engineering		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Pre-requisite	Nil				

Course Description:

The purpose of this course is to introduce the student to enrich their knowledge of the materials science field. Begin with the microscopic level the structure at the atomic and their impact on the material properties are discussed. The relation between heat treatment, phases and alloying elements properties of materials is also highlighted. The course mainly discusses about the different types of testing methods for materials. The final part of the course covers non-metallic materials such as ceramics and polymers.

Course Objectives:

1. To understand the stability of phases in various alloy systems and to comprehend the crystalline structure of various metals.
2. To study the properties of alloys and metals, both ferrous and nonferrous, and their uses in various fields
3. To know the impact of alloying element addition and heat treatment on the characteristics of ferrous metals.
4. To understand how to make metal powders and the uses of powder metallurgy.
5. To realize the functions and characteristics of composites, ceramics, and other cutting-edge techniques.

UNIT I	**STRUCTURE OF METALS AND EQUILIBRIUM DIAGRAMS**	**9 hours**

Structure of Metals and Constitution of alloys: Crystallization of metals, Packing Factor - SC, BCC, FCC & HCP- line density, plane density. Grain and grain boundaries, effect of grain boundaries – determination of grain size. Imperfections, Slip and Twinning. Necessity of alloying, Types of solid solutions - Hume-Rothery rule.

Equilibrium Diagrams: Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of binary phase diagrams such as Cu-Ni and Fe-Fe_3C, Lever rule. Simple numerical problems.

UNIT II	**FERROUS AND NON-FERROUS METALS AND ITS ALLOYS**	**9 hours**

Ferrous metals and alloys: Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheroidal graphite cast iron, Alloy cast iron. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.
Non-ferrous Metals and Alloys: Structure and properties of copper and its alloys, aluminium and its alloys, Titanium and its alloys, Magnesium and its alloys, Super alloys.

UNIT III	**HEAT TREATMENT OF STEELS**	**9 hours**

Effect of alloying elements on Fe-Fe_3C system, annealing, normalizing, hardening, TTT diagrams, tempering, hardenability, surface - hardening methods, age hardening treatment, Cryogenic treatment. Introduction to surface coating (PVD, CVD).

UNIT IV	**POWDER METALLURGY**	**9 hours**

Basic processes- Methods of producing metal powders- milling atomization- Granulation-Reduction-Electrolytic Deposition. Compacting methods – Sintering - Methods of manufacturing sintered parts. Secondary operations, Applications of powder metallurgical products.

UNIT V	**ADVANCED MATERIALS**	**9 hours**

Crystalline ceramics, glasses, cermet, abrasive materials, Classification of composites, manufacturing methods, particle reinforced composites, fibre-reinforced composites, PMC, MMC, CMC and CCCs. Introduction to Nanomaterials, smart materials and Bio-materials - applications.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand the crystalline structure of different metals and study the stability of phases in different alloy systems by equilibrium diagrams.

CO2: Study the behaviour of ferrous and nonferrous metals and alloys and their application in different domains

CO3: Understand the effect of heat treatment and addition of alloying elements on properties of ferrous metals.

CO4: Apply the different methods of making metal powders and its applications in powder metallurgy.

CO5: Comprehend the properties and applications of ceramic, composites and other advanced methods

Text Books:

1.	Callister, William D., Jr., and David G. Rethwisch. *Materials Science and Engineering: An Introduction*. 10th ed., Wiley, 2018.
2.	S.H.Avner, Introduction to Physical Metallurgy, 2/e, Tata McGraw- Hill, 2017.

Reference Books:

1.	Kodgire, V. D., and S. V. Kodgire. *Material Science and Metallurgy for Engineers*. 46th ed., Everest Publishing House, 2021.
2	V.Raghavan, Material Science and Engineering, 6/e, Prentice Hall of India, 2015.

3	Donald R.Askeland, Essentials of Materials science and Engineering, 4/e, CL Engineering publications, 2018.
4.	George E.Dieter, Mechanical Metallurgy, 3/e, McGraw-Hill, 2017.
5.	Yip-Wah Chung, Introduction to Material Science and Engineering, 2/e, CRC Press, 2022.
Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.	

B. Tech II Year I Semester

23ME203 MECHANICS OF SOLIDS AND MATERIALS SCIENCE LABORATORY

L	T	P	C
0	0	3	1.5

Course Description:

The course is about to expose the students to a broad knowledge of experimental and analyzing techniques useful in Mechanics of solids as well as in Materials engineering field. The subject introduces the correlation of properties of various materials and their structure. It revises student's knowledge of crystal structure and phase diagrams of various alloy systems. This laboratory course offers practical knowledge of heat treatment applicable to ferrous materials and studies microstructural changes and hardness evaluation.

Course Objectives:

1. To perform and determine the mechanical properties of various materials.
2. To prepare samples for micro-structural examination
3. To study the microstructures of various materials under heat treatment

List of Experiments:

A) MECHANICS OF SOLIDS EXPERIMENTS:

1. Tensile test
2. Bending test on
   a) Simply supported beam
   b) Cantilever beam
3. Torsion test
4. Hardness test
   a) Brinell's hardness test
   b) Rockwell hardness test
   c) Vickers hardness test
5. Impact test
   a) Charpy test
   b) Izod test
6. Double shear test

B) MATERIALS SCIENCE EXPERIMENTS:

1. Specimen preparation for micro-structural examination – Cutting, Grinding, Polishing, Etching.
2. Preparation and study of the Microstructure of Mild steel, medium carbon steels, and High carbon steels.
3. Study of the Microstructures of Cast Irons.
4. Study of the Microstructures of Non-Ferrous alloys.
5. Study of the Microstructures of Heat-treated steels.
6. Hardenability of steels by Jominy End Quench Test.

Virtual lab experiments:

1. http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpAM/

2. https://www.vlab.co.in/
3. https://edutechindia.com/virtual-lab-higher-education/

Course Outcomes:

After completion of the course students will be able to

CO1: Understand the stress strain behavior of different materials.

CO2: Evaluate the mechanical properties of different materials.

CO3: Explain the relation between elastic constants of materials.

CO4: Identify various microstructures of steels and cast irons.

CO5: Measure the hardenability of steels.

Text Book: Lab manual provided by the department

Reference Books:

1. Brandon D. G, "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986.

2. Prabhudev. K. H. "Handbook of Heat Treatment of Steels", Tata McGraw-Hill Publishing Co., New Delhi, 1988.

3. Sydney H. Avner, "Introduction to Physical Metallurgy", Tata McGraw Hill, New Delhi, 1997.

4. William D. Callister, "Materials Science and Engineering" John Wiley and Sons, 8th Edition, 2009.

Mode of Evaluation:
Continuous Assessment of record, Viva-voce, Model Exam, End Semester Examination

B.Tech. II Year I Semester

23ME204 COMPUTER-AIDED MACHINE DRAWING LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: Engineering Graphics

Course Description:

The course is about the theory and technique of two-dimensional (2D) and three-dimensional (3D) modelling utilizing appropriate software. Topics include the creation and modification of 3D geometric shapes; and rendering techniques; and use of camera light sources, texture, and surface mapping.

Course Objectives:

1. During the term of the course, students will learn to work within virtual 3-D space.
2. Build volumetric objects including: vertices, splines, polygons, primitive shapes and Sub Patch geometry.
3. Students will use these tools to build complex objects, and then learn the basic 3-D rendering tools and techniques.
4. The student will be able to produce 2D drawing from the 3D part geometry to assure the proper dimensioning of the parts.
5. To make the students to understand and draw assemblies of machine parts and to draw their sectional views.

List of experiments

1. Introduction to 2D and 3D modelling
2. Drawing of Detachable Joints: bolt and nut with different screw thread
3. Drawing of Riveted Joints for Plates
4. Drawing of Welded Joints
5. Assembly of Shaft Coupling
6. Assembly of Universal Joint
7. Assembly of Knuckle Joint
8. Assembly of Simple Eccentric
9. Assembly of Screw Jack
10. Assembly of Plummer Block
11. Assembly of Machine vice

Course Outcomes:

On successful completion of the course, the student will be able to:

1 Identify different types of bolts, nuts, welding joints screw threads, keys and fasteners.
2. Visualize and prepare a detail drawing of a given object.
3. Draw details and assembly of mechanical systems.
4. Read and interpret the given drawing.
5. Create 3-D models using any standard CAD software

Virtual lab experiments:

1. http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpAM/
2. https://www.vlab.co.in/
3. https://edutechindia.com/virtual-lab-higher-education/

Text Books:

1. Lab manual provided by the department
2. Machine Drawing by K.L.Narayana, P.Kannaiah and K.Venkat Reddy, New Age International Publishers, 3/e, 2014

References:

1. Gopalakrishnan K.R, "Machine Drawing", Subhas Stores, 2007.
2. N.D.Bhatt, Machine Drawing, Charotar Publishers, 50/e, 2014.
3. James Barclay, Brain Griffiths, Engineering Drawing for Manufacture, Kogan Page Science, 2003.

Mode of Evaluation:

Continuous Assessment of record, Viva-voce, Model Exam, End Semester Examination

B.Tech. II Year II Semester

23ME106 MANUFACTURING TECHNOLOGY – I

L	T	P	C
3	0	0	3

Pre-requisite: Basic Civil and Mechanical Engineering

Course Description:

Manufacturing is the creation, through one or several processing operations, of components or products from basic raw materials. The effectiveness of process selection will be based on the inter-related criterion of design parameters, material selection and process economies. The course helps the students to understand the significance and applications of various traditional and advanced metal casting, joining and forming processes. The concept of stress, strain, plain stress, plain strain and yield criteria is encompassed in the course.

Course Objectives:

1. To provide abreast knowledge on working principles of different metal casting processes and gating systems.
2. To acquaint the students with the working of different types of welding processes and welding defects.
3. To impart an in-depth understanding on plastic deformation of metals, cold and hot working processes, working of a rolling mill and types, extrusion processes.
4. To impart fundamental knowledge of drawing process and sheet metal processes.
5. To familiarize the students with a basic understanding high energy rate forming process and additive manufacturing process.

UNIT 1: METAL CASTING PROCESS **9 hours**

Casting & Moulding Process: Introduction & types of casting process.
Patterns: Definition, classification, materials used for pattern, various pattern allowances and their importance.
Sand Moulding: Types of base sand, requirement of base sand. Binder, Additive's definition, need and types; preparation of sand moulds.
Sand casting, principles of gating, gating ratio, function of risers & runners.
Die casting – Types of die casting, gravity die casting, centrifugal casting & Investment casting.
Melting Furnaces: Principle of cupola furnace, induction furnace, electric arc furnace.
Casting defects, their causes and remedies. Testing of cast products.

UNIT 2: METAL JOINING PROCESS **9 hours**

Introduction: Introduction, basic principle and classification of welding processes.
Principle, advantages, limitations and Applications of Arc welding, Gas welding, Inert gas welding (TIG & MIG), Submerged arc welding,
Special type of welding: Resistance welding principles, Spot welding, friction stir welding, Thermit welding, plasma arc welding and laser beam welding
Allied processes: Soldering, Brazing and adhesive bonding
Welding defects, Heat Affected Zone, NDT techniques for weldments inspection.
Advanced Joining Processes: Joining of plastics, ceramics and glass and composites.

Metal Injection Moulding Process.

UNIT 3: METAL FORMING PROCESS & FORGING

9 hours

Introduction of metal forming process: Mechanical behaviour of metals in elastic and plastic deformation, stress-strain relationships, Tresca and Von-Misses yield criteria, concept of plain stress and plain strain and temperature in metal working; Hot working and cold working and annealing.

Forging – Introduction & classification, open die forging, impression die forging, closed die forging. Classification of forging press, Principle of mechanical press and hydraulic press. Calculation of forging load and power. Defects in forging.

UNIT 4: ROLLING, EXTRUSION & DRAWING

9 hours

Rolling – Introduction & classification, Types of rolling mills, die design and design considerations, Application of rolling, calculation of rolling forces. Defects in rolling.

Extrusion – Introduction & classification, backward and forward extrusion, extrusion defects, design of extrusion dies, design considerations, extrusion equipment, and application of extrusion. Defects in extrusion.

Drawing: Introduction, wire drawing, tube drawing, lubrication, die design for drawing, drawing defects. Application of drawing, advantages and limitations, calculation of drawing forces.

UNIT 5: SHEET METAL FORMING PROCESS

9 hours

Sheet Metal Forming Processes: Introduction and classification, principle and applications of different types of sheet metal forming processes. Super plastic forming. Rubber forming. Limiting drawing ratio (LDR). Spring back effect. Forming limit criterion. Types of sheet metal forming dies and press - progressive die, compound die, combination die, working of mechanical press, hydraulic press. (Cold drawing, LASER cutting)

High Energy Rate Forming Methods: Principles, advantages and applications, explosive forming, electrohydraulic forming, Electromagnetic forming.

Course Outcomes:

On successful completion of the course, the student will be able to:

CO1: Describe manufacturing process for a given product by pattern making, design of gating systems, preparation of moulding and pouring of molten metal for casting and defects.
CO2: Explain different types of welding techniques and other joining methods.
CO3: Compare cold working and hot working processes, also elucidate the forging process.
CO4: Elucidate the rolling, extrusion and drawing process.
CO5: Depict the principle of drawing process and various sheet metal processes like blanking, piercing, forming, bending, deep drawing process.

Text Books:

1. S. Kalpakjian and Steven R. Schmid – 'Manufacturing Engineering and Technology' – Prentice Hall – 2023 – 8th Edition

2. G.E. Dieter, Mechanical metallurgy (SI units), Mc Graw Hill, pub., 3rd edition, 2001
3. P. N. Rao, Manufacturing Technology: Foundry, Forming and Welding, Volume1, McGraw Hill Education (India) Private Limited, 5th Edition, 2018
4. Degramo, J.T. Black, Ronald, A.K., Materials and Processes in Manufacturing, Wiley, 13rd Edition 2020.

References:

1. B. L. Juneja, Fundamentals of Metal Forming Processes, New age publishers; Second edition, 2018
2. Amitabha Ghosh & A.K. Malik, Manufacturing Science, - East – West press,2e 2010
3. Roy A Lindberg, Processes and Materials of Manufacture, 4th Ed. Pearson Edu. 2015.

Mode of Evaluation:

Assignments, Mid Term Tests, End Semester Examination

B.Tech. II Year II Semester

23ME107 Fluid Mechanics and Hydraulic Machines

L	T	P	C
2	1	0	3

Pre-requisite: Physics

Course Description:

Understanding the behaviour of fluid flow is crucial for many scientific and engineering applications. Various phenomena are related to fluid mechanics, such as atmospheric and oceanic circulation, combustion in engines, and biological processes. In this course, students are introduced to various fluid properties, concepts of fluid statics, fluid kinematics and governing equations of fluid flow derived from fundamental principles of mass and momentum conservation. The course also covers fluid flow in closed conduits and over different geometries, and also introduces the design and working principles of hydraulic turbines and pumps.

Course Objectives:

1. To provide a basic understanding of the properties and behaviour of fluids by means of analytical equations.
2. To develop an understanding about hydrostatic law, principle of buoyancy and stability of a floating body, and application of mass, momentum and energy equation in fluid flow.
3. To determine the losses in a flow system, flow through pipes, boundary layer flow and flow past immersed bodies.
4. Determine the force applied by a jet on stationary and moving vanes.
5. To understand the working principle of hydraulic machines: Turbines and pumps.

UNIT 1: FLUID PROPERTIES AND FLUID STATICS

9 hours

Properties of a Fluid, Newton's law of viscosity, Surface Tension and Capillarity, Pressure, Hydrostatic law, Manometry, Hydrostatic forces acting on submerged surfaces, Buoyancy and Stability, Hydrostatic forces.

UNIT 2: FLUID KINEMATICS AND DYNAMICS

9 hours

System and Control volume, Classification of flows, Lagrangian and Eulerian descriptions, Acceleration, Streamlines, Path lines and Streak lines, Fluid body motion, Conservation of mass, Stream function, Body and surface forces, Reynold Transport Theorem, Euler's Equation, Bernoulli's Equation, Venturimeter and Orifice meter, Application of Momentum equation on pipe bends.

UNIT 3: INTERNAL AND EXTERNAL FLOW

9 hours

Laminar flow in ducts, Turbulent flow in ducts, Minor and Major losses, Pipe Networks, Flow over flat plate, Boundary layer equations, Displacement, Momentum and Energy thicknesses, Momentum integral technique for boundary layers.

UNIT 4: IMPACT OF JET & HYDRAULIC TURBINES
9 hours
Hydrodynamic force of jet striking on stationary and moving vanes, flat and curved vanes, jet impinging centrally and tangentially. Impulse and reaction turbines; Basic equation of energy transfer in rotodynamic machines, Pelton turbine: Velocity triangles, Power and Efficiency, Reaction turbines: Francis turbine and Kaplan turbine, Velocity triangles, Power and Efficiency.
UNIT 5: HYDRAULIC PUMPS
9 hours
Working principle and main parts of a centrifugal pump; Classification of centrifugal pumps; Static and Manometric head of a centrifugal pump; Efficiencies of centrifugal pump. Main parts and working of reciprocating pump; Discharge, work done and power required to drive a reciprocating pump; Slip of a reciprocating pump.
Course Outcomes:
On successful completion of the course, the student will be able to:
CO1: Understand the various properties of fluids and their applications, calculate pressure using manometric principles, determine the stability of floating bodies, and evaluate hydrostatic forces on different surfaces. CO2: Identify fluid flow patterns and apply the governing equations of mass and momentum conservation to solve fluid flow problems. CO3: Understanding of internal and external fluid flow physics concepts and evaluating the losses in pipe flows and analysing the boundary layer thickness. CO4: Calculate the forces acting on different vane geometries and evaluate performance parameters of hydraulic turbines. CO5: Differentiate different pumps and calculate their performance characteristics.
Text Books:
1. Cengel, Y.A, Cimbala, John, M., "Fluid Mechanics, Fundamentals and Applications", McGraw Hill Education; Fourth edition (28th May, 2019).
2. B.K. Venkanna, "Fundamentals of Turbomachinery", PHI Learning Pvt Ltd, 2018
Reference Books:
1. R. K. Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, Ltd., 2005, Revised Ninth Edition.
2. Robert W. Fox and Alan T. Mc Donald, "Introduction to Fluid Mechanics", John Wiley & Sons Private Ltd., 2010, Eighth Edition.
3. James R. Welty, Charles E. Wicks and Robert E. Wilson, "Fundamentals of Momentum, Heat and Mass transfer", John Wiley & Sons (Asia) private limited., 2008, 5th Edition.
4. Frank M White, "Fluid Mechanics", Tata McGraw-Hill, Ninth Edition, 2022.
5. Milton Van Dyke, "An Album of Fluid Motion", Parabolic Press, Fourteenth Edition.
Mode of Evaluation:
Assignments, Mid Term Tests, End Semester Examination

B. Tech. II Year II Semester

23ME107 THEORY OF MACHINES

L	T	P	C
2	0	1	3

Course Prerequisite: Engineering Mechanics, Mathematics (Calculus and equations)

Course Description:

Course Description: The objective of this course is to understand the theory involved behind the design of a machine/mechanism. After an introduction about the structure (links, joints), degrees of freedom (DOF), inversions of kinematic chains; the commonly used mechanisms derived from the 4-bar chain are then dealt. The graphical methods for performing velocity and acceleration analyses of the constituent links of lower pair mechanisms are included. The theory of gears, kinematics of gear trains, gyroscopic motion and its application, and governors, are also studied. Cam profile synthesis corresponding to different combinations of follower motions is included and so is balancing of rotating masses in machinery. Lastly, the course gives an insight into the basic concepts of vibration analysis in mechanical systems.

Course Objectives:

1. To introduce basic definitions, commonly used mechanisms and their applications.
2. To understand the kinematic analysis (velocity and acceleration analysis) of lower pair mechanisms.
3. To synthesize cam profiles; and to perform balancing calculations for rotating masses.
4. To learn the theory of gearing and kinematic analysis of gear trains; and understand about the practical application of gyroscopic couple and also working of governors.
5. To learn to formulate the equation of motion and solving the same for analyzing mechanical vibrations.

UNIT I: SIMPLE MECHANISMS

9 hours

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom– Grashof law; kinematic inversions of four bar chain and slider crank chains; Limit positions – Mechanical advantage- Transmission angle; Quick return mechanism, Straight line mechanism.

UNIT II: VELOCITY & ACCELERATION ANALYSIS

9 hours

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centres, velocity and acceleration analysis using loop closure equations - kinematic analysis of simple mechanisms - Coriolis component of acceleration.

UNIT III: GOVERNORS & GYROSCOPE

9 hours

Governors: Types of governors; force analysis of Porter and Hartnell governors. Controlling force, stability, sensitiveness, isochronism, effort and power.

Gyroscope: Vectorial representation of angular motion, gyroscopic couple. Effect of gyroscopic couple on ship, plane disc, aero plane, stability of two wheelers.

UNIT IV: GEARS AND GEAR TRAINS

9 hours
Gear Profile: Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference / undercutting-helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.
UNIT V: ROTATING MASSES AND CAMS
9 hours
Balancing of Rotating masses: Need for balancing, balancing of single mass and several masses in different planes, using analytical and graphical methods. Cams: Classification of cams and followers- Terminology and definitions- Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions-cam profile analysis - pressure angle and undercutting.
Course Outcomes:
On successful completion of the course, the student will be able to:
CO1: Identify the different mechanisms and their inversions in real life applications. CO2: Calculate the velocity and acceleration of simple mechanisms by analytical & graphical methods. CO3: Understand the principle of working of a gyroscope and determine the range of speed of different governors CO4: Classify gears and gear trains and computing the velocity ratio. CO5: Determine the magnitudes and angular positions of masses for balancing and sketch the cam profiles for different follower motions.
Text Books:
1. S S Rattan, Theory of Machines, 5th edition, Mc Graw Hill, 2019
2. R.S. Khurmi, Theory of Machines, 14th edition, S.Chand, 2020.
References:
1. J.E.Shigley, Theory of Machines and Mechanisms, 4/e, Oxford, 2014
2. Sadhu Singh, Theory of Machines: Kinematics and Dynamics, 3/e, Pearson, 2011.
3. P.L.Ballaney, Theory of Machines & Mechanisms, 25/e, Khanna Publishers, Delhi, 2003.
4. Norton, R.L., Design of Machinery - An introduction to Synthesis and Analysis of Mechanisms and Machines,-3/e, McGraw Hill, New York, 2003.
5. William T. Thomson, Theory of vibration with applications, 5/e, Pearson Education, 2008.
6. F. Haidery, Dynamics of Machines, 13/e, Tech-Neo Publications, 2019.
Mode of Evaluation:
Assignments, Mid Term Tests, End Semester Examination

B.Tech. II Year II Semester

23ME205 Fluid Mechanics and Hydraulic Machines Laboratory

L	T	P	C
0	0	3	1.5

Pre-requisite: Fluid Mechanics and Hydraulic Machines

Course Description:

It is intended that the student would learn to use different techniques to measure discharge and measure head losses through straight and bent pipes. The students will also learn the performance evaluation of Pelton Wheel, Francis and Kaplan turbine, and centrifugal and reciprocating pumps.

Course Objectives:

1. To determine the coefficient of discharge various flow measuring equipment
2. To determine the loss of head in a pipeline
3. To conduct the performance test of hydraulic turbines and pumps.

LIST OF EXPERIMENTS

Fluid Mechanics Experiments:

1. Verification of Bernoulli's theorem
2. Determination of Coefficient of discharge of Venturimeter
3. Determination of Coefficient of discharge of Orificemeter
4. Determination of Coefficient of discharge of Turbine flow meter.
5. Determination of friction factor for a given pipeline.
6. Determination of loss of head due to sudden enlargement and contraction in a pipeline.

Hydraulic Machines Experiments

1. Performance test on Pelton wheel.
2. Performance test on Francis turbine.
3. Performance test on Kaplan turbine.
4. Performance test on centrifugal pump.
5. Performance test on reciprocating pump.

Wind Tunnel Experiments

1. Flow visualization of different objects using wind tunnel
2. Force measurement – Lift, Drag, Side force on different objects using wind tunnel

Course Outcomes:

After completion of the course, students will be able to

CO1: Verify Bernoulli's theorem for incompressible fluid flows.

CO2: Determine the co-efficient of discharge of flow measuring devices like Venturimeter and Orificemeter.

CO3: Determine the co-efficient of vanes like flat and curved vanes.

CO4: Determine the loss of head in pipelines due to friction, sudden contraction, enlargement, bends and elbows.

CO5: Determine the performance and draw operating characteristic curves for Pelton wheel, Reciprocating pump, and Multi-stage Centrifugal pump.
Virtual lab experiments: 1. http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpAM/ 2. https://www.vlab.co.in/ 3. https://edutechindia.com/virtual-lab-higher-education/
Text Books:
1. Manual provided by the department.
2. Cengel, Y.A, Cimbala, John, M., "Fluid Mechanics, Fundamentals and Applications", McGraw Hill Education; Third edition (1 July 2017)
References:
1. R. K. Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, Ltd., 2005 2. Robert W. Fox and Alan T. Mc Donald, "Introduction to Fluid Mechanics", John Wiley & Sons Private Ltd., 2009, 7th Edition.
Mode of Evaluation:
Continuous Assessment of record, Viva-voce, Model Exam, End Semester Examination

B.Tech. II Year II Semester

23ME206 MANUFACTURING TECHNOLOGY – I Laboratory

L	T	P	C
0	0	3	1.5

Pre-requisite: Basic Mechanical Engineering

Course Description:

Manufacturing Technology -I lab is intended for operational experience on Metal casting, Welding, Mechanical Press working and processing of Plastics. These exercises inculcate the skills to the students starting from preparing a wooden pattern to completion of a casting which also comprises different Sand testing techniques. Students will also get good skills on Welding, mechanical press working, processing of plastics & composite which will be helpful to get an employment in Industries.

Course Objectives:

1. To provide hands-on experience of different sand-casting processes and determine the foundry sand properties
2. To provide the experience of welding process practice.
3. To familiarize with sheet metal operations practice.
4. To impart knowledge of forging operations and its practice.
5. To introduce the plastic and composite processing techniques.

LIST OF EXPERIMENTS **9 hours**

1. METAL CASTING LAB:
   a. Pattern Design and making – for one casting drawing.
   b. Sand properties testing - Exercise - for strengths, and permeability
   c. Moulding: Melting and Casting

2. WELDING LAB:
   Arc Welding: Lap & Butt Joint
   a. Spot Welding b. TIG Welding c. MIG welding d. Brazing

3. MECHANICAL PRESS WORKING:
   a. Blanking & Piercing operation and study of simple, compound and progressive press tool.
   b. Hydraulic Press: Operation –Forming exercise.

4. FORGING:
   a. Preparation of simple forging model involving upsetting and bending operations.

5. PROCESSING OF PLASTICS & COMPOSITE:
   a. Injection Moulding b. Fabrication of Composite plate

Course Outcomes:

This practical course is designed to enrich practical knowledge about common production techniques used in manufacturing. The students after completing the course will be able to:

1. Produce real time casting moulds on their own.
2. Prepare various joints by using various welding processes.

3. Perform blanking, piercing and forming operations on the sheet metal. 4. Prepare a model using forging operation. 5. Prepare a specimen using injection moulding and hand lay-up process.
Virtual lab experiments: 1. http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpAM/ 2. https://www.vlab.co.in/ 3. https://edutechindia.com/virtual-lab-higher-education/
Text Books:
1. Manual provided by the department 2. S. Kalpakjian and Steven R. Schmid – 'Manufacturing Engineering and Technology' – Prentice Hall – 2013 – 7th Edition 3. P. N. Rao, Manufacturing Technology: Foundry, Forming and Welding, Volume1, McGraw Hill Education (India) Private Limited, 5th Edition, 2018
References:
1. B. L. Juneja, Fundamentals of Metal Forming Processes, New age publishers; Second edition, 2018 2. Roy A Lindberg, Process and Materials of Manufacturing, 4th Ed. Pearson Edu. 2006.
Mode of Evaluation:
Continuous Assessment of record, Viva-voce, Model Exam, End Semester Examination