SNJB's

Late Sau. Kantabai Bhavarlalji Jain

College of Engineering

(Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

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SNJB

Curriculum Structure and Evaluation Scheme for B. Tech. in Mechanical Engineering

To be implemented for 2024-28 Batch

(With Effect from Academic Year 2025-26)

Vision of the Institute

CHAIRMAN
BOARD OF STUDIES MECHANICAL ENGINEERING
SNJB's
LSKBJ COLLEGE OF ENGINEERING
Chandwad Dist.Nashik

Chandwad (Nashik) Pin-423101

CHAIRMAN
ACADEMIC COUCIL
SNJB's
LSKBJ COLLEGE OF ENGINEERING
Chandwad Dist.Nashik

SNJB's Late Sau. K. B. Jain College of Engineering, Chandwad

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

Curriculum and Evaluation Scheme for Second Year B. Tech. in Mechanical Engineering with Multidisciplinary Minor

To be implemented for 2024-28 Batch

(With Effect from Academic Year 2025-26)

Vision of the Institute

Transform young aspirant learners towards creativity and professionalism for societal growth through quality technical education.

Mission of the Institute

1. To transfer the suitable technology, particularly for rural development.
2. To enhance diverse career opportunities among students for building a nation.
3. To acquire the environment of learning to bridge the gap between industry and academics.
4. To share values, ideas, beliefs by encouraging faculties and students for welfare of society.

The vision of the Mechanical Engineering Department

To impart quality technical education in the field of Mechanical Engineering for the benefits of society

Mission of the Mechanical Engineering Department

1. To provide quality education among the students through the curriculum and industrial exposure.
2. To develop a learning environment leading to innovations, skill development and professional ethics through curricular and extracurricular activities for societal growth.

Program Outcomes (POs) for an engineering graduate:

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural,language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Program Specific Outcomes:

PSO1 Graduates will have an ability to identify, analyze, and develop appropriate solution(s) to Mechanical Engineering Problems.

PSO2: Graduates will be able to use modern engineering tools for analyzing and solving practical problems of industry and society.

PSO3: Graduates will be able to learn and grow constantly, with good technical, spiritual, and ethical values with a zeal for life-long learning.

Table 1: Abbreviations

Abbreviation	Meaning
CIE	Continuous Internal Evaluation
MSE	Mid Semester Examination
SEE	Semester End Examination
BSC	Basic Science Courses
ESC	Engineering Science Courses
VSEC/VSC	Vocational and Skill Enhancement Courses
VEC	Value Education Courses
AEC	Ability Enhancement Courses
PCC	Program Core Courses
PEC	Program Elective Courses
MDM	Multidisciplinary Minor
OE/OEC	Open Elective - other than a particular program
EEM	Entrepreneurship/Economics/ Management Courses (HSSM)
ELC	Research Methodology
	Community Engagement Project (CEP)/ Field Project (FP)
	Project
	Internship/ On Job Training (OJT)
IKS	Indian Knowledge System
CC/CCC	Co-Curricular Courses
HOC	Honor Courses
EXT	Exit Courses
DMC	Double Minor Courses
HRC	Honor with Research Courses
SIP	Student Induction Program
L	Lecture
T	Tutorial
P/PR	Practical
TH	Theory
Lab	Laboratory
TW	Term Work
OR	Oral
CE	Civil Engineering
CS	Computer Engineering
ME	Mechanical Engineering
AD	Artificial Intelligence and Data Science Engineering
ET	Electronics and Telecommunication Engineering

GENERAL COURSE STRUCTURE

A. Definition of Credit:

Table 2: Credit Definition

1 Hour Lecture (L) per week	1 Credit
1 Hour Tutorial (T) per week	1 Credit
2 Hours Practical (P) per week	1 Credit

B. Range of Credits: (B.Tech. or Equivalent) in Tech. with Multidisciplinary Minor:

In the light of the fact that a typical NEP Compliant Model Four-year Undergraduate degree program in Technology has about 176 credits, the total number of credits proposed for the four-year B.Tech. in **Mechanical Engineering** with Multidisciplinary minor degree is kept as **172.**

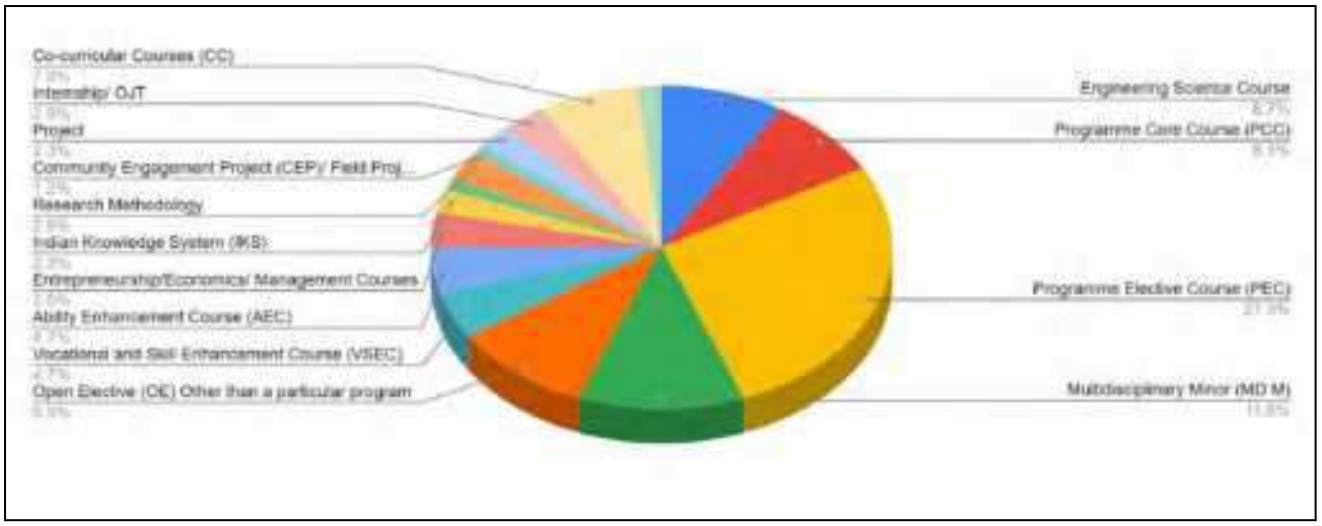
Table 3: Range of Credits

Course Category		Credits As PER NEP Guidelines	Proposed Credits
Basic Science Course	BSC/ESC	14-18	15
Engineering Science Course		16-12	14
Programme Core Course (PCC)	Program Courses	44-56	47
Programme Elective Course (PEC)		20	20
Multidisciplinary Minor (MD M)	Multidisciplinary Courses	14	17
Open Elective (OE) Other than a particular program		8	8
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	8	8
Ability Enhancement Course (AEC)	Humanities Social Science and Management (HSSM)	4	6
Entrepreneurship/Economics/ Management Courses		2	4
Indian Knowledge System (IKS)		2	2
Value Education Course (VEC)		4	5
Research Methodology(RM)	Experiential Learning Courses	4	4
Community Engagement Project (CEP)/ Field Project (FP)		2	2
Project		4	5
Internship/ OJT		12	12
Co-curricular Courses (CC)	Liberal Learning Courses	4	3
Total Credits		**160-176**	**172**

C. Semester wise Credit Distribution Structure for Four Year B. Tech in Mechanical Engineering with Multidisciplinary Minor:

Table 4: Semester-wise Credit Distribution Structure

Semester		I	II	III	IV	V	VI	VII	VIII	Total Credits
Basic Science Course	BSC/ESC	8	7	-	-	-	-	-	-	15
Engineering Science Course		7	7	-	-	-	-	-	-	14
Programme Core Course (PCC)	Program Courses	-	3	11	8	9	4	9	3	47
Programme Elective Course (PEC)		-	-	-	-	6	5	6	3	20
Multidisciplinary Minor (MD M)	Multidisciplinary Courses	-	-	3	3	3	2	3	3	17
Open Elective (OE) Other than a particular program		-	-	-	3	2	3	-	-	8
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	2	2	-	2	-	2	-	-	8
Ability Enhancement Course (AEC)	Humanities Social Science and Management (HSSM)	1	-	1	2	2	-	-	-	6
Entrepreneurship/Economics/ Management Courses		-	-	2	2	-	-	-	-	4
Indian Knowledge System (IKS)		2	-	-	-	-	-	-	-	2
Value Education Course (VEC)		-	-	3	2	-	-	-	-	5
Research Methodology	Experiential Learning Courses	-	-	-	-	-	4	-	-	4
Community Engagement Project (CEP)/ Field Project (FP)		-	-	2	-	-	-	-	-	2
Project		-	-	-	-	-	2	3	-	5
Internship / OJT		-	-	-	-	-	-	-	12	12
Co-curricular Courses (CC)	Liberal Learning Courses	1	2	-	-	-	-	-	-	3
Total Credits (Major)		**21**	**21**	**22**	**22**	**22**	**22**	**21**	**21**	**172**



Students can opt for any of the following as per the rules and regulations given by the institute:

1. B. Tech with Multidisciplinary Minor = Total 172 Credits
2. B. Tech with Multidisciplinary Minor and Honor = Total 190 Credits
3. B. Tech with Multidisciplinary Minor and Honor by Research = Total 190 Credits
4. B. Tech with Multidisciplinary Minors (Double Minor) = Total 190 Credits

Students will have the flexibility to enter a program in odd semesters and exit a programme after the successful completion of even semesters as per their future career needs. **Students exiting will be awarded provided they secure additional EIGHT credits in skill-based vocational courses.**

The credit structure for different levels under the Four-year Bachelor's Multidisciplinary B. Tech Programme with multiple entries and multiple exit options are as given below**:**

Table 5: Credit Requirements

Level	Qualification Title	Credit Requirements	Semester	Year
4.5	One Year UG Certificate in Tech.	42	2	1
5.0	Two Years UG Diploma in Tech.	86	4	2
5.5	Three Years Bachelor's Degree in Vocation (B. Voc.) or B. Sc. (Tech.)	130	6	3
6.0	4-Years Bachelor's degree (B.Tech. or Equivalent) in Tech. with Multidisciplinary Minor	172	8	4

D. Category-wise Courses

1. MULTIDISCIPLINARY MINOR (MDM)

- List of Multidisciplinary Minor Courses from other departments: Total 17 Credits
- The Minor courses may be from the different disciplines of the Engineering faculty, or they can be from different faculty altogether.
- Students have to choose the MD M in the Second Year and once opted then students can not change it throughout the semesters.

Table 6: Multidisciplinary Minors

Multidisciplinary Minor Baskets (UG)					
MDM Offered by Department	**To be Opted By Department**	**Sr No**	**Course Code**	**Course Name**	**Semester**
Civil Engineering	**Students other than Civil department**	1	24-MDM-CE-2-01	Fundamentals of Green Technology	III
			24-MDM-CE-2-02	Fundamentals of Green Technology Lab	
		2	24-MDM-CE-2-03	Green Building Rating System	IV
		3	24-MDM-CE-3-01	Water and Land Management	V
			24-MDM-CE-3-02	Water and Land Management Lab	
		4	24-MDM-CE-3-03	Socio-economic Management	VI
		5	24-MDM-CE-4-01	Urban Policy Framework	VII
			24-MDM-CE-4-02	Urban Policy Framework Lab	
		6	24-MDM-CE-4-03	Life Cycle Assessment	VIII
Computer Engineering & Artificial Intelligence and Data Science	**Students other than the Computer and AIDS department**	1	24-MDM-CS-2-01	Data Structure	III
			24-MDM-CS-2-02	Data Structure Lab	
		2	24-MDM-CS-2-03	Database Management System	IV
		3	24-MDM-CS-3-01	Object Oriented Programming in Java	V
			24-MDM-CS-3-02	Java Programming Lab	
		4	24-MDM-CS-3-03	Cloud Computing	VI
		5	24-MDM-CS-4-01	Data Science and Machine Learning	VII
			24-MDM-CS-4-02	Data Science and Machine Learning Lab	
		6	24-MDM-CS-4-03	Blockchain Technologies	VIII
Electronics & Telecommunication	**Students other than E&TC department**	1	24-MDM-ET-2-01A	Internet of Things	III
			24-MDM-ET-2-02A	Internet of Things Laboratory	
		2	24-MDM-ET-2-03A	Digital Electronics and Microprocessor	IV

Engineering		3	24-MDM-ET-3-01A	Drone Technology	V
			24-MDM-ET-3-02A	Drone Technology Laboratory	
		4	24-MDM-ET-3-03A	Robotics	VI
		5	24-MDM-ET-4-01A	Mobile Computing	VII
			24-MDM-ET-4-02A	Mobile Computing Laboratory	
		6	24-MDM-ET-4-03A	Wireless Sensor Networks	VIII
Electronics & Telecommunication Engineering	**Students other than E&TC department**	1	24-MDM-ET-2-01B	Lean Systems Fundamentals	III
		2	24-MDM-ET-2-02B	Industry 4.0 Concepts and Technologies	IV
		3	24-MDM-ET-3-01B	Advanced Lean Practices	V
			24-MDM-ET-3-02B	Lean Simulation and Automation Lab	
		4	24-MDM-ET-3-03B	Smart Manufacturing Systems and Digital Transformation	VI
		5	24-MDM-ET-4-01B	Robotics and Automation for Smart Manufacturing	VII
			24-MDM-ET-4-02B	Robotics and AI Implementation Lab	
		6	24-MDM-ET-4-03B	Lean Industry 4.0	VIII
Mechanical Engineering	**Students other than Mechanical department**	1	24-MDM-ME-2-01	Engineering Materials and Safety	III
			24-MDM-ME-2-02	Engineering Materials and Safety Lab	
		2	24-MDM-ME-2-03	Sustainable Energy Technology	IV
		3	24-MDM-ME-3-01	Remote Sensing and GIS	V
			24-MDM-ME-3-02	Remote Sensing and GIS Lab	
		4	24-MDM-ME-3-03	Project Planning & Management	VI
		5	24-MDM-ME-4-01	Estimation and Costing	VII
			24-MDM-ME-4-02	Estimation and Costing Lab	
		6	24-MDM-ME-4-03	System Approach in Engineering	VIII

#Note: You can refer syllabus of all SEM III and SEM IV MDM Courses from
https://snjb.org/engineering/uploads/media/2025/03/SY2025-26-MDM-2024-28.pdf

2. OPEN ELECTIVES

- A Student can opt for any one course out of available institute-wide courses defined in the following list as Open Elective – provided he/she has not taken that particular course in his/her Programme core, Programme elective, Multidisciplinary Minor, other Open elective, and Vocational and Skill Enhancement courses, etc. throughout his/her four years of B. Tech Programme.
- The student must opt for a course that is compulsory from another discipline/branch, not from the same Major discipline/branch, and also the course must be not related to his/her major degree/branch courses.
- For Open Electives 8 credits are offered from semester IV to semester VI.
- Two courses of 3 credits and one course of 2 credits.

Table 7: Open Electives

Sr. No	Course Code	Course Name
Open Elective I (SEM-IV)		
1	24-OEC-2-4-01	Precision Agriculture
2	24-OEC-2-4-02	Soil and Water Conservation for Agriculture
3	24-OEC-2-4-03	Business Development, Marketing and Finance
4	24-OEC-2-4-04	Financial Accounting and Management
5	24-OEC-2-4-05	Information Technology Laws and Policies
Open Elective II (SEM-V)		
1	24-OEC-3-5-01	Agronics
2	24-OEC-3-5-02	Digital Marketing
3	24-OEC-3-5-03	Estimation and Costing
4	24-OEC-3-5-04	Sustainable Energy Engineering
5	24-OEC-3-5-05	Occupational Health and Safety
Open Elective III (SEM-VI)		
1	24-OEC-3-6-01	E-Governance in Agriculture
2	24-OEC-3-6-02	Agro Entrepreneurship
3	24-OEC-3-6-03	Startup and New Venture Management
4	24-OEC-3-6-04	Rural Finance Management and Budgeting
5	24-OEC-3-6-05	Green Energy

#Note: You can refer syllabus of sem IV Open Elective Courses from
https://snjb.org/engineering/uploads/media/2025/03/SY2025-26-Open-Electives-2024-28.pdf

3. DOUBLE MINORS

- In addition to 172 credits of B. Tech Programmes (Bachelor of Technology) i.e. Major in which the student has taken admission, a student may opt for Specialization Minor in another discipline/branch/emerging areas, not in Major discipline/branch.
- A student is required to earn an additional 18 credits in another discipline/ branch/ emerging areas for Specialization Minor distributed over semesters III to VIII.
- The total number of credits required to complete the Specialization Minor in another discipline/ emerging area is 18 credits, in addition to 172 credits in the Major.
- Minor Courses can be completed through an online platform.

Table 8: Double Minors

Double Minor Basket (UG) (2024-28)						
Double Minor Offered by	**To be Opted By Department**	**Double Minor Basket Name**	**Sr No**	**Course Code**	**Course Name**	**Semester**
Artificial Intelligence & Data Science Engineering	**Students other than the Computer and AIDS department**	**High Performance Computing**	1	24-DMC-AD-2-01	Computer Networks	**III**
			2	24-DMC-AD-2-02	Cloud Computing	**IV**
			3	24-DMC-AD-3-03	Distributed Computing	**V**
			4	24-DMC-AD-3-04	Blockchain Technology	**VI**
			5	24-DMC-AD-4-05	High Performance Computing	**VII**
			6	24-DMC-AD-4-06	Mastering in Cloud Architecture	**VIII**
Civil Engineering	**Students other than Civil department**	**Infrastructure Engineering**	1	24-DMC-CE-2-01	Infrastructure Planning and Management	**III**
			2	24-DMC-CE-2-02	Infrastructure Economics	**IV**
			3	24-DMC-CE-3-03	Project Formulation and Appraisal	**V**
			4	24-DMC-CE-3-04	Advanced and Sustainable Materials in Infrastructure	**VI**
			5	24-DMC-CE-4-05	Management Information Systems	**VII**
			6	24-DMC-CE-4-06	Computational Methods in Infrastructure Engineering	**VIII**
Computer Engineering	**Students other than Computer and AIDS department**	**Data Science**	1	24-DMC-CS-2-01	Foundation of Data Science	**III**
			2	24-DMC-CS-2-02	Principles of Artificial Intelligence and Machine Learning	**IV**
			3	24-DMC-CS-3-03	Data analytics with Python	**V**
			4	24-DMC-CS-3-04	Business Intelligence & Analytics	**VI**
			5	24-DMC-CS-4-05	Natural Language Processing	**VII**

			6	24-DMC-CS-4-06	Large Language Models	**VIII**
Electronics & Telecommunication Engineering	**Students other than E&TC department**	**Embedded System**	1	24-DMC-ET-2-01	Digital Electronics	**III**
			2	24-DMC-ET-2-02	Microprocessor & Microcontroller	**IV**
			3	24-DMC-ET-3-03	Analog Circuits	**V**
			4	24-DMC-ET-3-04	Mechatronics	**VI**
			5	24-DMC-ET-4-05	Embedded System	**VII**
			6	24-DMC-ET-4-06	Internet of Things	**VIII**
Mechanical Engineering	**Students other than Mechanical department**	**Sustainable Energy Engineering**	1	24-DMC-ME-2-01	Introduction to Sustainable Energy Systems	**III**
			2	24-DMC-ME-2-02	Solar PV Design Optimization & Manufacturing	**IV**
			3	24-DMC-ME-3-03	Future Solar Energy Harnessing Technologies	**V**
			4	24-DMC-ME-3-04	Grid Integration and Smart Grid Technologies	**VI**
			5	24-DMC-ME-4-05	Sustainable Engineering Solutions	**VII**
			6	24-DMC-ME-4-06	Sustainability Assessment and Analysis	**VIII**

#Note for NPTEL/SYAYAM: Approved courses and platforms will be enlisted timely by authorities along with rules and regulations

#Note: You can refer syllabus of all SEM III and IV Double Minor Courses from
https://snjb.org/engineering/uploads/media/2025/03/SY2025-26-Double-Minors-2024-28.pdf

4. HONORS

- In addition to 172 credits of B. Tech Programmes (Bachelor of Technology) i.e. Major in which the student has taken admission, a student may opt for Honors in the same Tech. discipline/branch / Emerging Areas.
- A student is required to earn an additional 18 credits in the same Tech. discipline/ branch / Emerging Areas for Honors distributed over semesters III to VIII.
- The total number of credits required to complete the Honors in the same Tech. discipline/ Emerging Areas is 18 credits, in addition to 172 credits in Major.
- Students will have to compulsorily choose Honors from the same Tech. discipline/branch.
- Honors Degree in the Bachelor of Engineering programme shall be awarded to students earning additional total credits of all six semesters from the second year to final year, i.e., 18 Credits, in addition to 172 credits or 130 credits respectively. The student admitted in the first year must earn 172 credits and 130 credits admitted in lateral entry (admitted after Diploma or B.Sc.) in the second year.
- Minor Courses can be completed through an online platform.

The student has to choose One Honor out of the Two Honor groups provided below

Honours offered by Mechanical Engineering are as follows:

Table 9: Honors

Sr No	Name of Honors Offered by Department
A.	Fundamentals of Robotics
B.	E-Vehicle Technology

The detailed syllabus structure for the same is as follows:

Table 10A: Specialization Honors in Fundamentals of Robotics

Sr. No	Category	SEM	Course Code	Course Name	Teaching Scheme				
					Hours				Credits
					L	T	P	Total Hours	
01	HOC	III	24-HOC-ME-2-01A	Fundamentals of Robotics	3	-	-	3	3
02	HOC	IV	24-HOC-ME-2-02A	Robot Kinematics & Dynamics	3	-	-	3	3
03	HOC	V	24-HOC-ME-3-03A	Embedded Systems in Robotics	3	-	-	3	3
04	HOC	VI	24-HOC-ME-3-04A	Robot Vision & Motion Planning	3	-	-	3	3
05	HOC	VII	24-HOC-ME-4-05A	Robotics Programming & Controls	3	-	-	3	3
06	HOC	VIII	24-HOC-ME-4-06A	Intelligent Robots	3	-	-	3	3
Total					**18**	-	-	**18**	**18**

Table 10B: Specialization Honors in E-Vehicle Technology

Sr. No	Category	SEM	Course Code	Course Name	Teaching Scheme				
					Hours				Credits
					L	T	P	Total Hours	
01	HOC	III	24-HOC-ME-2-01B	e-Vehicle Technology	3	-	-	3	3
02	HOC	IV	24-HOC-ME-2-02B	EV Power Systems and Battery Technology	3	-	-	3	3
03	HOC	V	24-HOC-ME-3-03B	Electric DriveTrain and Propulsion Systems	3	-	-	3	3
04	HOC	VI	24-HOC-ME-3-04B	EV Charging Infrastructure	3	-	-	3	3
05	HOC	VII	24-HOC-ME-4-05B	Vehicle Dynamics and Control in EVs	3	-	-	3	3
06	HOC	VIII	24-HOC-ME-4-06B	e-Mobility: Sustainability and the Future	3	-	-	3	3
Total					**18**	-	-	**18**	**18**

#Note for NPTEL/SYAYAM: Approved courses and platforms will be enlisted timely by authorities along with rules and regulations

#Note: You can refer syllabus of all SEM III and SEM IV Honors Courses from
https://snjb.org/engineering/uploads/media/2025/03/SY_Btech_Mech_honors_2025-26.pdf

5. HONORS WITH RESEARCH AND MULTIDISCIPLINARY MINOR

- The Student will work on a Research Project or Dissertation for 18 Credits in the Fourth Year in the respective discipline.
- The distribution of 18 Credits for Research projects in Sem-VII and Sem-VIII is given below.
- To get a B. Tech in Mechanical Engineering-Honors with Research and Multidisciplinary Minor degree Students need to earn a total of 190 Credits which consist of 172 credits of regular Multidisciplinary Minor courses, 18 Credits of Honor courses, 18 credits of Research courses.

Table 11: Honors with Research and Multidisciplinary Minor (Sem-VII)

Final Year B. Tech Semester-VII													
Course Code	Course Name	Teaching Scheme				Evaluation Scheme							
		Hours			Credit	Theory Course				Lab Course			Total Marks
		L	T	P	Total	CIE	MSE	SEE	TH Marks	TW	PR	OR	
24-HRC-4-01	Intellectual Property Right (IPR)	2	-	-	2	-	50	50	100	-	-	-	100
24-HRC-4-02	Research Project (Synopsis) Phase-I	-	-	4	2	-	-	-	-	50	-	50	100
24-HRC-4-03	Research Specific Core Course-I (Online NPTEL Course#)	3	-	-	3	-	50	50	100	-	-	-	100
Total		**5**	**-**	**4**	**7**	**-**	**100**	**100**	**200**	**50**	**-**	**50**	**300**

#Note for NPTEL/SYAYAM: Approved courses and platforms will be enlisted timely by authorities along with rules and regulations

Table 12: Honors with Research and Multidisciplinary Minor (Sem-VIII)

Final Year B. Tech Semester-VIII													
Course Code	Course Name	Teaching Scheme				Evaluation Scheme							
		Hours			Credit	Theory Course				Lab Course			Total Marks
		L	T	P	Total	CIE	MSE	SEE	TH Marks	TW	PR	OR	
24-HRC-4-04	Research Project Phase-II	-	-	22	11	-	-	-	-	50	-	50	100
Total		**-**	**-**	**22**	**11**	**-**	**-**	**-**	**-**	**50**	**-**	**50**	**100**

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To be implemented for 2024-28 Batch

(With Effect from Academic Year 2025-26)

TEACHING AND EVALUATION SCHEME FOR FIRST YEAR B-TECH

Semester – I

Sr. No	Category	Course Code	Course Name	Teaching Scheme					Evaluation Scheme							
				Hours				Credits	Theory Course				Lab Course			Total Marks
				L	T	P	Total Hours		CIE	MSE	SEE	TH Marks	TW	PR	OR	
1	BSC	24-BSC-1-02	Engineering Chemistry	3	-	-	3	3	20	20	60	100	-	-	-	100
2	BSC	24-BSC-1-03	Linear Algebra And Differential Calculus	3	1	-	4	4	20	20	60	100	-	-	-	100
3	ESC	24-ESC-1-03	Engineering Graphics	3	-	-	3	3	20	20	60	100	-	-	-	100
4	ESC	24-ESC-1-04	Smart Building and Materials	2	-	-	2	2	20	20	60	100	-	-	-	100
5	BSC	24-BSC-1-06	Engineering Chemistry Laboratory	-	-	2	2	1	-	-	-	-	25	-	-	25
6	ESC	24-ESC-1-08	Engineering Graphics Lab	-	-	2	2	1	-	-	-	-	25	-	-	25
7	ESC	24-ESC-1-09	Smart Building and Materials Lab	-	-	2	2	1	-	-	-	-	25	-	-	25
8	VSEC	24-VSC-1-02	TechShop	-	-	4	4	2	-	-	-	-	50	-	-	50
9	CCC		Co-curriculum Course -I	-	-	2	2	1	-	-	-	-	50	-	-	50
10	IKS	24-IKS-1-01	Indian Knowledge System	-	2	-	2	2	-	-	-	-	50	-	-	50
11	AEC	24-AEC-1-01	Professional Communication Skills	-	1	-	1	1	-	-	-	-	25	-	-	25
Total				**11**	**4**	**12**	**27**	**21**	**80**	**80**	**240**	**400**	**250**	**-**	**-**	**650**

Course Code	Basket of Co-curricular Course
24-CCC-1-A	Yoga
24-CCC-1-B	Sports
24-CCC-1-C	NSS (National Service Scheme)
24-CCC-1-D	Cultural

Note: Students have to select any one course from the above basket.

Induction Program (Mandatory)	3 Weeks Duration
The induction program (as per AICTE guidelines) is to be completed at the start of the first year.	• SIP Module 1: UHV 1 • SIP Module 2: Physical Health and Related Activities • SIP Module 3: Familiarization of Department/ Branch and Innovation • SIP Module 4: Visit to a Local Area • SIP Module 5: Lectures by Eminent People • SIP Module 6: Proficiency Modules • SIP Module 7: Literature / Literary Activities • SIP Module 8: Creative Practices • SIP Module 9: Extra Curricular Activities

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Semester – II

Sr. No	Category	Course Code	Course Name	Teaching Scheme					Evaluation Scheme							
				Hours				Credits	Theory Course				Lab Course			Total Marks
				L	T	P	Total Hours		CIE	MSE	SEE	TH Marks	TW	PR	OR	
1	BSC	24-BSC-1-01	Engineering Physics	3	-	-	3	3	20	20	60	100	-	-	-	100
2	BSC	24-BSC-1-04	Statistics Probability and Integral Calculus	3	-	-	3	3	20	20	60	100	-	-	-	100
3	ESC	24-ESC-1-01	Basic Electrical and Electronics Engineering	3	-	-	3	3	20	20	60	100	-	-	-	100
4	ESC	24-ESC-1-06	Programming and Problem Solving using Python	2	-	-	2	2	20	20	60	100	-	-	-	100
5	PCC	24-PCC-ME-1-01	Mechanical Engineering Systems	2	-	-	2	2	20	-	30	50	-	-	-	50
6	BSC	24-BSC-1-05	Engineering Physics Laboratory	-	-	2	2	1	-	-	-	-	25	-	-	25
7	ESC	24-ESC-1-05	Basic Electrical and Electronics Engineering Lab	-	-	2	2	1	-	-	-	-	25	-	-	25
8	ESC	24-ESC-1-10	Python Programming Lab	-	-	2	2	1	-	-	-	-	25	-	-	25
9	PCC	24-PCC-ME-1-02	Mechanical Engineering Systems Lab	-	-	2	2	1	-	-	-	-	25	25	-	50
10	VCEC	24-VSC-1-01	TechSkill	-	-	4	4	2	-	-	-	-	50	-	-	50
11	CCC	24-CCC-1-05	Co-curriculum Course -II	-	-	4	4	2	-	-	-	-	25	-	-	25
Total				**13**	**-**	**16**	**29**	**21**	**100**	**80**	**270**	**450**	**175**	**25**	**-**	**650**

Level 4.5 Exit Criteria: Mandatory Courses to be completed after the first year to obtain One Year UG Certificate in Mechanical Engineering

Sr. No	Category	Course Code	Course Name	Teaching Scheme					Evaluation Scheme							
				Hours				Credits	Theory Course				Lab Course			Total Marks
				L	T	P	Total Hours		CIE	MSE	SEE	TH Marks	TW	PR	OR	
1	EXT	24-EXT-1-01	Internship / Fieldwork/OJT	-	-	8	8	4	-	-	-	-	100	-	-	100
2	EXT	24-EXT-1-02	Mini Project	-	-	8	8	4	-	-	-	-	50	-	50	100
Total				**-**	**-**	**16**	**16**	**8**	**-**	**-**	**-**	**-**	**150**	**-**	**50**	**200**

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TEACHING AND EVALUATION SCHEME FOR SECOND YEAR B-TECH

Semester – III

Sr. No	Category	Course Code	Course Name	Teaching Scheme					Evaluation Scheme							
				Hours				Credits	Theory Course				Lab Course			Total Marks
				L	T	P	Total Hours		CIE	MSE	SEE	TH Marks	TW	PR	OR	
1	PCC	24-PCC-ME-2-01	Solid Mechanics	3	-	-	3	3	20	20	60	100	-	-	-	100
2	PCC	24-PCC-ME-2-02	Engineering Materials & Metallurgy	3	-	-	3	3	20	20	60	100	-	-	-	100
3	PCC	24-PCC-ME-2-03	Engineering Thermodynamics	3	-	-	3	3	20	20	60	100	-	-	-	100
4	MDM		Multi Disciplinary Minor-I	3	-	-	3	3	20	20	60	100	-	-	-	100
5	PCC	24-PCC-ME-2-04	Materials & Mechanics Lab	-	-	2	2	1	-	-	-	-	25	-	25	50
6	PCC	24-PCC-ME-2-05	Engineering Thermodynamics Lab	-	-	2	2	1	-	-	-	-	25	-	25	50
7	EEM	24-EEM-2-01	Engineering Economics	1	-	2	3	2	-	-	-	-	25	-	-	25
8	AEC	24-AEC-2-01	Business Communication Skill	-	-	2	2	1	-	-	-	-	25	-	-	25
9	VEC	24-VEC-2-01	Universal Human Values-II	3	-	-	3	3	-	-	-	-	50	-	-	50
10	ELC	24-ELC-ME-2-01	Community Engagement Project/Field Project	-	-	4	4	2	-	-	-	-	25	-	25	50
Total				**16**	**-**	**12**	**28**	**22**	**80**	**80**	**240**	**400**	**175**	**-**	**75**	**650**

Semester – IV

Sr. No	Category	Course Code	Course Name	Teaching Scheme					Evaluation Scheme							
				Hours				Credits	Theory Course				Lab Course			Total Marks
				L	T	P	Total Hours		CIE	MSE	SEE	TH Marks	TW	PR	OR	
1	PCC	24-PCC-ME-2-06	Fluid Mechanics	3	-	-	3	3	20	20	60	100	-	-	-	100
2	PCC	24-PCC-ME-2-07	Theory of Machines	3	-	-	3	3	20	20	60	100	-	-	-	100
3	MDM		Multi-Disciplinary Minor-II	3	-	-	3	3	20	20	60	100	-	-	-	100
4	OE		Open Elective-I	3	-	-	3	3	20	20	60	100	-	-	-	100
5	PCC	24-PCC-ME-2-08	Fluid Mechanics & Machinery Lab	-	-	2	2	1	-	-	-	-	25	-	25	50
6	PCC	24-PCC-ME-2-09	Theory of Machines Lab	-	-	2	2	1	-	-	-	-	25	-	25	50
7	AEC		Modern Language	1	-	2	3	2	-	-	-	-	-	-	25	25
8	EEM	24-EEM-2-02	Entrepreneurship Development	1	-	2	3	2	-	-	-	-	50	-	-	50
9	VSEC	24-VSC-ME-2-01	Computer-Aided Machine Drawing	-	-	4	4	2	-	-	-	-	25	25		50
10	VEC	24-VEC-2-02	Digital and Technological Solutions	1	-	2	3	2	-	-	-	-	25	-	-	25
Total				**15**	**0**	**14**	**29**	**22**	**80**	**80**	**240**	**400**	**150**	**25**	**75**	**650**

AEC- Modern Language Basket		
Course Code	**Course Name**	**Who can Opt**
Indian Languages		
24-AEC-2-02-A	Modern Language- Basic Marathi	Students who have not studied this course from Grade I to Grade X can opt this course in the curriculum
24-AEC-2-02-B	Modern Language- Advance Marathi	Students who have studied this course from Grade I to Grade XIcan opt this course in the curriculum
24-AEC-2-02-C	Modern Language- Basic Hindi	Students who have not studied this course from Grade I to Grade X can opt this course in the curriculum
24-AEC-2-02-D	Modern Language- Advance Hindi	Students who have studied this course from Grade I to Grade X can opt this course in the curriculum
24-AEC-2-02-E	Modern Language- Sanskrit	Students who have not studied this course from Grade I to Grade X can opt this course in the curriculum
Foreign Languages		
24-AEC-2-02-F	Modern Language- Japanese	Students who have not studied this course from Grade I to Grade X can opt this course in the curriculum
24-AEC-2-02-G	Modern Language- German	Students who have not studied this course from Grade I to Grade X can opt this course in the curriculum
24-AEC-2-02-H	Modern Language- French	Students who have not studied this course from Grade I to Grade X can opt this course in the curriculum

#Note: Students have to select any one course from the above basket.

#Note: You can refer syllabus all AEC- Modern Language Basket from
https://snjb.org/engineering/uploads/media/2025/03/SY2025-26-Modern-Languages-2024-28.pdf\

Level 5.0 Exit Criteria

Mandatory Courses to be completed after Second Year for obtaining Two Years UG Diploma in Mechanical Engineering

Sr. No	Category	Course Code	Course Name	Teaching Scheme					Evaluation Scheme							
				Hours				Credits	Theory Course				Lab Course			Total Marks
				L	T	P	Total Hours		CIE	MSE	SEE	TH Marks	TW	PR	OR	
1	EXT		Internship / Fieldwork/OJT	-	-	8	8	4	-	-	-	-	100	-	-	100
2	EXT		Mini Project	-	-	8	8	4	-	-	-	-	50	-	50	100
Total				**-**	**-**	**16**	**16**	**8**	**-**	**-**	**-**	**-**	**150**	**-**	**50**	**200**

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TEACHING AND EVALUATION SCHEME FOR THIRD YEAR B-TECH

Semester – V

Sr. No	Category	Course Code	Course Name	Teaching Scheme					Evaluation Scheme							
				Hours				Credits	Theory Course				Lab Course			Total Marks
				L	T	P	Total Hours		CIE	MSE	SEE	TH Marks	TW	PR	OR	
1	PCC	24-PCC-ME-3-01	Heat Transfer	3	-	-	3	3	20	20	60	100	-	-	-	100
2	PCC	24-PCC-ME-3-02	Design of Machine Element	3	-	-	3	3	20	20	60	100	-	-	-	100
3	PEC		Program Elective Course –I	4	-	-	4	4	20	20	60	100	-	-	-	100
4	MDM		Multi-Disciplinary Minor-III	2	-	-	2	2	20	-	30	50	-	-	-	50
5	OE		Open Elective-II	2	-	-	2	2	20	-	30	50	-	-	-	50
6	PCC	24-PCC-ME-3-03	Heat Transfer Lab	-	-	2	2	1	-	-	-	-	25		25	50
7	PCC	24-PCC-ME-3-04	Design of Machine Element Lab	-	-	2	2	1	-	-	-	-	25	-	-	25
8	PCC	24-PCC-ME-3-05	Hydraulics & Pneumatics Lab	-	-	2	2	1	-	-	-	-	25	-	-	25
9	MDM		Multi-Disciplinary Minor Lab-III	-	-	2	2	1	-	-	-	-	25	-	25	50
10	PEC		Program Elective Lab-I	-	-	4	4	2	-	-	-	-	25		25	50
11	AEC	24-AEC-3-01	Environmental Science	-	-	4	4	2	-	-	-	-	50	-	-	50
Total				**14**	**-**	**16**	**30**	**22**	**100**	**60**	**240**	**400**	**175**	**-**	**75**	**650**

Program Elective Course – I				
	Course Code-TH	Name of the Course- TH	Course Code-PR	Name of the Course(PR/OR)
A	24-PEC-ME-4-01A	Design for Manufacturing and Assembly	24-PEC-ME-4-02A	DFMA Lab
B	24-PEC-ME-4-01B	Computer Integrated Manufacturing	24-PEC-ME-4-02B	CIM Lab
C	24-PEC-ME-4-01C	Energy Conversion	24-PEC-ME-4-02C	Energy Lab
D	24-PEC-ME-4-01D	Introduction to AIML	24-PEC-ME-4-02D	AIML Lab

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Semester – VI

Sr. No	Category	Course Code	Course Name	Teaching Scheme					Evaluation Scheme							
				Hours				Credits	Theory Course				Lab Course			Total Marks
				L	T	P	Total Hours		CIE	MSE	SEE	TH Marks	TW	PR	OR	
1	PCC	24-PCC-ME-3-06	Manufacturing Processes	3	-	-	3	3	20	20	60	100	-	-	-	100
2	PEC		Program Elective Course–II	3	-	-	3	3	20	20	60	100	-	-	-	100
3	MDM		Multi-Disciplinary Minor-IV	2	-	-	2	2	20	-	30	50	-	-	-	50
4	OE		Open Elective-III	3	-	-	3	3	20	20	60	100	-	-	-	100
5	PCC	24-PCC-ME-3-07	Manufacturing Processes Lab	-	-	2	2	1	-	-	-	-	25	25		50
6	PEC		Program Elective Lab-II	-	-	4	4	2	-	-	-	-	25	-	25	50
7	VSEC	24-VSC-ME-3-01	Numerical Programming Lab	-	-	2	2	1	-	-	-	-	25	-	-	25
8	VSEC	24-VSC-ME-3-02	Metrology & Quality Control Lab	-	-	2	2	1	-	-	-	-	25	-	-	25
9	ELC	24-ELC-ME-3-01	Research Methodology	4	-	-	4	4	20	20	60	100	-	-	-	100
10	ELC	24-ELC-ME-3-02	Project-stage-I	-	-	4	4	2	-	-	-	-	25	-	25	50
Total				**15**	**-**	**14**	**29**	**22**	**100**	**80**	**270**	**450**	**125**	**25**	**50**	**650**

Program Elective Courses For SEM VI				
	Course Code-TH	Name of the Course- TH	Course Code-PR	Name of the Course(PR/OR)
A	24-PEC-ME-4-03A	Computer-Aided Design and Analysis	24-PEC-ME-4-04A	CAD Lab
B	24-PEC-ME-4-03B	Additive Manufacturing Process	24-PEC-ME-4-04B	AMP Lab
C	24-PEC-ME-4-03C	Refrigeration and Air conditioning	24-PEC-ME-4-04C	RAC Lab
D	24-PEC-ME-4-03D	Data Acquisition and Preprocessing	24-PEC-ME-4-04D	Data Acquisition Lab

Level 5.5 Exit Criteria
Mandatory Courses to be completed after Third Year for obtaining Three Year Bachelor's Degree in Vocation (B. Voc.) in Mechanical Engineering

Sr. No	Category	Course Code	Course Name	Teaching Scheme					Evaluation Scheme							
				Hours				Credits	Theory Course				Lab Course			Total Marks
				L	T	P	Total Hours		CIE	MSE	SEE	TH Marks	TW	PR	OR	
1	EXT		Internship / Fieldwork / OJT	-	-	8	8	4	-	-	-	-	100	-	-	100
2	EXT		Mini Project	-	-	8	8	4	-	-	-	-	50	-	50	100
Total				**-**	**-**	**16**	**16**	**8**	**-**	**-**	**-**	**-**	**150**	**-**	**50**	**200**

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TEACHING AND EVALUATION SCHEME FOR FINAL YEAR B-TECH

Semester – VII

Sr. No	Category	Course Code	Course Name	Teaching Scheme					Evaluation Scheme							
				Hours				Credits	Theory Course				Lab Course			Total Marks
				L	T	P	Total Hours		CIE	MSE	SEE	TH Marks	TW	PR	OR	
1	PCC	24-PCC-ME-4-01	Mechanical System Design	3	-	-	3	3	20	20	60	100	-	-	-	100
2	PCC	24-PCC-ME-4-02	Finite Elements Analysis	3	-	-	3	3	20	20	60	100	-	-	-	100
3	PEC		Program Elective Course –III	4	-	-	4	4	20	20	60	100	-	-	-	100
4	MD M		Multi Disciplinary Minor-V	2	-	-	2	2	20	-	30	50	-	-	-	50
5	MD M		Multi Disciplinary Minor Lab-V	-	-	2	2	1	-	-	-	-	25	25	-	50
6	PCC	24-PCC-ME-4-03	MSD Lab	-	-	4	4	2	-	-	-	-	25	-	25	50
7	PCC	24-PCC-ME-4-04	FEA Lab	-	-	2	2	1	-	-	-	-	25	25	-	50
8	PEC		Open Elective Lab-III	-	-	4	4	2	-	-	-	-	25	25	-	50
9	ELC	24-ELC-ME-4-01	Project-stage-II	-	-	6	6	3	-	-	-	-	50	-	50	100
Total				**12**	**-**	**18**	**30**	**21**	**80**	**60**	**210**	**350**	**150**	**75**	**75**	**650**

Program Elective Course For SEM VII				
	Course Code-TH	Name of the Course- TH	Course Code-PR	Name of the Course(PR/OR)
A	24-PEC-ME-4-05A	Engineering Tribology	24-PEC-ME-4-06A	Engineering Tribology Lab
B	24-PEC-ME-4-05B	Sustainable Manufacturing	24-PEC-ME-4-06B	SM Lab
C	24-PEC-ME-4-05C	Power Plant Engineering	24-PEC-ME-4-06C	PPE Lab
D	24-PEC-ME-4-05D	Predictive Maintenance and Fault Diagnosis with ML	24-PEC-ME-4-06D	Data Analysis Lab

Semester – VIII

Sr. No	Category	Course Code	Course Name	Teaching Scheme					Evaluation Scheme							
				Hours				Credits	Theory Course				Lab Course			Total Marks
				L	T	P	Total Hours		CIE	MSE	SEE	TH Marks	TW	PR	OR	
1	PCC	24-PCC-ME-4-05	Industrial Engineering & Project Management	3	-	-	3	3	40	-	60	100	-	-	-	100
2	PEC		Program Elective Course –IV	3	-	-	3	3	40	-	60	100	-	-	-	100
3	MD M		Multi Disciplinary Minor-VI	3	-	-	3	3	40	-	60	100	-	-	-	100
4	ELC	24-ELC-ME-4-02	Internship	-	-	24	24	12	-	-	-	-	200	-	150	350
Total				**9**	**-**	**24**	**33**	**21**	**120**	**-**	**180**	**300**	**200**	**-**	**150**	**650**

Note: The above Courses from Sr. No. 1 to 3 of SEM-VIII will be conducted in online mode or may be mapped with suitable NPTEL/SWAYAM Courses.

Program Elective Course For SEM VIII		
	Course Code-TH	**Name of the Course- TH**
A	24-PEC-ME-4-07A	Design for Sustainability and Circular Economy
B	24-PEC-ME-4-07B	World Class Manufacturing
C	24-PEC-ME-4-07C	Renewable Energy System
D	24-PEC-ME-4-07D	Optimization Techniques

SEM III

24-PCC-ME-2-01: Solid Mechanics

Teaching Scheme:	**Credit:** 03	**Examination Scheme:**
Theory: 03 Hours/Week		**CIE**: 20 Marks **MSE:** 20 Marks **SEE**: 60 Marks

Prerequisites Courses: (24-BSC-1-03) Linear Algebra And Differential Calculus, (24-BSC-1-04) Statistics and Integral Calculus.

Companion Course: (24-PCC-ME-2-04) EMM Laboratory.

Course Objectives:

- To understand the fundamental concepts of simple stress, strain, thermal stresses and their effects on materials.
- To analyze shear force and bending moment in beams under various loading conditions.
- To calculate bending and shear stresses in beams and understand their distribution
- To determine the slope and deflection of beams using analytical methods
- To analyze torsion in circular shafts and design columns for safety against buckling.
- To calculate principal stresses and evaluate material strength under complex loading conditions using failure theories.

Course Outcomes:

After completion of the course, learners should be able to

CO No	CO	BL
CO1	**Explain** the fundamental concepts of simple stress, strain, and thermal stresses and their effects on materials.	2
CO2	**Calculate** shear forces and bending moments for beams subjected to various loading conditions	3
CO3	**Construct** bending and shear stress distribution diagrams for beams.	3
CO4	**Determine** the slope and deflection of beams using analytical methods.	3
CO4	**Identify** torsional shear stress in the shaft & power calculation.	3
CO5	**Analyze** the columns considering the theory of buckling.	3
CO6	**Utilize** principal stresses and theories of elastic failure to calculate material strength.	3

Course Contents

Unit I	**Simple Stress-Strain and Thermal Stresses**	**10 Hours**

Simple Stress Strain: Introduction to types of loads (Static, Dynamic & Impact Loading) and various types of stresses with applications, Hooke's law, Poisson's ratio, Modulus of Elasticity, Modulus of Rigidity, Bulk Modulus. Interrelation between elastic constants, Stress-strain diagram for ductile and brittle materials, factor of safety, Stresses and strains in determinate and indeterminate beams.

Thermal Stresses: Thermal stresses in plain and composite members

#Exemplar/Case Studies: Thermal stress in railway tracks.		
***Mapping of Course Outcomes**	**CO1, CO4**	
Unit II	**Shear Force and Bending Moment**	**8 Hours**
Beam, Column, Support, Type of load, Equilibrium condition and their calculation. Introduction to SFD, BMD, SFD & BMD for statically determinate beam due to concentrated load, uniformly distributed load, uniformly varying load, couple and combined loading, Relationship between rate of loading, shear force and bending moment, Concept of zero shear force, Maximum bending moment, point of contra-flexure.		
#Exemplar/Case Studies: Analysis of a Truck Loading Platform Beam		
***Mapping of Course Outcomes**	**CO2, CO3**	
Unit III	**Bending and Shear Stresses in Beams**	**8 Hours**
Bending stress on a Beam: Introduction to bending stress on a beam with application, Theory of Simple bending, assumptions in pure bending, derivation of flexural formula, Moment of inertia of common cross-section (Circular, Hollow circular, Rectangular, I & T), Bending stress distribution along the same cross-section) **Shear Stress on a Beam**: Introduction to transverse shear stress on a beam with application, shear stress distribution diagram along the Circular, Hollow circular, Rectangular, I & T cross-section		
#Exemplar/Case Studies: Design and Analysis of a Crane Hook		
***Mapping of Course Outcomes**	**CO2**	
Unit IV	**Slope & Deflection on a Beam**	**8 Hours**
Introduction to slope & deflection on a beam with application. Slope, deflection and Radius of Curvature, Macaulay's Method, Slope and Deflection for all standard beams		
#Exemplar/Case Studies: Slope and Deflection Analysis of a Crane Boom		
***Mapping of Course Outcomes**	**CO2**	
Unit V	**Torsion, Buckling**	**8 Hours**
Torsion of circular shafts: Introduction to torsion on a shaft with application, Basic torsion formulae and assumption in torsion theory, Torsion in stepped and composite shafts, Torque transmission on strength and rigidity basis, Torsional Resilience **Buckling of columns:** Introduction to buckling of columns with its application, Different column conditions and critical, safe load determination by Euler's theory. Limitations of Euler's Theory		
#Exemplar/Case Studies: Torsional stress analysis in automotive drive shafts.		
***Mapping of Course Outcomes**	**CO3, CO4**	
Unit VI	**Principal stress & theory of elastic failure**	**8 Hours**
Principal stresses: Introduction to principal stresses with application, Transformation of Plane Stress, Principal Stresses and planes (Analytical method and Mohr's Circle), Stresses due to combined Normal and Shear stresses **Theories of Elastic failure:** Introduction to theories of failure with application, Maximum principal stress theory, Maximum shear		

stress theory, Maximum distortion energy theory, Maximum principal strain theory, Maximum strain energy theory	
#Exemplar/Case Studies: Analysis of Principal Stresses and Theories of Elastic Failure in a Pressure Vessel	
***Mapping of Course Outcomes**	**CO3, CO4**
Learning Resources	
Text Books	
T1. Ramamrutham, S. *Strength of Materials*. Dhanpat Rai Publishing. **T2.** Bansal, R.K. *Strength of Materials*. Laxmi Publishing.	
Reference Books :	
R1. Engineering Mechanics of Solids" by E.P. Popov, Pearson Education. **R2.** Introduction to Solid Mechanics" by Shames and Pitarresi, Prentice Hall.	
Additional Resources: (Books, e-Resources): • Solid Mechanics: https://nptel.ac.in/courses/112102284 • Virtual Labs: https://www.vlab.co.in/	
MOOC Courses links : • "Solid Mechanics" by edX (https://www.edx.org/)	

24-PCC-ME-2-02: Engineering Materials & Metallurgy

Teaching Scheme:	**Credit:** 3	**Examination Scheme:**
Theory: 03 Hours/Week		**CIE**: 20 Marks **MSE**: 20 Marks **SEE**: 60 Marks

Prerequisite Courses: (24-BSC-1 -02) Engineering Chemistry, (24-PCC-ME-1-01) Mechanical Engineering Systems,(24-BSC-1-01) Engineering Physics

Companion Course: (24-PCC-ME-2-04**)** Materials & Mechanics

Course Objectives:

- **To understand** the fundamental structure and mechanical behaviour of engineering materials.
- **To analyze** basic materials and metallographic techniques for evaluating material properties.
- **To comprehend** the theory of alloys and phase diagrams and their practical applications.
- **To study** the heat treatment processes of steels to enhance their mechanical properties.
- **To explore** destructive and non-destructive testing methods to assess material quality and integrity.
- **To investigate** advanced materials and emerging technologies to enhance engineering applications.

Course Outcomes:

After completion of the course, learners should be able to

CONo	**CO**	**BL**
CO1	**Understand** the fundamental concepts of crystal structures, lattice imperfections, mechanical behaviour, and their influence on material properties.	2
CO2	**Apply** the principles of material classification, metallographic techniques, and microscopic analysis to identify and evaluate the properties and structure of engineering materials.	3
CO3	**Analyze** phase diagrams and microstructural changes in metals and alloys, as well as the effect of heat treatment processes on material properties.	3
CO4	**Apply** different heat treatment processes for modifying and Evaluate the properties of steel	3
CO5	**Assess** the role of advanced materials in engineering applications.	3
CO6	**Understand** the technological advancements in engineering materials.	2

Course Contents

Unit I	**Structure & Mechanical Behaviour of Materials**	**8 Hours**

Structure of Materials: Basic concepts of Crystal structures, Types of crystal systems, Crystal structure of metals(BCC, FCC and HCP systems), Miller indices, indexing of lattice planes & directions, Lattice parameters (coordination number, no. of atoms per unit cell, atomic packing factor, density-only theory no derivation and numerical)

Lattice Imperfections: Definition, classification and significance of Imperfections Point defects: vacancy, interstitial and impurity

atom defects, Their formation and effects, Dislocation - Edge and screw dislocations Burger's, Surface defects -Grain boundary, sub-angle grain boundary and stacking faults, their significance, Deformation: Definition, elastic and plastic deformation, Mechanism, Ashby diagrams		
#Exemplar/Case Studies: Numericals on Miller Indexing and Find its Directions		
***Mapping of Course Outcomes**	**CO1**	
Unit II	**Basic Materials & Metallography**	**6 Hours**
Basic Materials: Metallic materials, Polymeric Materials, Ceramics and Composites: Definition, composition, general properties, applications with examples **Metallography:** Classification of metal observations: their definition, difference & importance. Microscopy: specimen preparation, specimen mounting (hot & cold mounting), electrolytic polishing, etching procedure and reagents, electrolytic etching. **Microscopic techniques**: optical microscopy, electron microscopy techniques(Principles only) Study of Metallurgical microscope, Macroscopy: Sulphur printing, flow line observations		
#Exemplar/Case Studies: Failure Analysis of mechanical Components Using Metallography		
***Mapping of Course Outcomes**	**CO2,CO3,**	
Unit III	**Iron-Iron Carbide Equilibrium Diagrams**	**8 Hours**
Solidification of pure metal, Different types of phase diagrams (Isomorphous, Eutectic, Peritectic, Eutectoid, Peritectoid) and their analysis, Importance of Iron as engineering material, Allotropic forms of Iron, Significance of alloying, Influence of carbon in Iron-Carbon alloy diagram, Iron-Iron carbide diagram and its analysis, Graphitization of Iron- Grey Cast iron, white cast iron, Nodular and malleable cast irons, their microstructures, properties and applications, Introduction to designation of steels		
#Exemplar/Case Studies: Applications of Fuse and Soldering Wires		
***Mapping of Course Outcomes**	**CO1,CO2,CO3**	
Unit IV	**HEAT-TREATMENT OF STEELS**	**8 Hours**
Transformation products of Austenite, Time Temperature Transformation Diagrams, critical cooling rate, continuous cooling transformation diagrams.Heat treatment of steels: Annealing, Normalising, Hardening, & Tempering, and other treatments such as Martempering, Austempering, Patenting, and Ausforming. Retention of austenite, effects of retained austenite. Elimination of retained austenite (Subzero treatment). Hardenability & hardenability testing, Classification of surface hardening treatments, Carburising, heat treatment after Carburizing, Nitriding, Carbo-nitriding, Flame hardening, and Induction Hardening. Vacuum and plasma hardening.		
#Exemplar/Case Studies: Heat Treatment of Cutting Tools and Gears		
***Mapping of Course Outcomes**	**CO1,CO2,CO4,CO5,**	
Unit V	**DESTRUCTIVE & NON-DESTRUCTIVE TESTING**	**8 Hours**
Study of destructive testing, different hardness tests Vickers, Rockwell, Brinell, Poldi, Micro Hardness Test, Durometers, Impact test, fatigue test, creep test, Erichsen Cupping Test.		

Non Destructive Testing: Principles & procedure, advantages, disadvantages and Industrial applications of NDT, such as Visual Inspection, Liquid /dye penetrant test, Magnaflux test, Eddy current test, Sonic & Ultrasonic testing and Radiography testing, Acoustic Emission Testing, Infrared Thermography, Magnetic Flux Leakage (MFL)		
#Exemplar/Case Studies: Applications of Petroleum Pipeline, Compressor Casting Leakage		
***Mapping of Course Outcomes**	**CO2,CO4,CO6**	
Unit VI	**Advance Materials**	**6 Hours**
Composites: Basic concepts of composites, Processing of composites, advantages over metallic materials, various types of composites and their applications **Nano Materials:** Introduction, Concepts, synthesis of nanomaterials, examples, applications and Nanocomposites Selection of the right material for the given requirement from application, cost, weight, availability, and sustainability point of view **Conducting and resisting materials** – types, properties and applications; Semiconducting materials – properties and applications		
#Exemplar/Case Studies: Material selection for a given application based on cost, weight, availability, and sustainability.		
***Mapping of Course Outcomes**	**CO1,CO5,CO6**	
Learning Resources		
Text Books		
T1. Kodgire, V. D., and S. V. Kodgire. *Engineering Materials and Metallurgy*. Everest Publishing House **T2.** Raghavan, V. *Material Science & Engineering*. Prentice Hall of India, 2003		
Reference Books :		
R1. Callister, William D., Jr., and R. Balasubramaniam. *Materials Science and Engineering*. Wiley India Pvt. Ltd. **R2.** Courtney, Thomas H. *Mechanical Behaviour of Materials*. McGraw Hill International, New Delhi. **R3.** Agrawal, B.K. *Introduction of Engineering Materials*. McGraw Hill Publishing Co. Ltd. **R4.** Dieter, G.E. *Mechanical Metallurgy*. McGraw Hill International, New Delhi. **R5.** Smith, W.F. *The Structure and Properties of Engineering Alloys*. McGraw Hill International..		
Additional Resources: (Books, e-Resources) ● https://books.google.co.in/books?id=7y8xqSqu3gwC&printsec=frontcover&source=gbs_book_other_versions_r&redir_esc=y#v=onepage&q&f=false		
MOOC Courses links : ● Material Science& Engineering: https://onlinecourses.nptel.ac.in/noc20_mm09/preview ● Material Science & Technology Apllications: https://www.coursera.org/specializations/materials-science-for-technological-application		

24-PCC-ME-2-03: Engineering Thermodynamics

Teaching Scheme: Theory: 03 Hours/Week	**Credit:** 03	**Examination Scheme:** **CIE**: 20 Marks **MSE: 20** Marks **SEE**: 60 Marks

Prerequisite Courses: (24-BSC-1-03) Linear Algebra And Differential Calculus, (24-BSC-1-04) Statistics and Integral Calculus, (24-BSC-1-01) Engineering Physics, **(**24-BSC-1 -02) Engineering Chemistry, (24-PCC-ME-1- 01)Mechanical Engineering System

Companion Course: (24-PCC-ME-2-05) Engineering Thermodynamics Lab

Course Objectives:

- To provide a fundamental understanding of thermodynamic principles, laws, and their applications to energy systems.
- To develop the ability to analyze thermodynamic systems using the first and second laws of thermodynamics.
- To introduce the concept of entropy, availability, and their role in determining the efficiency of thermodynamic systems.
- To impart knowledge about ideal gas laws, processes, and properties of pure substances to solve practical engineering problems.
- To study the properties of steam, the Rankine cycle, and their applications in power generation systems.
- To familiarize students with the construction, working, and performance evaluation of steam boilers and the basics of fuels and combustion.

Course Outcomes:

After completion of the course, learners should be able to

CO No	CO	BL
CO1.	**Apply** First law of Thermodynamics to flow and Non Flow processes to find heat and work in systems	3
CO2.	**Apply** the second law of thermodynamics to evaluate the performance of heat engines, refrigerators, and heat pumps.	3
CO3.	**Evaluate** Entropy change for various processes and determine the reversibility or irreversibility	3
CO4.	**Analyze** the work heat internal energy enthalpy associates with ideal gas process	4
CO5.	**Evaluate** properties of pure substance and analyse Ideal vapour power rankine cycle	4
CO6.	**Estimate** the performance of steam generators equivalent evaporation efficiency and heat balance sheet	3

Course Contents

Unit I	Laws of Thermodynamics	7 Hours

Fundamentals of Thermodynamics: Review of basic definitions, Zeroth law of Thermodynamics, Macro and Microscopic Approach, State Postulate, State, Path, Process and Cycles, Point function and Path function, quasi static process, Equilibrium,

Thermal Reservoir. **First Law of Thermodynamics**: Concept of heat and work, Application of first law to flow and non-flow Processes and Cycles. Steady flow energy equation (SFEE), Applications of SFEE to various devices such as Nozzle, Turbine, Compressors, Boilers etc.**(Numerical Treatment),** PMM-I kind,		
#Exemplar/Case Studies: example Real world application		
***Mapping of Course Outcomes**	**CP1**	
Unit II	**Second law of Thermodynamics**	**7 Hours**
Second Law of Thermodynamics: Limitations of first law of thermodynamics, Kelvin-Planck & Clausius Statement of the Second law of Thermodynamics, Equivalence of the two statements, PMM-II kind, Heat Engine, Refrigerator and Heat pump, Schematic representation, Efficiency and Coefficient of Performance (COP), Concept of Reversibility and Irreversibility, Carnot Theorem, Carnot Cycle **(Numerical Treatment).**		
#Exemplar/Case Studies: example Real world application		
***Mapping of Course Outcomes**	**CO2**	
Unit III	**Entropy**	**6 Hours**
Entropy: Entropy as a property, Clausius Inequality, increase of Entropy Principle,Entropy changes for an Open and Closed System, Change of Entropy, Concept of Entropy generation. Entropy - a measure of Disorder. **(Numerical Treatment)**,Concept of Availability		
#Exemplar/Case Studies:example Real world application		
***Mapping of Course Outcomes**	**CO3**	
Unit IV	**Ideal Gas Properties and Processes**	**6 Hours**
Properties and Processes of Ideal Gas: Boyle's law, Charle's law, Avogadro's Law, Equation of State, Ideal Gas constant and Universal Gas constant, Ideal gas Processes- on P-v and T-s diagrams, Constant Pressure, Constant Volume, Isothermal, Adiabatic, Polytropic, (Open and Closed systems), Heat transfer, Work done, Internal Energy **(Numerical Treatment).** & Entropy Change		
#Exemplar/Case Studies: Demonstration of gas expansion and compression processes in automobile engines using P-v and T-s diagrams.		
***Mapping of Course Outcomes**	**CO4**	
Unit V	**Properties of Pure substances**	**8 Hours**
Properties of Pure substances: Formation of steam, Phase changes, Properties of steam, Use of Steam Tables, Study of P-v, T-s and h-s plots (Mollier Chart) for steam, Dryness fraction and its determination.**(Numerical Treatment on Steam Table)** **Thermodynamics of Vapour Cycle:** Ideal Rankine Cycle, Efficiency of Rankine Cycle, Relative Efficiency, Effect of Varying operating		

parameters like Superheat, Boiler and Condenser Pressure on performance of Rankine cycle**(Numerical Treatment on ideal rankine cycle).**		
#Exemplar/Case Studies: Comparison of Ideal Carnot cycle & Ideal Rankine vapour power cycle with Numerical Treatment		
***Mapping of Course Outcomes**	**CO5**	
Unit VI	**Steam Generators**	**8 Hours**
Steam Generators: Types of fuels, Proximate and ultimate analysis of fuel, Classification, Constructional details of low pressure boilers, Primary Features of high pressure (Power) boilers, Location, Construction and working principle of boiler**,**.Introduction to IBR Act,Boiler Draught, Classification of draught, Boiler performance,Equivalent Evaporation, Boiler efficiency, Heat balance Sheet **(Numerical Treatment).**		
#Exemplar/Case Studies: Study of Boiler Manufacturing process through videos		
***Mapping of Course Outcomes**	**CO6**	
Learning Resources		
Text Books		
T1. P. K. Nag, "Engineering Thermodynamics", Tata McGraw Hill Publications **T2.** P. L Ballaney, "Thermal Engineering", Khanna Publishers **T3.** C.P. Arora, "Thermodynamics", Tata McGraw Hill **T4.** Domkundwar, Kothandaraman and Domkundwar,"Thermal Engineering",Dhanpat Rai Publishers **T5.** M M Rathore, "Thermal Engineering", Tata McGraw-Hill		
Reference Books :		
R1. Rayner Joel, "Basic Engineering Thermodynamics", AWL-Addison Wesley **R2.** Cengel and Boles, "Thermodynamics an Engineering Approach", McGraw Hill **R3.**M Achuthan, "Engineering Thermodynamics", PHI **R4**. Steam Tables/Data book		
MOOC Courses links : **M1.** Engineering Thermodynamics By Prof. Jayant K. Singh IIT Kanpur https://onlinecourses.nptel.ac.in/noc25_ch22/preview https://onlinecourses.nptel.ac.in/noc25_me21/preview **M2.**Engineering Thermodynamics By Prof. D.P. Mishra IIT Kanpur https://onlinecourses.nptel.ac.in/noc25_ae16/preview		

24-PCC-ME-2-04: Materials & Mechanics Lab

Teaching Scheme:	**Credit:** 01	**Examination Scheme:**
Practical: 02 Hours/Week		Termwork: 25 Marks Oral: 25 Marks

Prerequisites Courses: (24-BSC-1-03) Linear Algebra And Differential Calculus, (24-BSC-1-04) Statistics and Integral Calculus.

Companion Course: (24-PCC-ME-2-01 Solid Mechanics) , (24-PCC-ME-2-02) Engineering Material & Metallurgy

Course Objectives:

- To understand the mechanical properties of materials through practical experiments.
- To analyze stress, strain, and deformation in various materials using standard testing procedures.
- To develop skills to use tools and equipment for material testing.
- To apply theoretical concepts of mechanics to real-world problems.
- To enhance teamwork and critical thinking through collaborative experimentation and result analysis.

Course Outcomes:

After completion of the course, learners should be able to

CO No	CO	BL
CO1	**Analyze** and interpret the results of material testing experiments to determine mechanical properties.	3
CO2	**Measure** stress, strain, and modulus of elasticity of different materials through testing.	3
CO3	**Utilize** testing equipment for experimental evaluation of mechanical properties.	3
CO4	**Examine and interpret** the microstructure of materials under testing using metallurgical microscopes.	3

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a reference and hands-on resource. It should include a prologue (about the University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by students as a journal. The journal consists of a Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments will be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environmental awareness, attaching printed papers as part of write-ups and program listing to journals must be avoided. DVDs containing student programs maintained by the laboratory in charge are highly encouraged. For reference, one or two journals may be kept with program prints in the Laboratory.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work should be based on a student's overall performance in Laboratory assignments. Each Laboratory assignment assessment will assign grades/marks based on parameters such as timely completion, performance, innovation, efficient codes, and punctuality.

Guidelines for Practical Examination

Problem statements must be decided jointly by the internal examiner and external examiner. During the practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student's understanding of the fundamentals and effective and efficient implementation. This will encourage transparent assessment and a fair approach and, hence, will not create any uncertainty or doubt in the minds of the students. So, adhering to these principles will consummate our team efforts to the promising start of student's academics.

Guidelines for Laboratory Conduction

Students should clear all doubts before starting the experiment. The equipment must be returned to its designated place after use. Any discrepancies in the readings should be reported immediately. Students should not manipulate results or indulge in malpractice. Proper care should be taken while handling sensitive equipment. Any form of misbehaviour will result in disciplinary action. Students must follow the step-by-step procedure mentioned in the lab manual. Machines must be properly calibrated before every experiment. Collect accurate observations and enter them directly into the journal. Graphs and tables should be drawn neatly using graph paper. Only authorized tools and equipment should be used.

Virtual Laboratory :

- Strength of Materials Lab: https://sm-nitk.vlabs.ac.in/List%20of%20experiments.html

Suggested List of Laboratory Experiments/Assignments

Group A: Assignments (Mandatory Assignment)

Sr No	Assignment Title	*Mapping of Course Outcomes
1.	Tensile Testing on Universal Testing Machine	CO1, CO2, CO3
2.	Compression Test on Mild Steel and Cast Iron	CO1, CO2, CO3
4.	Shear Test on Mild Steel	CO1, CO2, CO3
5.	Bending Test on Beams	CO1, CO2, CO3
6.	Torsion Test on Circular Shafts	CO1, CO2, CO3

Group B: Assignments (Out of List perform any 4 (Optional)

Sr No	Assignment Title	*Mapping of Course Outcomes
1.	Destructive testing - Hardness testing (Rockwell/Vickers) Hardness	CO1, CO2,CO3
2.	Brinell and Poldi hardness Test	CO1, CO2,CO3,

3.	Impact Test for Steel, Aluminum, Brass and Copper (Charpy/Izod)	CO1, CO2,CO3
4.	Steps for Specimen Preparation for microscopic examination & Demonstration of Optical Metallurgical microscope	CO3, CO4
5	Observation and Drawing of Microstructure of Steels, Cast Iron of Non-Ferrous Metals of various compositions	CO3, CO4,

24-PCC-ME-2-05: Engineering Thermodynamics Lab

Teaching Scheme:	**Credit: 1**	**Examination Scheme:**
Practical: 2Hours/Week		**Termwork (TW)** : 25Marks **Oral (OR)** : 25Marks

Prerequisites Courses: (24-BSC-1-03) Linear Algebra And Differential Calculus, (24-BSC-1-04) Statistics and Integral Calculus, (24-BSC-1-01) Engineering Physics, **(**24-BSC-1 -02) Engineering Chemistry, (24-PCC-ME-1- 01)Mechanical Engineering System

Companion Course:

Course Objectives:

- To understand and apply the principles of thermodynamic measurement using instruments like thermocouples and calorimeters in accordance with thermodynamic laws.
- To experimentally determine the specific heat of air and water, theoretical concepts are applied, and results are compared with standard values.
- To verify the First Law of Thermodynamics by analyzing energy transfer and heat flow in steady-flow devices like heated pipes.
- To determine the calorific value of fuels using a Bomb calorimeter and evaluate combustion efficiency using exhaust gas analyzers and smoke meters.
- To apply knowledge of boiler systems and industrial equipment during a plant visit.

Course Outcomes:

After completion of the course, learners should be able to

CONo	CO	BL
CO 1	**Measure** the body's temperature using various devices and explain how it conforms to the Zeroth Law of Thermodynamics.	3
CO 2	**Conduct experiments** on steady-flow devices like heated pipes and interpret the results, applying the First Law of Thermodynamics.	3
CO 3	**Perform** the experiments to determine the specific heat of air/water	3
CO 4	**Conduct** trials on various Calorimeters using thermodynamics knowledge, including analysis and interpolation of data to provide valid conclusions	4
CO5	**Understand** the functions of boiler components, their operations during visits to process industries(boiler)	2

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a reference and hands-on resource. It should include a prologue (about University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by students as a journal. The journal consists of a Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments will be submitted as Hard copy.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work should be based on a student's overall performance in Laboratory assignments. Each Laboratory assignment assessment will assign grades/marks based on parameters such as timely completion, performance, innovation, efficient codes, and punctuality.

Guidelines for Practical Examination

Problem statements must be decided jointly by the internal examiner and external examiner. During the practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student's understanding of the fundamentals and effective and efficient implementation. This will encourage transparent assessment and a fair approach and, hence will not create any uncertainty or doubt in the minds of the students. So, adhering to these principles will consummate our team efforts to the promising start of student's academics.

Guidelines for Laboratory Conduction

These guidelines ensure the safe, efficient, and productive execution of laboratory experiments and activities:

1. Preparation Before the Experiment

- **Understand the Objective:** Students must review the theory, principles, and expected outcomes of the experiment beforehand.
- **Read the Procedure:** Refer to the lab manual or handouts to familiarize yourself with the steps and equipment involved in the experiment.
- **Check the Apparatus:** Inspect the instruments and apparatus for proper functioning. Report any issues to the lab in charge.
- **Safety Measures:**
    - Ensure knowledge of safety protocols for handling equipment, chemicals, and power supplies.
    - Be aware of emergency procedures, such as using fire extinguishers or first aid kits.

2. Conduct During the Experiment

- **Follow the Procedure:** Experiment strictly according to the prescribed steps to ensure accuracy and safety.
- **Handle Equipment with Care:** Avoid rough handling of lab equipment or devices. Use tools as intended.
- **Collaborate Effectively:** Work in assigned groups, ensuring that tasks are divided equally among team members.
- **Record Observations Systematically:** In a lab notebook, note down all readings and observations neatly, organized, and systematically.
- **Ask for Guidance:** If you have any doubts or are facing operational difficulties, seek help from the instructor or lab technician.

3. Post-Experiment Practices

- **Analyze and Interpret Results:**
    - Perform calculations and analyses based on observations.
    - Compare results with theoretical expectations and discuss any deviations.

- **Document the Experiment:**
  - Prepare a detailed lab report that includes the objective, procedure, observations, calculations, and conclusions.
- **Feedback:** Provide constructive feedback to the lab in charge if equipment or procedures can be improved.

4. Safety and Discipline

- **No Unauthorized Access:** Do not operate equipment or begin experiments without instructor approval.
- **Avoid Distractions:** Maintain focus; avoid the use of mobile phones or engaging in unrelated activities.
- **Report Accidents Immediately:** Notify the instructor of any accidents, spills, or equipment failures to ensure prompt resolution.
- **Maintain Lab Decorum:** Work quietly and respectfully without disturbing others.

5. Attendance and Punctuality

- Attend all scheduled lab sessions promptly and sign the attendance sheet as instructed.
- Students arriving late or without prior preparation may not be allowed to experiment.

Virtual Laboratory:

Sr No	Name of Experiment	Link for Virtual Lab
1	The Study of Phase Change	http://htv-au.vlabs.ac.in/heat-thermodynamics/Study_of_Phase_Change/
2	Characterise the Temperature Sensor	https://sl-coep.vlabs.ac.in/exp/temperature-sensor/theory.html
3	Thermocouple Seebeck Effect	http://htv-au.vlabs.ac.in/heat-thermodynamics/Thermo_Couple_Seebeck_Effect/experiment.html

Sr No	List of Experiment	*Mapping of Course Outcomes
1	Temperature Measurement by various Devices in Conformity to Zeroth Law Of Thermodynamics.	**CO1**
2	Experimental Determination of Specific Heat of Air/Water.	**CO3**
3	Verification of the first law of thermodynamics for steady flow devices: Water flow through heated pipes.	**CO2**
4	Demonstration of Joule's experiment, the first law of thermodynamics.	**CO2**
5	Determination of Dryness Fraction by Separating and Throttling Calorimeter	**CO3**
6	Study of Boiler Mountings, Accessories & IBR ACT1923	**CO5**
7	Determination of calorific value of fuel by using a Bomb calorimeter.	**CO4**

8	Demonstration on Exhaust Gas Analyser.	**CO4**
9	Visit any Process Industry or plant having Boilers equipped with Accessories. The visit report consists of Details about the Industry or process Plant and an Operational description of the Equipment with specifications, its use, capacity, application, etc.	**CO5**

Learning Resources (If applicable)

Text Books

T1. P. K. Nag, "Engineering Thermodynamics", Tata McGraw Hill Publications
T2. P. L Ballaney, "Thermal Engineering", Khanna Publishers
T3. C.P. Arora, "Thermodynamics", Tata McGraw Hill
T4. Domkundwar, Kothandaraman and Domkundwar,"Thermal Engineering",Dhanpat Rai Publishers
T5. M M Rathore, "Thermal Engineering", Tata McGraw-Hill

Reference Books :

R1. Rayner Joel, "Basic Engineering Thermodynamics", AWL-Addison Wesley
R2. Cengel and Boles, "Thermodynamics an Engineering Approach", McGraw Hill
R3. G.VanWylen, R.Sonntag and C.Borgnakke, "Fundamentals of Classical Thermodynamics", John Wiley & Sons
R4. M Achuthan, "Engineering Thermodynamics", PHI
R5. Steam Tables/Databook

24-EEM-2-01: Engineering Economics

Teaching Scheme: Theory: 1 Hours/Week Practical: 2 Hours/Week	**Credit:** 02	**Examination Scheme:** Term work (TW): 25 Marks

Prerequisites Courses: - –

Companion Course:- –

Course Objectives:

- To introduce the fundamentals of Economics and its application in engineering.
- To learn to apply the time value of money in project evaluation.
- To understand cost behavior and classification for decision-making.
- To analyze and apply depreciation policies in calculating asset depreciation.

Course Outcomes:

After completion of the course, learners should be able to

CO No	CO	BL
CO1	**Explain** the key concepts of microeconomics and macroeconomics and their relevance in engineering decision-making.	2
CO2	**Understand** the present value and future value of the business.	2
CO3	**Calculate** break-even for different production levels.	3
CO4	**Understanding** different depreciation methods and their impact on asset valuation.	2

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a reference and hands-on resource. It should include a prologue (about University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by students as a journal. The journal consists of a Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement,Assessment grade/marks and assessor's sign, Theory- Concept in brief, test cases, conclusion/analysis.All performed assignments will be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environmental awareness, attaching printed papers as part of write-ups to journals must be avoided. For reference one or two journals may be maintained in the Laboratory.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work should be based on the overall performance of Laboratory assignments by a student. Each Laboratory assignment assessment will assign grades/marks based on parameters, such as timely completion, performance and punctuality.

Guidelines for Laboratory Conduction

Students are expected to perform one assignment each week, do a thorough case study and prepare a presentation on it. He/She has to present it during lab hours within 6-10 minutes. The instructor is expected to assign Assignments and conduct presentations in two separate practical sessions.

Sr No	Assignment Title	*Mapping of Course Outcomes
1.	Determination of equilibrium price under perfect competition for a Company	CO1
2.	Determining elasticity of demand for a company	CO1
3.	Determining elasticity of Supply for a company.	CO1
4.	Evaluation of engineering projects using Present worth method and Future worth method for a Company	CO2
5.	Determining the Break-even analysis for a product of a company.	CO3
6.	Preparation of cost sheet of a company.	CO3
7.	Calculating Depreciation of Assets using Straight line method.	CO4
8.	Calculating Depreciation of Assets using declining balance method.	CO4

Note:-Companies will be assigned to the students before the practical.

Learning Resources (If applicable)

Text Books

T1. Fundamentals of Engineering Economics by Pravin Kumar, John Wiley Publishing INC
T2. Engineering Economics R. Panneerselvam Ed.2nd © 2001 by PHI Learning Private Limited, New Delhi.

Reference Books :

R1.Economics for engineering students,.Seema Singh,2009,IK International Publication House.
R2. Engineering Economics,James L. Riggs, David D. Bedworth, and Sabah U. Randhawa,, Ed.4th Tata McGraw Hill Education Private Limited.

Additional Resources: (Books, e-Resources)

- https://www.hzu.edu.in/engineering/engineering%20economy.pdf
- https://www.uoanbar.edu.iq/eStoreImages/Bank/6298.pdf
- https://brijbhooshan.in/Brij%20Data/Industrial%20Management/Book/Engineering%20Economics%20By%20R.%20Paneerselvam.pd

MOOC Courses links :

- Link to NPTEL course contents: Engineering Economics Analysis
  https://archive.nptel.ac.in/courses/112/107/112107209/#
- Udemy Course - Fundamental of Engineering Economics
  https://www.udemy.com/course/fundamentals-of-engineering-economics/?couponCode=NVDIN35

24-AEC-2-01 : Business Communication Skill

Teaching Scheme: Practical: 2 Hours/Week	**Credit:** 01	**Examination Scheme:** Termwork **(TW)** : 25 Marks

Prerequisites Courses: 24-AEC-1-01 Professional Communication Skill

Companion Course: NA

Course Objectives:

- **Professional Writing Skill:** To understand the concepts of professional writing skills.
- **Business drafting skills**: Develop proficiency in professional business correspondence, including writing formal Memorandum, Drafting notices and preparing agendas
- **Team Based Learning**: To enhance learning through collaborative teamwork and active problem-solving.
- **Business ethics and conduct:** To promote ethical decision-making and integrity in professional business practices.

Course Outcomes:

After completion of the course, learners should be able to

CO No	CO	BL
CO1	**Apply writing** techniques to craft clear and professional job application letters, resumes, and emails using advanced tools and strategies.	3
CO2	**Apply** business drafting concepts to create clear, professional and impactful business documents	3
CO3	**Perform** tasks utilizing knowledge to enhance critical thinking, problem-solving, and communication skills in a team setting.	3
CO4	**Understand** the concepts of business ethics and conduct	2

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a reference and hands-on resource. It should include a prologue (about University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by students as a journal. The journal consists of a Certificate,

table of contents, and handwritten write-up /print of each assignment (Title, Date of Completion, Objectives, Problem Statement, Assessment grade/marks and assessor's sign, Theory- Concept in brief).

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work should be based on the overall performance of Laboratory assignments by a student. Each Laboratory assignment assessment will assign grades/marks based on parameters, such as timely completion, performance, innovation, and punctuality.

Virtual Laboratory:

- https://ve-iitg.vlabs.ac.in/Business%20Communication.html

Suggested List of Laboratory Experiments/Assignments

Sr No	Assignment Title	*Mapping of Course Outcomes
1.	**Draft a job application letter** for a fresher applying to your dream company, along with a professional email to accompany the application.	CO1
2	**Create a resume** as a fresher applying to your dream company	CO1
3	**Compose a professional email** to accompany the job application, following proper email etiquette.	CO1
4	**Write a memorandum** announcing the guest lecture, providing details about the speaker, the date, time, venue, and any preparation students should do before attending	CO2
5	**Draft a notice** to inform students about the Annual Gathering Symposium, including key event details such as the date, time, venue, and registration procedure, along with any specific instructions for participants or attendees.	CO2
6	**Prepare a meeting agenda** for the upcoming project review meeting. Include topics such as progress updates on the prototype, technical challenges, resource requirements, timelines, and the next steps for each department. Ensure time is allocated for discussions and question-	CO2
7	**Develop a unique advertisement** poster for a product, keeping in mind the characteristics and preferences of their target market	CO3

	(Group of 4-5 Students)	
8	**Conduct case studies on business ethics** by analyzing any corporate organizations (e.g., Enron, Volkswagen, TATA).	CO4

Learning Resources (If applicable)

Text Books :

T1.The Ace of Soft Skills - Attitude Communication and Etiquette for Success by Ramesh Gopal Swamy Ramesh Mahadevan

T2. Personality Development & Communication Skills by Gupta Sachin

References Books :

R1. Global Business Foundation Skills by : Accenture Convergys

R2. Business Ethics by: Awasthappab K

Additional Resources: (Books, e-Resources)

- https://nptel.ac.in/courses/109104031
- https://archive.nptel.ac.in/courses/109/106/109106129/

MOOC Courses links :

- https://www.coursera.org/courses?query=communication%20skills
- https://www.britishcouncil.in/english/online/resources-websites/moocs

24-VEC-2-01: Universal Human Values-II

Teaching Scheme: Theory: 3 Hours/Week	**Credit:** 03	**Examination Scheme:** **Termwork(TW): 50 Marks**

Prerequisites Courses: 24-IKS-1-01: IKS, SIP Module 1- UHV-I

Companion Course: NA

Course Objectives:

- To appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings.
- To facilitate the development of a holistic perspective among students to lead their personal and professional lives in an ethical way
- To highlight plausible implications of such a holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior, and mutually enriching interaction with nature.

Course Outcomes:

After completion of the course, learners should be able to

CO No	CO	BL
CO1	**Demonstrate** the relevance of 'Universal Human Values'.	3
CO2	**Develop** an understanding about human being as coexistence of 'Self' & 'Body'	2
CO3	**Apply** the learnings to ensure harmony in family and society.	3
CO4	**Model** coexistence with nature by integrating Universal Human Values for ethical personal and professional lives.	3

Course Contents

Unit 1	**Introduction to Value Education**	**6 Hours**

Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity - the Basic Human Aspirations and their Fulfilment, Right Understanding, Relationship and Physical Facility, Happiness and Prosperity - Current Scenario, Method to Fulfil the Basic Human Aspirations

#Exemplar/Case Studies : PS1 Sharing about Oneself, PS2 Exploring Human Consciousness, PS3 Exploring Natural Acceptance

***Mapping of Course Outcomes**	**CO1,CO2**

Unit 2	**Harmony in the Human Being**	**6 Hours**

Understanding Human being as the Co-existence of the Self and the Body,
Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self

Harmony of the Self with the Body, Programme to Ensure self-regulation and Health		
#Exemplar/Case Studies: PS4 Exploring the difference of Needs of Self and Body, PS5 Exploring Sources of Imagination in the Self PS6 Exploring Harmony of Self with the Body		
***Mapping of Course Outcomes**	**CO1,CO2**	
Unit 3	**Harmony in the Family and Society**	**6 Hours**
Harmony in the Family - the Basic Unit of Human Interaction "Trust' - the Foundational Value in Relationship, 'Respect' - as the Right Evaluation Values in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order		
#Exemplar/Case Studies : PS7 Exploring the Feeling of Trust, PS8 Exploring the Feeling of Respect PS9 Exploring Systems to fulfil Human Goal		
***Mapping of Course Outcomes**	**CO1,CO3**	
Unit 4	**Harmony in the Nature (Existence)**	**6 Hours**
Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Coexistence at All Levels, The Holistic Perception of Harmony in Existence		
#Exemplar/Case Studies : PS10 Exploring the Four Orders of Nature, PS11 Exploring Co-existence in Existence		
***Mapping of Course Outcomes**	**CO1,CO4**	
Unit 5	**Implications of the Holistic Understanding - a Look at Professional Ethics**	**6 Hours**
Basis for Universal Human Values, Definitiveness of (Ethical) Human Conduct, Professional Ethics in the light of Right Understanding, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Holistic Technologies, Production Systems and Management Models Typical Case Studies, Strategies for Transition towards Value-based Life and Profession		
#Exemplar/Case Studies: PS12 Exploring Ethical Human Conduct, PS13 Exploring Humanistic Models in Education, PS14 Exploring Steps of Transition towards Universal Human Order		
***Mapping of Course Outcomes**	**CO1,CO2,CO3,CO4**	
Learning Resources		
Text Books		
T1. A Nagraj, 1998, Jeevan Vidya EkParichay, Divya Path Sansthan, Amarkantak.		
Reference Books :		
R1. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers. **R2.** A N Tripathy, 2003, Human Values, New Age International Publishers. **R3.** E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press.		
Additional Resources: (Books, e-Resources) • https://fdp-si.aicte-india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%2026-28%20Ethics%20v1.pdf • https://www.aicte-india.org/sites/default/files/Model_Curriculum/Minor%20Degree%20in%20UHV.pdf		

- https://www.youtube.com/c/UniversalHumanValues
- https://atmiyauni.ac.in/public/file/HVPE%20Text%20Book.pdf
- https://drive.google.com/file/d/1C8qp78Uesoptk5lLR2PQNJOOm43ni7da/view?usp=sharing
- https://drive.google.com/file/d/1q_uwhIGqNJuYLgIAu9hOjciZ6q2RsNIc/view?usp=sharing
- https://fdp-si.aicte-india.org/UHVII.php

MOOC Courses links :

- http://madhyasth-darshan.info/postulations/knowledge/knowledge-of-humane-conduct/
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
- https://youtu.be/OgdNx0X923I
- https://fdp-si.aicte-india.org/UHV-II%20Practice%20Sessions.php
- https://fdp-si.aicte-india.org/download.php#1/

24-ELC-ME-2-01: Community Engagement Project / Field Project

Teaching Scheme: **Practical:** 4 Hours/Week	**Credit:** 02	**Examination Scheme:** **TW**: 25 Marks **OR:** 25 Marks

Prerequisites Courses: (24-CCC-1-05) Co-curricular Course -II, (24-VSC-1-01) Techskill, (24-AEC-1-01) Professional Communication Skills

Companion Course: (24-AEC-2-01) Basic Communication Skills.

Course Objectives:

- To develop an appreciation of rural culture, lifestyle, and wisdom amongst students.
- To learn about the status of various agricultural and development programmes.
- To understand the causes for distress and poverty faced by vulnerable households and explore solutions for the same.
- To apply classroom knowledge of courses to field realities and thereby improve the quality of learning.

Course Outcomes:

After completion of the course, learners should be able to

CO No	CO	BL
1	Gain an understanding of rural life, Indian culture & ethos, and social realities	2
2	Develop a sense of empathy and bonds of mutuality with the local community	3
3	Appreciate the significant contributions of local communities to Indian society and economy	2
4	Learn to value the local knowledge and wisdom of the community	2
5	Identify opportunities for contributing to the community's socio-economic improvements	2

Course Contents

Preamble

The Community Engagement Project/Field Project subject involves activities that will expose students to socio-economic issues in society so that the theoretical learning can be supplemented by actual life experiences to generate solutions to real-life problems.

Assessment

The course requires students to participate in any **TWO** field-based learning/projects as listed below under the supervision of faculty. This will help educate local communities about new technological innovations as well as make students aware of ways to harness local technology and knowledge. In this approach, students apply their knowledge and skills in a chosen community to improve the lives of people in that community. The activities may also be conducted other of working hours.

Recommended field-based activities (Tentative):

1. Interaction with Self Help Groups (SHGs) women members, and study of their functions and challenges; planning for their skill building and livelihood activities

2. Visit the Mahatma Gandhi National Rural Employment Guarantee Act 2005 (MGNREGS) project sites, interact with beneficiaries, and interview functionaries at the work site
3. Field visit to Swachh Bharat project sites, conduct analysis, and initiate problem-solving measures
4. Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan (GPDP)
5. Interactive community exercise with local leaders, panchayat functionaries, grass-root officials, and local institutions regarding village development plan preparation and resource mobilization
6. Visit Rural Schools / mid-day meal centres, study academic and infrastructural resources and gaps
7. Participate in Gram Sabha meetings, and study community participation
8. Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries
9. Visit to local Nagarpalika office and review schemes for urban informal workers and migrants
10. Attend Parent Teacher Association meetings, and interview school dropouts
11. Visit the local Anganwadi Centre and observe the services being provided
12. Visit local NGOs, civil society organisations, and interact with their staff and beneficiaries,
13. Organize awareness programmes, health camps, Disability camps, and cleanliness camps
14. Aware / conduct soil health tests, drinking water analysis, energy use and fuel efficiency surveys and guide solar powered village
15. Raise understanding of people's impacts of climate change, building up community's disaster preparedness
16. Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants
17. Formation of committees for common property resource management, village pond maintenance and fishing
18. Identifying small business ideas for rural areas to make the people self-reliant.
19. Undertaking research projects in partnership with the local community through community-based research methods
20. Social innovation projects with a social impact
21. Financial Literacy Awareness Programme
22. Digital Literacy Awareness Programme
23. Education Loan Awareness Programme
24. Entrepreneurship Awareness Programme
25. Awareness Programmes on Government Schemes
26. Products Market Awareness
27. Services Market Awareness
28. Consumer Awareness Programme
29. Accounting Awareness Programme for Farmers
30. Accounting Awareness Programme for Street Vendors etc.
31. Nutrition survey for mothers and children, and educate them about hygiene and nutrition.

Students must conduct comprehensive studies on various challenges that they face in their chosen field. Every work relevant to the subject matter should be compiled and documented.

Students should keep a separate fieldwork diary or maintain a journal to record their fieldwork experiences, i.e. reading, e-contents, tasks, planning, and work hours have to be recorded in the diary. Detailed work records report on students' fieldwork experiences and activities to be submitted and should be presented.

Every student shall submit a report in the form of a journal that may include, but not be limited to, the following.

1. A map (physical, visual, or digital) of the village you visited, and write an essay about inter-family relations in that village/community.
2. Videos and/or Geo-tagged photographs of events/activities conducted
3. Describe your analysis of the rural household economy, its challenges, and possible pathways to address them

4. How effectively are institutions functioning? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual).
5. Describe the benefits received and challenges faced in the delivery of one of these programmes in the local community; give suggestions about improving the implementation of the programme for the community.

Guidelines for Students

Students must submit an assignment in the form of a journal. Faculty in charge will monitor and assess continuously, with grade or mark each project on the completion date declared for each of them. Assessments of students shall include a review of their involvement and contributions to community engagement. It shall also include the presentation of project findings as documented in the journal.

SEM IV

24-PCC-ME-2-06: Fluid Mechanics

Teaching Scheme: Theory: 03 Hours/Week	**Credit:** 03	**Examination Scheme:** **CIE**: 20 Marks **MSE:** 20 Marks **SEE**: 60 Marks

Prerequisites Courses: (24-BSC-1-01) Engineering Physics, (24-BSC-1-02) Engineering Chemistry, (24-BSC-1-03) Linear Algebra And Differential Calculus, (24-BSC-1-04) Statistics Probability and Integral Calculus.

Companion Course: -(24-PCC-ME-2-08) Fluid Mechanics & Machinery Lab

Course Objectives:

- To understand basic properties of fluids and Fluid statics.
- To study the basics of flow visualization
- To understand Bernoulli's theorem and its applications.
- To learn concepts of boundary layer theory & to establish relation between flow parameters.
- To provide the knowledge of basic principles, governing equations and applications of Turbomachines.
- To evaluate the performance characteristics of Turbomachines.

Course Outcomes:

After completion of the course, learners should be able to

CONo	CO	BL
CO1.	**Apply** the fundamental properties and laws of fluid mechanics to solve engineering problems related to fluid statics	3
CO2.	**Apply** the principles of fluid kinematics and dynamics to fluid flow and utilize flow measurement techniques.	3
CO3.	**Apply** principles and equations of internal flow to solve numerical problems related to pipe flow systems.	3
CO4.	**Understand** boundary layer formation over an external surface & dimensionless parameters for model laws.	2
CO5.	**Analyze** the performance of hydraulic turbines using velocity diagrams and the impulse-momentum principle.	4
CO6.	**Evaluate the** performance of centrifugal pumps using velocity triangles in terms of work done, manometric and overall efficiency.	3

Course Contents

Unit I	**Properties of Fluid & Fluid Statics**	**8 Hours**

Properties of Fluid: Definition of fluid, concept of continuum, density, specific weight, specific gravity, viscosity, viscosity laws, types of fluid and rheology, measurement of viscosity, vapour pressure, surface tension, capillarity, compressibility [Numerical]
Laws of fluid statics: forces acting on fluid elements, Pascal's law, hydrostatics law,
Forces acting on surfaces immersed in fluid: total pressure and centre of pressure on submerged plane surfaces.[Numericals]
Buoyancy & Floatation: Concept of Buoyancy, Metacentre and Metacentric Height, Stability of Floating and Submerged Bodies.

#Exemplar/Case Studies: Hydraulic jack		
***Mapping of Course Outcomes**	**CO1**	
Unit II	**Fluid Kinematics and Fluid Dynamics**	**8 Hours**
Fluid Kinematics: Flow description methods, types of flows, velocity and acceleration fields, continuity equation in 1D & 3D flow, flow visualization (path line, streamline and streak line), stream tube, angularity, vorticity, stream function and velocity potential function, flow net.[Numerical] **Fluid Dynamics:** Euler's equation of motion differential form, Euler's equation of motion along streamlines, Bernoulli's theorem and modified Bernoulli's theorem, Applications of Bernoulli's Theorem.[Numerical]		
#Exemplar/Case Studies: Flow measurement: venturimeter, orifice meter, pitot tubes, static pitot tube,		
***Mapping of Course Outcomes**	**CO2**	
Unit III	**Internal Flow and Flow through Pipes**	**8 Hours**
Internal flow: Entrance region theory, velocity and shear Stress distribution for laminar flow through the pipe and fixed parallel plates. [Numerical] **Flow through Pipes:** Darcy's equation for Major/frictional losses, Minor losses in pipe fittings and valves, Hydraulic gradient line and total energy line, Pipes in series, Pipes in parallel and concept of Equivalent Pipe, Transmission of Power [Numerical].		
#Exemplar/Case Studies: Water Distribution Networks		
***Mapping of Course Outcomes**	**CO3**	
Unit IV	**External Flow and Dimensionless Numbers**	**8 Hours**
External Flow: Boundary layer formation over a flat plate, boundary layer thickness, displacement thickness, momentum thickness and energy thickness, boundary layer separation and methods to control separation, drag and lift concepts, types of drag, drag & lift coefficient, aerofoil, bluff body, streamline body, Dimensionless numbers and their physical significance		
#Exemplar/Case Studies: Golf ball		
***Mapping of Course Outcomes**	**CO4**	
Unit V	**Impact of Jet and Hydraulic Turbines**	**10 Hours**
Introduction and Impact of Jet: Introduction to Turbomachines (Hydraulic & Thermal), Classification of Turbo Machines, Applications of Turbomachines. Impulse momentum principle and its application to fixed and moving flat, inclined, and curved plate/vanes. Velocity triangles and their analysis, work done equations, vane efficiency. **Hydraulic Turbines:** Introduction to Hydropower plant, Classification of Hydraulic Turbines, Concept of Impulse and Reaction Turbines. Construction, Principle of Working, design aspects, velocity diagrams and its analysis of Pelton wheel, Francis, and Kaplan turbines, Degree of reaction, Draft tube: types and efficiencies, governing of hydraulic turbines.[Numerical]		
#Exemplar/Case Studies: Pelton Wheel Turbine in Hydroelectric Power Plants		
***Mapping of Course Outcomes**	**CO5**	

Unit VI	**Centrifugal Pumps**	**6 Hours**
Introduction & classification of rotodynamic Pumps, Main Components of Centrifugal Pump, Construction and Working of Centrifugal Pump, Types of heads, Velocity triangles and their analysis, Effect of outlet blade angle, Work done and Efficiency, Series and parallel operation of pumps, Priming of pumps, specific speed, Cavitation. [Numerical]		
#Exemplar/Case Studies: Municipal Water Pumping Stations		
***Mapping of Course Outcomes**	**CO6**	

Learning Resources

Text Books

T1. R. K. Bansal, "Fluid Mechanics & Hydraulic Machines", Laxmi Publications.
T2. R. K. Rajput, "Fluid Mechanics & Hydraulic Machines", S. Chand and Company Ltd. Sixth
T3. D. S. Kumar, "Fluid Mechanics and Fluid Power Engineering", S. K. Kataria and Sons.
T4. Cengel & Cimbala, "Fluid Mechanics", Tata McGraw-Hill.

Reference Books :

R1. Munson, Young, and Okiishi, "Fundamentals of Fluid Mechanics", Wiley India.
R2. Potter Wiggert, "Fluid Mechanics", Cengage Learning.
R3. Fox, Pichard, "Introduction to Fluid Mechanics", McDonald-Wiley.
R4. Modi P. N. and Seth S. M., "Hydraulics and Fluid Mechanics", Standard Book House.
R5. F. M. White, "Fluid Mechanics", Tata McGraw-Hill.
R6. Kundu, Cohen, Dowling, "Fluid Mechanics", Elsevier India.

Additional Resources: (Books, e-Resources)

- Fluid Mechanics**:** https://nptel.ac.in/courses/105103192

MOOC Courses links :

- **Introduction to Fluid Mechanics:** https://onlinecourses.nptel.ac.in/noc25_me41/preview

24-PCC-ME-2-07: Theory of Machines

Teaching Scheme:	**Credit:** 03	**Examination Scheme:**
Theory: 03 Hours/Week		**CIE**: 20 Marks **MSE:** 20 Marks **SEE**: 60 Marks

Prerequisites Courses: (24-BSC-1-03) Linear Algebra And Differential Calculus, (24-BSC-1-04) Statistics and Integral Calculus, (24-ESC-1-03) Engineering Graphics, (24-BSC-1-01) Engineering Physics, (24-PCC-ME-1- 01) Mechanical Engineering Systems

Companion Course: 24-PCC-ME-2-09 Theory of Machines Lab

Course Objectives:

- To develop the ability to analyze and synthesize mechanisms using kinematic principles and analytical methods.
- To perform velocity and acceleration analysis of mechanisms through both graphical and analytical techniques.
- To apply gear and cam theory to analyze and design mechanical components in various applications.
- To understand the principles of automated mechanical systems and their role in modern industry.

Course Outcomes:

After completion of the course, learners should be able to

CONo	CO	BL
CO1.	**Explain** the fundamental concepts of kinematic analysis and simple mechanisms.	2
CO2.	**Perform** velocity and acceleration analysis of planar mechanisms using graphical and analytical methods.	3
CO3.	**Synthesize** four-bar and slider-crank mechanisms to achieve desired motion and function.	3
CO4.	**Apply** gear theory to design spur and helical gears for power transmission applications.	3
CO5.	**Construct** cam profiles for follower motion.	3
CO6.	**Examine** automation mechanisms and their applications in modern systems.	2

Course Contents

Unit I	**Fundamentals of Mechanism**	**06 Hours**

Kinematic link, Types of links, Kinematic pair, Types of constrained motions, Types of Kinematic pairs, Kinematic chain, Types of joints, Mechanism, Machine, Degree of freedom, Mobility of Mechanism, Inversion, Grashoff's law, Four-Bar Chain and its Inversions, Slider crank Chain and its Inversions, Double slider crank Chain and its Inversion

#Exemplar/Case Studies: Conveyor System - Kinematic Link, Kinematic Pair, and Kinematic Chain

***Mapping of Course Outcomes**	**CO1**

Unit II	**Kinematic Analysis of Mechanisms**	**08 Hours**

Analytical methods: Displacement, velocity and acceleration (Theoretical Treatment only). **Graphical method:** Displacement,

velocity and acceleration in mechanisms by Relative Velocity Method (Mechanisms up to 6 Links), Instantaneous Centre of Rotation, Kennedy's Theorem, Angular Velocity ratio Theorem, Analysis of mechanism by ICR method (Mechanisms up to 6 Links)		
#Exemplar/Case Studies: Automated Robotic Arm for Pick-and-Place Operations		
***Mapping of Course Outcomes**	**CO2**	
Unit III	**Synthesis of Mechanisms**	**08 Hours**
Steps in Synthesis: Type synthesis, Number Synthesis, Dimensional synthesis, Tasks of Kinematic synthesis - Path, function and motion generation (Body guidance), Precision Positions, Chebychev spacing, Mechanical and structural errors **Graphical Synthesis:** Inversion and relative pole method for three-position synthesis of Four-Bar and Single Slider Crank Mechanisms **Analytical Synthesis:** Three-position synthesis of Four-Bar mechanism using Freudenstein's equation		
#Exemplar/Case Studies: Automotive Suspension Systems (Dimensional and Path Generation Synthesis)		
***Mapping of Course Outcomes**	**CO3**	
Unit IV	**Kinematics of Gears**	**08 Hours**
Gear: Classification, Helical and Spiral Gears, Bevel Gear & Worm and Worm Wheel (Theoretical Treatment only) **Spur Gear:** Terminology, the law of gearing, Involute and cycloidal tooth profile, the path of contact, the arc of contact, sliding velocity, Interference and undercutting, Minimum number of teeth to avoid interference, Force Analysis ***Gear Train:*** *Types, Analysis of Epicyclic gear Trains, Holding torque - simple, compound and Epicyclic gear Trains, Torque on Sun and Planetary gear Train compound Epicyclic gear Train*		
#Exemplar/Case Studies: Automobile Transmission System (Spur Gears, Force Analysis, and Minimum Teeth)		
***Mapping of Course Outcomes**	**CO4**	
Unit V	**Cams & Followers**	**06 Hours**
Introduction, Classification of Followers and Cams, Terminology of Cam Displacement diagram for the Motion of follower as Uniform velocity, Simple Harmonic Motion (SHM), Uniform Acceleration and Retardation Motion (UARM), Cycloid motion, Cam Profile construction for Knife-edge Follower and Roller Follower.		
#Exemplar/Case Studies: Engine Valve Actuation System (Cam and Follower Motion)		
***Mapping of Course Outcomes**	**CO5**	
Unit VI	**Mechanisms in Automation Systems**	**06 Hours**
Mechanisms used in Robotic Application: Serial Mechanisms (Open-Chain Mechanisms), Parallel Mechanisms (Closed-Loop Mechanisms), Delta Mechanism, SCARA (Selective Compliance Assembly Robot Arm) **Automation:** Introductions, Types of Automation **Method of Work Part Transport:** Continuous transfer, Intermittent or Synchronous Transfer, Asynchronous transfer, Different type of transfer mechanisms - Linear transfer mechanisms and Rotary transfer mechanisms **Automated Assembly-Line:** Types, Assembly line balancing Buffer Storages, Artificial intelligence in automation		
#Exemplar/Case Studies: Automated assembly line for car manufacturing		

*Mapping of Course Outcomes	CO6

Learning Resources

Text Books

T1. Rattan, S. S. *Theory of Machines*. 3rd ed., McGraw Hill Education (India) Pvt. Ltd., New Delhi.
T2. Bevan, T. *Theory of Machines*. 3rd ed., Longman Publication.
T3. Ambekar, G. *Mechanism and Machine Theory*. PHI.
T4. Uicker, J. J., G. R. Pennock, and J. E. Shigley. *Theory of Machines and Mechanisms*. 5th ed., International Student Edition, Oxford.

Reference Books :

R1. Norton, R. L. *Kinematics and Dynamics of Machinery*. 1st ed., McGraw Hill Education (India) Pvt. Ltd., New Delhi.
R2. Singh, Sadhu. *Theory of Machines*. Pearson.
R3. Singh, V. P. *Theory of Machine*. Dhanpat Rai and Sons.
R4. Sharma, C. S., and Kamlesh Purohit. *Theory of Machine and Mechanism*. PHI.
R5. Groover, M. P. *Automation, Production Systems, and Computer-Integrated Manufacturing*. Prentice-Hall of India Pvt. Ltd., New Delhi.
R6. Ballaney, P. L. *Theory of Machines and Mechanism*. Khanna Publishers, 2008.

Additional Resources: (Books, e-Resources)

- Kinematics of Machines: https://nptel.ac.in/courses/112104121/ https://nptel.ac.in/courses/112/106/112106270/
- Kinematics of Mechanisms and Machines: https://nptel.ac.in/courses/112/105/112105268/
- Mechanism and Robot Kinematics: https://nptel.ac.in/courses/112/105/112105236/

MOOC Courses links :

- **https://www.my-mooc.com/en/mooc/kinematics-describing-the-motions-of-spacecraft**
- **https://www.my-mooc.com/en/mooc/robotics-kinematics-and-mathematical-foundations**
- **https://www.my-mooc.com/en/mooc/modern-robotics-course-2-robot-kinematics**
- **https://www.my-mooc.com/en/mooc/mechanics-kinematics-dynamics-mitx-8-01-1x**

24-PCC-M E-2-08: Fluid Mechanics & Machinery Lab

Teaching Scheme:	**Credit:** 1	**Examination Scheme:**
Practical: 2 Hours/Week		Termwork: 25 Marks Oral: 25 Marks

Prerequisites Courses: (24-BSC-1-01) Engineering Physics, (24-BSC-1-02) Engineering Chemistry, (24-BSC-1-03) Linear Algebra And Differential Calculus, (24-BSC-1-04) Statistics Probability and Integral Calculus.

Companion Course: (24-PCC-ME-2-06) Fluid Mechanics

Course Objectives:

- To understand the fundamental principles of Fluid Mechanics, such as the Continuity equation Bernoulli's theorem.
- Demonstrate the classical experiments in fluid mechanics and hydraulic machinery.
- To enhance practical understanding of Fluid Machinery through experiments, industrial visits, and technical report writing.
- To develop skills in evaluating the performance of Fluid Machinery such as hydraulic turbines and centrifugal pumps.

Course Outcomes:

After completion of the course, learners should be able to

CONo	**CO**	**BL**
CO1	**Apply** fundamental principles of fluid mechanics to measuring devices.	3
CO2	Conduct trials on Fluid Machinery (Hydraulic turbine and centrifugal pump) using fluid mechanics principles to **analyze** and interpret data and provide valid conclusions.	4
CO3	**Understand** concepts of compressible flow and Computational Fluid Dynamics.	2
CO4	**Understand** the components of fluid machinery during a visit to a hydroelectric power plant and prepare a detailed report.	2

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a reference and hands-on resource. It should include a prologue (about the University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

Students are to submit the laboratory assignments as a journal. The journal consists of a Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Assessment grade/marks and assessor's sign, Theory—concept in brief, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis).

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work should be based on a student's overall performance in Laboratory assignments. Each Laboratory assignment assessment will assign grades/marks based on parameters such as timely completion, performance, innovation, efficient codes, and punctuality.

Guidelines for Practical Examination

Problem statements must be decided jointly by the internal examiner and external examiner. During the practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student's understanding of the fundamentals and effective and efficient implementation. This will encourage transparent assessment and a fair approach and, hence, will not create any uncertainty or doubt in the minds of the students. So, adhering to these principles will consummate our team efforts to the promising start of student's academics.

Guidelines for Laboratory Conduction

Guidelines for Laboratory Conduction

These guidelines ensure the safe, efficient, and productive execution of laboratory experiments and activities:

1. Preparation Before the Experiment

- Understand the Objective: Students must review the theory, principles, and expected outcomes of the experiment beforehand.
- Read the Procedure: Refer to the lab manual or handouts to familiarize yourself with the steps and equipment involved in the experiment.
- Check the Apparatus: Inspect the instruments and apparatus for proper functioning. Report any issues to the lab in charge.
- Safety Measures:
  Ensure knowledge of safety protocols for handling equipment, chemicals, and power supplies.
  Be aware of emergency procedures, such as using fire extinguishers or first aid kits.

2. Conduct During the Experiment

- Follow the Procedure: Experiment strictly according to the prescribed steps to ensure accuracy and safety.
- Handle Equipment with Care: Avoid rough handling of lab equipment or devices. Use tools as intended.
- Collaborate Effectively: Work in assigned groups, ensuring that tasks are divided equally among team members.
- Record Observations Systematically: In a lab notebook, note down all readings and observations neatly, organized, and systematically.
- Ask for Guidance: If you have any doubts or are facing operational difficulties, seek help from the instructor or lab technician.

3. Post-Experiment Practices

- Analyze and Interpret Results:
- Perform calculations and analyses based on observations.
- Compare results with theoretical expectations and discuss any deviations.
- Document the Experiment: Prepare a detailed lab report that includes the objective, procedure, observations, calculations, and conclusions.
- Feedback: Provide constructive feedback to the lab in charge if equipment or procedures can be improved.

4. Safety and Discipline

- No Unauthorized Access: Do not operate equipment or begin experiments without instructor approval.
- Avoid Distractions: Maintain focus; avoid the use of mobile phones or engaging in unrelated activities.
- Report Accidents Immediately: Notify the instructor of any accidents, spills, or equipment failures to ensure prompt resolution.
- Maintain Lab Decorum: Work quietly and respectfully without disturbing others.

5. Attendance and Punctuality

- Attend all scheduled lab sessions promptly and sign the attendance sheet as instructed.

- Students arriving late or without prior preparation may not be allowed to perform the experiment.

6. Visit Report

The visit report consists of

- Details about industry/power plant
- Operational description of components with specification, their use, capacity, etc.

Virtual Laboratory: (If Any):

- Hydraulics and Fluid Mechanics Lab: https://eerc03-iiith.vlabs.ac.in/
- Virtual Fluid Laboratory: https://me.iitp.ac.in/Virtual-Fluid-Laboratory/

List of Laboratory Experiments

Group A: Experiments (Conduct any eight from the list)

Sr No	Experiment Title	*Mapping of Course Outcomes
1.	Study of Manometers & Determination of pressure using manometers	CO1
2.	Verification of modified Bernoulli's equation.	CO1
3.	Calibration of Orifice meter and Venturi Meter.	CO1
4.	Determination of major losses through metal/non-metal pipes.	CO1
5.	Determination of minor losses through metal/non-metal pipes.	CO1
6.	Trial on Pelton wheel turbine and plot the performance characteristics.	CO2
7.	Trial on Francis Turbine and plot the performance characteristics.	CO2
8.	Trial on Centrifugal Pump and plot the performance characteristics.	CO2
9.	Study of compressible flow.	CO3
10.	Introduction to Computational Fluid Dynamics.	CO3

Group B: Field Visit

Sr No	Assignment Title	*Mapping of Course Outcomes
1.	Visit the hydropower plant, and a report to be submitted.	CO4

24-PCC-ME-2-09 Theory of Machines Lab

Teaching Scheme:	**Credit:** 01	**Examination Scheme:**
Practical: 02 Hours/Week		**TW**: 25 Marks **OR**: 25 Marks

Prerequisites Courses: (24-BSC-1-03) Linear Algebra And Differential Calculus, (24-BSC-1-04) Statistics and Integral Calculus, (24-ESC-1-03) Engineering Graphics, (24-BSC-1-01) Engineering Physics, (24-PCC-ME-1- 01) Mechanical Engineering Systems

Companion Course: 24-PCC-ME-2-07 Theory of Machines

Course Objectives:

- To make the students conversant with the design and analysis of various mechanisms, including degrees of freedom, types of links, and pairs, applied to real-life and industrial applications.
- To equip the students with the ability to perform kinematic analysis of mechanisms using analytical and software-based approaches.
- To enable the students to construct gear and cam profiles and understand their practical implications in machinery and automation systems.

Course Outcomes:

After completion of the course, learners should be able to

CONo	**CO**	**BL**
CO1	Analyze various mechanisms and their applications for degrees of freedom, types of links, and pairs.	3
CO2	Perform kinematic analysis of mechanisms using analytical and software-based approaches.	3
CO3	Construct gear and cam profiles and understand their practical implications in machinery and automation.	3

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a reference and hands-on resource. It should include a prologue (about the University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

Students are to submit the laboratory assignments as a journal. The journal consists of a Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Assessment grade/marks and assessor's sign, Theory—concept in brief, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis).

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work should be based on a student's overall performance in Laboratory assignments. Each Laboratory assignment assessment will assign grades/marks based on parameters such as timely completion, performance, innovation, efficient codes, and punctuality.

Guidelines for Oral/ Practical Examination

Problem statements must be decided jointly by the internal examiner and external examiner. During the practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student's understanding of the fundamentals and effective and efficient implementation. This will encourage transparent assessment and a fair approach and, hence will not create any uncertainty or doubt in the minds of the students. So, adhering to these principles will consummate our team efforts to the promising start of student's academics.

Guidelines for Laboratory Conduction

Guidelines for Laboratory Conduction

These guidelines ensure the safe, efficient, and productive execution of laboratory experiments and activities:

1. Preparation Before the Experiment

- Understand the Objective: Students must review the theory, principles, and expected outcomes of the experiment beforehand.
- Read the Procedure: Refer to the lab manual or handouts to familiarize yourself with the steps and equipment involved in the experiment.
- Check the Apparatus: Inspect the instruments and apparatus for proper functioning. Report any issues to the lab in-charge.
- Safety Measures:
- Ensure knowledge of safety protocols for handling equipment, chemicals, and power supplies.
- Be aware of emergency procedures, such as using fire extinguishers or first aid kits.

2. Conduct During the Experiment

- Follow the Procedure: Experiment strictly according to the prescribed steps to ensure accuracy and safety.
- Handle Equipment with Care: Avoid rough handling of lab equipment or devices. Use tools as intended.
- Collaborate Effectively: Work in assigned groups, ensuring that tasks are divided equally among team members.
- Record Observations Systematically: In a lab notebook, note down all readings and observations neatly, organized, and systematically.
- Ask for Guidance: If you have any doubts or are facing operational difficulties, seek help from the instructor or lab technician.

3. Post-Experiment Practices

- Analyze and Interpret Results:
- Perform calculations and analyses based on observations.
- Compare results with theoretical expectations and discuss any deviations.
- Document the Experiment:
- Prepare a detailed lab report that includes the objective, procedure, observations, calculations, and conclusions.
- Feedback: Provide constructive feedback to the lab in-charge if equipment or procedures can be improved.

4. Safety and Discipline

- No Unauthorized Access: Do not operate equipment or begin experiments without instructor approval.
- Avoid Distractions: Maintain focus; avoid the use of mobile phones or engaging in unrelated activities.
- Report Accidents Immediately: Notify the instructor of any accidents, spills, or equipment failures to ensure prompt resolution.
- Maintain Lab Decorum: Work quietly and respectfully without disturbing others.

5. Attendance and Punctuality

- Attend all scheduled lab sessions promptly and sign the attendance sheet as instructed.
- Students arriving late or without prior preparation may not be allowed to perform the experiment.

Suggested List of Laboratory Experiments/Assignments

Group A: Practical (Mandatory Practical)		
Sr No	**Assignment Title**	***Mapping of Course Outcomes**
1.	To make a model of any mechanism by using waste material by a group of 4 to 6 students and to give a presentation using PPTs.	CO1
2.	Speed and torque analysis of epicyclic gear trains to determine holding torque.	CO2
3.	To verify the cam jump phenomenon.	CO2
4.	To study the manufacturing of gear using gear generation with rack as a cutter and to generate an involute profile.	CO3
5.	To study various types of gearboxes.	CO3
Group B: Assignments using Drawing Aids (Out of List perform any 4)		
Sr No	**Assignment Title**	***Mapping of Course Outcomes**
1.	Identify mechanisms in real life, analyze the types and numbers of links and pairs, and obtain degrees of freedom.	CO2
2.	Solve two Numericals on velocity and acceleration analysis using relative velocity and acceleration methods.	CO2
3.	Solve two Numericals on velocity analysis using the ICR method.	CO2
4.	To draw a conjugate profile for any general type of gear tooth.	CO3
5.	To draw a cam profile for any two problems with the combination of various follower motions with radial and off-set cam.	CO3
Group C: Assignments using Software (Out of List perform any 2)		
Sr No	**Assignment Title**	***Mapping of Course Outcomes**
1.	To design a simple planner mechanism using any software (Geogebra, SAM, Working Model, 3D Modelling Software, etc.)	CO3
2	To do computer programming (using software/programming languages like C, Python, Scilab, Matlab, etc.) for Kinematic Analysis of the Slider Crank Mechanism using Analytical Methods	CO2
3	To generate a Cam Profile using any Modelling Software (Mech Analyser, any 3D Modelling Software)	CO2
4	To synthesize the Four-Bar and Slider Crank Mechanism (Geogebra, SAM, any	CO2

	2D/3D Modelling Software)	
5	To do computer programming (using software/programming languages like C, Python, Scilab, Matlab, etc.) for the Synthesis of Mechanisms using Chebychevs spacing, Freudensteins equation and function generation	CO2
Group D: Assignments using Virtual Laboratory (Out of List perform any 2)		
Sr No	**Assignment Title**	***Mapping of Course Outcomes**
1	Mechanisms and Robotics - Oldham Coupling Mechanism, http://vlabs.iitkgp.ernet.in/mr/index.html	CO1
2	Mechanisms and Robotics - Quick Return Mechanism, http://vlabs.iitkgp.ernet.in/mr/index.html	CO1
3	Mechanisms and Robotics - CAM Follower Mechanism, http://vlabs.iitkgp.ernet.in/mr/index.html	CO1
Group E: Industrial Visits		

A compulsory industrial visit must be arranged to industries/ establishments that operate in automation and mechanization during the semester to provide awareness and understanding of the course. The Industrial Visit must be preferable to

- Manufacturing industries with Assembly-line Automation.
- Sugar factory
- Bottle filling plants

Students must submit a properly documented Detailed Industrial Visit Report in his/her own words.

24-EEM-2-02: Entrepreneurship Development

Teaching Scheme: Theory: 1 Hours/Week Practical: 2 Hours/Week	**Credit:** 02	**Examination Scheme:** **Term work (TW):** 50 Marks

Prerequisite Course: 24-EEM-2-01-Engineering Economics

Companion Courses: 24-OEC-1-4-03: Financial Accounting & Management, 24-OEC-2-4-03 Business Development, Marketing and Finance

Course Objectives:

- To equip students with the foundational knowledge of entrepreneurship
- To develop skills for identifying potential market opportunities and generating innovative ideas
- To equip students with the knowledge needed to create a viable business plan.
- To enable students to translate a business model to a startup by understanding market research, marketing, and navigating the legal aspects of entrepreneurship.

Course Outcomes:

After completion of the course, learners should be able to

CONo	CO	BL
1	Understand foundational concepts of entrepreneurship and traits of successful entrepreneurs.	2
2	Identify market gaps and assess feasibility of business ideas.	4
3	Apply Business Model Canvas framework.	3
4	Apply business models to actionable startup plans by leveraging market intelligence and navigating the relevant legal frameworks for their ventures.	3

Guidelines for Student's Termwork

The termwork assignments will be submitted as presentations/PDFs by students via Google Classroom.

Guidelines for Term Work Assessment

Continuous assessment ofterm work should be based on the overall performance of assignments by a student. Each assignment assessment will assign grades/marks based on parameters, such as timely completion, performance, innovation, presentation skills, and punctuality.

Guidelines for Laboratory Conduction

Students are expected to select one assignment each week, do a thorough case study and prepare a presentation on it. He/She has to present it during lab hours within 6-10 minutes. The instructor is expected to assign Assignment 'a' to half batch and 'b' to the remaining half batch and conduct presentations in two separate practical sessions. The instructor is expected to create as much variety he/she can so that students get equipped with a vast entrepreneurial environment in a short span.

Suggested List of Laboratory Experiments/Assignments		
Group A: Assignments (Mandatory Assignment)		
Sr No	**Assignment Title**	***Mapping of Course Outcomes**
1.	a. Journey of Entrepreneurship through E-Cell/ Incubation Centre Support b. Disruptive Technological Innovation (Amazon, RedBus, etc..)	CO1
2.	a. Successful businesses that solved market gaps (e.g., Uber, Airbnb, Oyo, etc...) b. Feasibility of an outlet (cafe, retail store, etc.. in institute campus) justifying whether or not it should be launched	CO2
3.	a. Market Analysis of a Product b. Social Media Commercial (present in the form of a self-made video)	CO4
4.	a. Develop a Business Plan for an existing Company b. Develop a Business Plan for an innovative idea*	CO3
5.	a. Startups Raising Investor Funds b. Govt. Schemes	CO4
Group B: Assignments (Out of List; perform any 1)		
Sr No	**Assignment Title**	***Mapping of Course Outcomes**
1.	An advertisement pamphlet using tools like Canva, etc.. for any new idea with a novel logo, company name, etc...	CO4
2.	Build a website using Google Sites or any other no-code tool for any new idea and integrate forms to collect email/name/phone of potential customers	CO4
Group C: Assignments		
Sr No	**Assignment Title**	***Mapping of Course Outcomes**
1.	a. Registering your first startup and generating Udyog Aadhar or b. Case Study Report on Shark Tank Pitches	CO4
Learning Resources (If applicable)		
Text Books		
T1. Paul Swamidass, Engineering Entrepreneurship from Idea to Business Plan, Cambridge		

Reference Books :

R1. Charantimath Poornima, Entrepreneurship Development and Small Business Enterprises, Pearson Education, 2014
R2. Vangundy Arthur, Getting To Innovation - How Asking The Right Questions Generates The Great Ideas Your Company Needs, Prentice - Hall Of India Private Limited, 2008
R3. Dorf Richard, Technology Ventures - From Idea To Enterprise, Mcgraw - Hill, 2005
R4. Nandan H, Fundamentals of Entrepreneurship, PHI Learning Pvt Ltd, 2018

Additional Resources: (Books, e-Resources)

- "Jugaad Innovation: A Frugal and Flexible Approach to Innovation for the 21st Century" by Navi Radjou, Jaideep Prabhu, and Simone Ahuja
- Shirk Martha, How To Become Your Own Boss - Eleven Women Who Escaped Poverty By Their Entrepreneurship, Viva Books Private Ltd, 2007
- National Innovation & Startup Policy (2019)

MOOC Courses links :

- Link to AICTE Evaluated Entrepreneurship Awareness Program: 16-Days Professional Certification by Turnip Innovations https://www.turnip.co.in/entrepreneurship-course/index.html
- Link to NPTEL course contents: Entrepreneurship https://nptel.ac.in/courses/110106141
- Link to NPTEL course contents: Entrepreneurship Development https://onlinecourses.swayam2.ac.in/cec20_mg19/preview

24-VSC-ME-2-01: Computer Aided Machine Drawing

Teaching Scheme:	**Credit:** 2	**Examination Scheme:**
Practical: 4 Hours/Week		Termwork **(TW)**: 25 Marks Practical **(PR)**: 25 Marks

Prerequisite Courses: Engineering Graphics (24-ESC-1-03)

Companion Course: NA

Course Objectives:

- To make the students understand and interpret drawings of machine components
- To acquire knowledge of Parametric Modelling and hence create 3D models of mechanical components and assemble them using CAD software
- To learn geometric dimensioning, limit fit and tolerance and apply them to machine drawings.
- To prepare assembly drawings and layouts, with part lists and bill of materials (BOM) that adhere to relevant standards and codes

Course Outcomes:

After completion of the course, learners should be able to

CO No	**CO**	**BL**
CO1	**Understand** and **Interpret** GD&T symbols, notations, and specifications in engineering drawings	2
CO2	**Apply** parametric modelling concepts to create 2D sketches and 3D models of mechanical components using CAD software	3
CO3	**Assemble** the components and **Develop** detailed assembly drawings and layouts for mechanical systems.	3
CO4	**Prepare** part lists, bills of materials (BOM), and other relevant documentation, ensuring compliance with applicable standards and codes in design and documentation	3

Guidelines for Student's Laboratory Journal

Students are to submit the laboratory assignments as a journal. The journal consists of a Certificate, Table of Contents, and handwritten write-up of the assignment, if applicable. All CAD-based assignments performed using computer software must be submitted as a soft copy. As a contribution to Green IT and environmental awareness, only a single-page print summary of each assignment will be attached to the journal. The Laboratory In-Charge will maintain a DVD containing student design files. For reference, one or two journals with detailed prints may be kept in the laboratory.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of CAD Modelling assignments will be based on the student's overall performance, considering timely completion, design accuracy, efficient use of CAD tools, and participation. Assignments will be graded as follows: Timely Submission (2 Marks) for on-time completion, Design Accuracy & Completeness (4 Marks) for correct dimensions, constraints, and adherence to the problem statement; efficient Use of CAD Tools (2 Marks) for proper application of parametric modelling and

assemblies, and Question & Answers (2 Marks) for the ability to explain and justify design choices.

Guidelines for Practical Examination

Problem statements must be decided jointly by the internal examiner and external examiner. During the practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student's understanding of the fundamentals and effective and efficient implementation. This will encourage transparent assessment and a fair approach and, hence, will not create any uncertainty or doubt in the minds of the students. So, adhering to these principles will consummate our team efforts to the promising student's academics.

Guidelines for Laboratory Conduction

Faculty must ensure that the laboratory is equipped with the required parametric modelling CAD software. The instructor should demonstrate essential CAD operations before students begin assignments. Faculty must ensure proper guidance in parametric modelling, GD&T, limits, fits, tolerances, and assembly design. Proper layering, dimensioning, and annotation techniques must be followed for drafting and layout preparation.
Practical 1 is supposed to be taught using Engineering Drawings and standard resources.
Practicals 2 to 7 are supposed to be conducted on computers using appropriate parametric modelling CAD software. A minimum of two assemblies are to be covered during the semester.
Different assemblies are to be given to different batches.

Suggested List of Laboratory Experiments/Assignments

Group A: Assignments (Mandatory Assignment)

Sr No	Practical Title	*Mapping of Course Outcomes
1.	Read and Understand Engineering Drawings for Geometric Dimensioning, Limits, Fits and Tolerances	CO1
2.	Draw 2D Sketches with Geometric Dimensioning	CO1, CO2
3.	3D Modelling of Mechanical Components - I	CO1, CO2
4.	3D Modelling of Mechanical Components - II	CO1, CO2
5.	Assembly of Components (from Practical 3 & 4)	CO3
6.	Drafting & Layouts of assembly with proper GD&T, Symbols (from Practical 5)	CO1, CO3
7.	Prepare exploded view of assembly and bills of materials (BOM) and ensure compliance with applicable standards and codes for assembly (from Practical 6)	CO3, CO4
8.	Self Study Assignment on Design for Manufacturing and Assembly	Content Beyond Syllabus

Learning Resources

Text Books

T1. N. D. Bhat and V. M. Panchal, Machine Drawing, Charoratar Publishing House
T2. Haideri Farazdak, Machine Drawing and Computer Graphics
T3. John K C, Textbook of Machine Drawing, PHI Learning Pvt Ltd 2009

Reference Books :
R1. Junnarkar N D, Machine Drawing **R2.** Murthy S Trymbaka, Computer-Aided Engineering Drawing **R3.** Narayana K L, Machine Drawing
Additional Resources: (Books, e-Resources) ● Tickoo Sham, Catia V5-6R2021 For Engineers And Designers, New Delhi Bpb Publications, 2023 ● Tickoo Sham, Solidworks 2021 For Engineers And Designers, New Delhi Bpb Publications, 2023

24-VEC-2-02: Digital and Technological Solutions

Teaching Scheme: Lecture: 1 Hour/Week Practical: 2 Hours/Week	**Credit:** 2	**Examination Scheme:** Termwork **(TW)**: 25 Marks

Prerequisite Courses: -

Course Description:

Digital Technological Solutions is a comprehensive course designed to equip students with essential skills and knowledge for navigating and contributing to the digital landscape. This course covers a broad spectrum of contemporary topics, and application software by examining critical tools and platforms used in modern workplaces, including productivity software, project management tools, and cloud-based applications.

A significant portion is dedicated to Digital India and e-Governance, where students explore India's initiatives to leverage digital technology for inclusive growth and improved governance. Through case studies and practical examples, they learn how digital transformation impacts citizens, businesses, and government functions.

The course also delves into Cybersecurity, a critical area as digital threats increase in frequency and complexity.

With a blend of theoretical knowledge and hands-on projects, students gain the ability to develop and implement digital solutions that align with current technological and economic trends, preparing them for roles in various tech-driven sectors

Course Objectives:

The objective of the **Digital Technological Solutions** course is to provide students with a foundational understanding and practical skills to thrive in a digital-first world. By the end of this course, students will be able to:

1. **Proficiency in Application Software**: Gain hands-on experience with key application software tools essential for productivity, collaboration, and management in digital workplaces.
2. **Understand Digital Transformation**: Grasp the significance of Digital India and e-Governance initiatives, recognizing how digitalization can enhance governance, inclusivity, and socio-economic growth in India and beyond.
3. **Enhance Cybersecurity Awareness**: Develop a solid understanding of cybersecurity principles, enabling students to identify potential threats, implement security measures, and contribute to safer digital ecosystems.
4. **Develop Digital Solutions**: Equip students with the knowledge and skills to design, implement, and manage digital solutions that address real-world challenges across sectors.

The course aims to empower students with a versatile skill set, preparing them for dynamic roles in the digital and technological domains.

Course Outcomes: After completion of the course, learners should be able to

CONo	**CO**	**BL**
CO1	Utilize workspace tools (Forms, Docs, Slides, and Sheets) to plan, organize, analyze data, and present information professionally while demonstrating critical thinking and problem-solving skills.	3

CO2	Develop impactful digital content, effectively use e-governance platforms, and perform secure financial transactions.	3
CO3	Apply cybersecurity principles to protect information and digital systems from threats and vulnerabilities.	3
CO4	Design and implement digital solutions for real-world challenges, demonstrating the ability to leverage technology for process optimization and improved outcomes.	3

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a reference and hands-on resource. It should include a prologue (about the University/Program/ Institute/ Department/ Foreword/ Preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by students as a journal. The journal consists of a Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software / Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm (if applicable), flowchart, test cases (if applicable), Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis). Attaching printed papers as part of writeups must be avoided. For reference, one or two journals may be maintained with program prints in the laboratory.

Guidelines for Laboratory/Term Work Assessment

Continuous assessment of laboratory work should be based on the overall performance of laboratory assignments by a student. Evaluate assignments based on timeliness, creativity, technical accuracy, and professionalism, maintaining transparency and fairness.

Guidelines for Laboratory Conduction

Familiarize yourself with the syllabus, lab guidelines, and necessary tools. Prepare the lab environment with the required software and hardware. Communicate the objectives, deliverables, and timeline for each practical. Ensure students understand the mapping between assignments and course outcomes. Encourage hands-on practice, collaboration, and innovative problem-solving.

Suggested List of Laboratory Experiments/Assignments

Group A: Assignments (Mandatory Assignment)

Scenario: You are a project manager for a school event. Your task is to plan and organize the event using Workspace tools.

Sr No	Assignment Title	Mapping of Course Outcomes
1.	Create a **Form (Google/ Microsoft Form/Zoho Forms/ JotForm etc.)** to survey students' preferences for the event theme, date, and activities. Include various question types (multiple-choice, short-answer, etc.) to gather diverse information. Customize the form's appearance with a relevant theme and clear instructions. Share the form with students through email or a class website.	CO1
2.	Create a **spreadsheet** (**Google Sheets/Excel/Zoho Sheet)** to analyze the survey responses. Use five functions like COUNT, SUM, AVERAGE, and SORT to summarize the data. Visualize the data using charts and graphs to identify trends and	CO1

	preferences.	
3.	Create a **Document (Google Docs/ Microsoft Docs Online/Zoho Docs)**to outline the event schedule, including timings, activities, and responsibilities. Share the document with team members and collaborate on the schedule. Use formatting tools (headings, bullet points, etc.) to organize the information.	CO1
4.	Design a presentation (**Google Slides/ Canva/Prezi/Figma)** to showcase the event plan to the school community. Use slides to highlight key information, such as the event theme, date, time, activities, and expected outcomes. Incorporate images, videos, and animations to enhance the presentation's visual appeal. Practice the presentation to ensure smooth delivery.	CO1
Group B: Assignments (Out of List perform any 2)		
Sr No	**Assignment Title**	**Mapping of Course Outcomes**
1.	**Digital India and E-Governance Initiatives and Infrastructure** Create a Report on any five major Digital India Initiatives (Aple Sarkar, Digital Locker/APAAR, National Academic Depository (NAD), NPTEL/SkillIndia/National Career Service) * , etc. and register on any learning and assessment portal mentioned above and earn certification ***Note: Digital India Initiative names will be declared as per availability of the initiatives available in that particular year for the semester**	CO2, CO4
2.	**Basics of E-Commerce and Digital Marketing** Create one LinkedIn-specific post promoting an aspect of your institute (e.g., academic excellence, alumni success stories, or collaborations). Write compelling ad captions for the post. Research and suggest 10 relevant and trending hashtags to maximize reach.	CO4
3.	**Digital Financial Tools and Applications** Create a tutorial video / a comparison table, or an infographic explaining any 5 digital tools and applications. Simulate or demonstrate a simple transaction using a dummy banking app using any of the studied tools and applications	CO2,CO4,CO5
Group C: Assignments (Out of List perform any 2)		
Sr No	**Assignment Title**	***Mapping of Course Outcomes**
1.	Analyze Your Digital Footprint for online privacy and security by performing the audit of privacy settings on Facebook, Instagram, or LinkedIn: profile visibility, post/story visibility, location sharing, and linked accounts.	CO3,CO4
2.	Use online tools such as WHOis Lookup, GoPhish, or similar platforms to verify the authenticity of any website.	CO3
3.	Prepare a report or presentation on the concept of Cybercrime, its classification, and provide a detailed analysis of any one type of cybercrime, including its working, real-world examples, and preventive measures.	CO3

Learning Resources (If applicable)
Text Books
T1 Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, Computer forensics and legal Perspectives", Wiley
Reference Books:
R1 Joel Elad, "LinkedIn For Dummies", OReilly, 5th Edition **R2** Dr. Nilakshi Jain, Dr Dhananjay R. Kalbande, "Digital Forensic", Wiley
Additional Resources: (Books, e-Resources) ● **GDrive:** https://support.google.com/a/users/answer/9389764?hl=en ● **Digital India Initiatives:** https://www.digitalindia.gov.in/about-us/ ● **Skill India :** https://www.skillindiadigital.gov.in/home ● **NPTEL:** https://onlinecourses.nptel.ac.in/ ● **National Career Service:** https://www.ncs.gov.in/Pages/default.aspx#main ● **WHOis Lookup:** https://who.is/ ● **GoPhish:** https://getgophish.com
MOOC Courses links: ● Digital Skilling: https://elearn.nptel.ac.in/shop/nptel/digital-skilling

Mid Semester Examination (MSE: <<MonthYear>>)

Programme: AIDS/Civil/Computer/E&TC/Mechanical/MBA-I	
Class:	**Pattern:**
Course Name:	**Course Code:**
AY:	**Semester:**
Time:	**Maximum Marks:** 20

Instructions to the candidates:

1. *Solve Q.1 OR Q.2, Q.3 OR Q.4, Q.5 OR Q.6*
2. *Bold-faced figures to the right indicate full marks.*
3. *Assume the suitable data if necessary*
4. *Any other instruction required for particular course may be added by subject/course chairman*

QN	Question	Mark
1a)	Q 1 can be bifurcated to maximum two sub questions	07
1b)		
	OR	
2	Q 2 can be bifurcated to maximum two sub questions	07
3	Q 3 can be bifurcated to maximum two sub questions	07
	OR	
4	Q 4 can be bifurcated to maximum two sub questions	07
5	Q 5 can be bifurcated to maximum two sub questions	06
	OR	
6	Q 6 can be bifurcated to maximum two sub questions	06

Shree Neminath Jain Brahmacharyashram's
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Semester End Examination (Regular) <<MonthYear>>

Programme: Class:

Course and Code: Semester:

Academic Year: Pattern:

Time: 2Hr 30 Min Examination: SEE (MonthYear) Max. Marks: 60

Instructions to the candidates:

1. *Solve Q.1 OR Q.2, Q.3 OR Q.4, Q.5 OR Q.6, Q.7 OR Q.8*
2. *Bold-faced figures to the right indicate full marks.*
3. *Assume the suitable data if necessary, but Justify it.*
4. *Draw the neat labelled diagrams, wherever necessary.*

QN	Question	Marks
1 a)	Unit I	6
1 b)	Unit II	7
1 c)	Unit III	7
	OR	
2 a)	Unit I	6
2 b)	Unit II	7
2 c)	Unit III	7
3 a)	Unit IV	7
3 b)	Unit IV	7
	OR	
4 a)	Unit IV	7
4 b)	Unit IV	7
5 a)	Unit V	7
5 b)	Unit V	6
	OR	
6 a)	Unit V	7
6 b)	Unit V	6
7 a)	Unit VI	7
7 b)	Unit VI	6
	OR	
8 a)	Unit VI	7
8 b)	Unit VI	6

Supporting Document

Sr.No.	Syllabus Contains	Short Answer	Yes / No	Page No. (In Syllabus)
1	अभ्यासक्रम	Enclosed in Syllabus	Yes	6
2	पात्रता	(As per the Rules and Regulations mentioned in MoM)	Yes	83
3	अभ्यासक्रमाची उद्दिष्टे	Enclosed in Syllabus	Yes	29
4	विषयाचे नाव	Enclosed in Syllabus	Yes	20
5	घटकांचा तपशील	Enclosed in Syllabus	Yes	20
6	तासिका	Enclosed in Syllabus	Yes	20
7	श्रेयांक पद्धत	Enclosed in Syllabus	Yes	20
8	संदर्भ साहित्य	Enclosed in Syllabus	Yes	31
9	संदर्भ ग्रंथ	Enclosed in Syllabus	Yes	31
10	प्रश्नपत्रिकेचे स्वरूप	Enclosed in Syllabus	Yes	81
11	अंतर्गत मूल्यमापनाचे स्वरूप	Enclosed in Syllabus	Yes	21
12	सत्र परीक्षेचे स्वरूप	Enclosed in Syllabus	Yes	81
13	गुणांकन	Enclosed in Syllabus	Yes	20