Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI COLLEGE OF ENGINEERING
An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

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Department of Mechanical Engineering

Curriculum FE to BE for A.Y 2025-26

First Year to Final Year Syllabus

Prepared by: Board of Studies for Mechanical Engineering

Approved By: Academic Council of Shree L.R. Tiwari College of Engineering

R 2025

Preamble

"Think. Design. Innovate. – Learning that Leads the Future."

SLRTCE is proud to be among the youngest institutions to attain academic autonomy—an achievement that strengthens our commitment to becoming a world-class center for socio- economic development and quality education. It is with great pride and purpose that we introduce the restructured curriculum under academic autonomy at SLRTCE. This initiative marks a significant step toward transforming engineering education by equipping our graduates with strong technical foundations, research acumen, interdisciplinary perspective, and an innovation-driven mindset essential for success in today's evolving professional landscape.

1. Curriculum Design: Theme-Based, Experiential, and Outcome-Oriented The autonomous curriculum adopts a bottom-up, learner-centric approach aligned with all 12 Program Outcomes. Each semester is driven by a central societal or technological theme, with problem statements rooted in local needs, socio-economic priorities, and the UN Sustainable Development Goals (UNSDGs). Students engage with these challenges through individual projects in the IDEA Lab, integrating social science methodologies with engineering solutions to foster innovation, contextual learning, and socially responsible problem-solving.

2. Purpose of Autonomy: Empowering Innovation and Real-World Learning Our pursuit of autonomy is rooted in bridging the gap between academic learning and industry relevance. By integrating undergraduate research through the **IDEA Lab**—our dedicated innovation and problem-solving hub—students engage with real-world challenges, apply interdisciplinary knowledge, and develop socially impactful solutions. This approach nurtures engineers who are not only technically sound but also responsible and creative thinkers.

3. Alignment with National Education Policy-2020 Aligned with NEP 2020, the curriculum emphasizes multidisciplinary, hands-on learning. Through theme-based projects, electives, value-added courses, and flexible assessments, SLRTCE ensures holistic student development driven by real-world application and academic rigor. SLRTCE, as a part of Rahul Education, benefits from being in a network of HEIs. All Higher Education Institutions under Rahul Education can collectively contribute to curriculum development, promoting multidisciplinary studies.

4. Innovative Pedagogy Initiative by IQAC As part of its transformation strategy, IQAC has introduced an innovative pedagogy model centered on interdisciplinary research and contextual problem-solving. The IDEA Lab enables students to apply subject knowledge through socially relevant projects, supported by design thinking and faculty mentorship. A two-tier assessment framework—covering both project execution and subject-wise application—ensures academic depth, continuous mentoring, and quality assurance.

5. **Empowering Faculty as Mentors and Innovators** SLRTCE believes that the success of academic autonomy lies in the hands of its faculty. By empowering educators to think beyond conventional boundaries, we enable them to instill Knowledge, Skills, and Attitudes (KSA) in students while enriching their own professional growth. Faculty serve as research mentors and project guides, supported through structured training in innovation pedagogy and assessment.

Sincerely,

IQAC Chairperson
Shree L. R. Tiwari College of Engineering

Chief Operating Officer
Rahul Education

Preface

The Department of Mechanical Engineering at Shree L. R. Tiwari College of Engineering (SLRTCE), in its pursuit of academic excellence and societal relevance, is proud to present a reimagined curriculum grounded in **problem-based learning**, **interdisciplinary education**, and **United Nations Sustainable Development Goals (UNSDGs)**.
In alignment with the institution's vision and guided by the framework established under the National Education Policy (NEP) 2020, this curriculum represents a radical shift from traditional teaching methods to a **learner-centric, project-driven, and purpose-oriented pedagogy**.
At the heart of the revised curriculum lies a unique **theme-based approach** across all eight semesters. Each semester is anchored around a specific real-world theme, from which **six problem statements** are derived. These problem statements are strategically mapped to relevant UNSDGs and used to design the semester's core content—ensuring that students not only gain engineering knowledge but also understand its application in solving pressing global and local challenges.
The Mechanical Engineering syllabus has been restructured to:

- Promote **experiential and contextual learning** through mini-projects, hands-on labs, internships, and industry-led assignments.
- Build **core competencies** in design, manufacturing, energy, sustainability, automation, and digital technologies.
- Introduce **multidisciplinary perspectives** through minors, open electives, and entrepreneurship/management courses.
- Equip students for **employability, innovation, and lifelong learning** through skill development courses, real-industry projects, and value-based education.

Each course—be it core or elective—is developed with explicit learning outcomes, aligned with Bloom's Taxonomy and designed to build competencies progressively. The curriculum introduces verticals such as:

- **Professional Core & Elective Courses** tailored to each semester's problem context.
- **Skill-based Courses** integrated into early semesters to foster practical ability and confidence.
- **Multidisciplinary Minors and Open Electives** to broaden student horizons and promote cross-functional thinking.
- **Humanities and Social Science Courses** to instill soft skills, ethics, and a sense of societal responsibility.

Furthermore, the final deliverable in each academic year, especially in the final year, is a **capstone project**—a tangible solution addressing the selected problem statement. This ensures that our graduates are not just academically sound but are also socially aware and innovation-ready.
With a **total credit load of 160**, thoughtfully distributed across all components, the curriculum ensures academic balance, manageable workload, and a pathway for students to graduate with **honors/minor specializations**, should they choose to do so.
This forward-thinking curriculum is a testament to the department's commitment to nurture **technically proficient, ethically grounded, and globally competent mechanical engineers**—ready to lead in industries, research, and entrepreneurship while addressing societal and environmental needs.
On behalf of the Board of Studies, I express deep appreciation to all contributors—faculty, industry experts, alumni, and academic leaders—who collaboratively shaped this transformative educational journey.
Let us move forward with the shared vision of redefining mechanical engineering education to meet the needs of **today's students, tomorrow's technologies, and humanity at large**.

Dr. Abhijit Samanta
Chairperson, Board of Studies
Mechanical Engineering Department
SLRTCE

Contents

Sr. No.	Item
1	Abbreviations
2	Curriculum Structure (F.E to B.E)
3	F.E Syllabus
4	S.E Syllabus
5	T.E Syllabus
6	B.E Syllabus

1. Abbreviations

Abbreviations	
AEC	Ability Enhancement Course
AECL	Ability Enhancement Course Laboratory
AU	Audit Course
BSC	Basic Science Course
BSCL	Basic Science Course Laboratory
CC	Co Curricular Courses
CEP	Community Engagement Project
ELC	Experiential Learning Course
ESC	Engineering Science Course
ESCL	Engineering Science Course Laboratory
HSSM	Humanities Social Sciences and Management
IKS	Indian Knowledge System
INTR	Internship
L	Lecture
LC	Laboratory Course
LLC	Liberal Learning Course
MDM	Multidisciplinary Minor
MDML	Multidisciplinary Minor Laboratory
MJP	Major Project
MP	Mini Project
OE	Open Elective
OJT	On Job Training
P	Practical
PCC	Program Core Course
PEC	Program Elective Course
SBL	Skill Based Laboratory
SEC	Skill Enhancement Course
SL	Self Learning
T	Tutorial
VEC	Value Education Course
VSEC	Vocational and Skill Enhancement Course

B. Curriculum Structure and Examination Scheme for B.E. in Mechanical Engineering

(FE with Effect from AY 2025-2026 Curriculum Structure – FE Semester-I)

Curriculum Structure – FE Semester I

Course Code	Course Type	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
			L	T	P	L	T	P	SL	Notional Learning Hour	
BSC	16111101	Linear Algebra and Calculus	2	1	--	30	15	--	45	90	3
BSC	1611102	Applied Physics	2	--	--	30	--	--	30	60	2
ESC	11121103	Engineering Mechanics	3	--	--	45	--	--	45	90	3
ESC	16121104	Basic Electrical and Electronics Engineering	2	--	--	30	--	--	30	60	2
ESC	16121105	C& C++ Programming	3	--	--	45	--	--	45	90	3
BSCL	11112106	Applied Physics Lab	--	--	1	--	--	15	--	15	0.5
ESCL	16122107	Engineering Mechanics Lab	--	--	2	--	--	30	--	30	1
ESCL	16122108	Basic Electrical and Electronics Engineering Lab	--	--	2	--	--	30	--	30	1
ESCL	11122109	C& C++ Programming Lab	--	--	2	--	--	30	--	30	1
ESCL	16122110	IDEA LAB - 1(Innovation Design Engineering and Apply)	1	--	2*	15		30	15	60	2
VSEC	16612111	Engineering Workshop -1	--	--	2	--	--	30	15	45	1.5

CC	**16412112**	**Universal Human Values**	**2**	**--**	**--**	**30**	**--**	**--**	**30**	**60**	**2**
AEC	**16421113**	**Strategic Communication and Management Skills**	**1**	**–**	**--**	**15**	**--**	**--**	**15**	**30**	**1**
AECL	**16422114**	**Strategic Communication and Management Skills Lab**	**–**	**–**	**2**	**–**	**–**	**30**	**–**	**30**	**1**
Total			**16**	**1**	**13**	**240**	**15**	**195**	**270**	**720**	**24**

Note:

1) CC will be common to all Branches. AEC will be group specific.
2) BSC , ESC and corresponding lab is Department Specific
3) Questions based on self-learning must not be asked in internal assessment and End semester Exam
4) *IDEA Lab: The IDEA Lab fosters individual interdisciplinary projects through theme-based, subject-integrated, experiential learning, assessed via standardized rubrics for innovation, application, and documentation.
5) Self-Learning (SL): Self-learning is integrated into both theory and practical subjects, particularly where practical sessions have only one contact hour per week. It emphasizes student-driven efforts in preparing for assignments, practical's, and examinations. Additionally, self-learning includes topics that go beyond the prescribed syllabus to align with current industry trends and requirements. Assessment of self-learning will follow a formative approach. For theory subjects that include term work, 30% of the assignment questions and student presentations/discussions should be based on self-learning topics. In subjects without term work, the corresponding laboratory sessions will incorporate self-learning, carrying a weightage of 30%. The subject with no term work and practical will have no assessment on self-learning topics. This may involve lab work using the latest tools or preparing technical write-ups/research papers on advanced topics.

Examination Scheme – FE Semester-I

Course Code	Course Type	Course Name	Examination Scheme							
			IAT-1	IAT-2	IAT-1 + IAT-2	End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)	Term Work	Practical & Oral	Total
16111101	BSC	Linear Algebra and Calculus	20	20	40	60	2.5	25	–	125
16111102	BSC	Applied Physics	20	20	40	60	2.5	–	–	100
16121103	ESC	Engineering Mechanics	20	20	40	60	2.5	–	–	100
16121104	ESC	Basic Electrical and Electronics Engineering	20	20	40	60	2.5	–	–	100
16121105	ESC	C& C++ Programming	20	20	40	60	2.5	–	–	100
16112106	BSCL	Applied Physics Lab	–	–	–	–	–	25	–	25
16122107	ESCL	Engineering Mechanics Lab	–	–	–	–	–	25	25	50
16122108	ESCL	Basic Electrical and Electronics Engineering Lab	–	–	–	–	–	25	25	50
16122109	ESCL	C& C++ Programming Lab	–	–	--	–	--	25	25	50
16122110	ESCL	IDEA LAB - 1(Innovation Design Engineering and Apply)	–	–	--	–	--	50	50	100
16412111	VSEC	Engineering Workshop -1	–	–	--	--	--	25	--	25
16461112	CC	Universal Human Values	–	–	–	–	–	25	--	25
16421113	AEC	Strategic Communication and Management Skills	20	20	40	40	1.5	-	--	80
16422114	AECL	Strategic Communication and Management Skills Lab	--	--	--	--	--	25	--	25
Total			120	120	240	340	14	250	125	955

Curriculum Structure – FE Semester-II

Course Code	Course Type	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
			L	T	P	L	T	P	SL	Notional Learning Hour	
16111201	BSC	Differential Equations and Integral Calculus	2	1	--	30	15	--	45	90	3
16111202	BSC	Engineering Chemistry	2	--	--	30	--	--	30	60	2
16121203	ESC	Engineering Graphics	2	--	--	30	--	--	30	60	2
16211204	PCC	Basic Fluid Mechanics	3	–	–	45	--	--	45	90	3
16111205	BSCL	Engineering Chemistry Lab	–	--	1	--	--	15	15	15	0.5
16122206	ESCL	Engineering Graphics Lab	–	--	2	--	--	30	30	30	1
16122207	ESCL	Programming Lab (Python)	2	--	2	30	--	30	-	60	2
16122208	ESCL	IDEA LAB -2(Innovation Design Engineering and Apply	1	--	2*	15	--	30	15	60	2
16212209	PCCL	Basic Fluid Mechanics Lab	–	--	2	--	--	30	--	30	1
16412210	VSEC	Engineering Workshop II	--	--	2	--	--	30	15	45	1.5
16441211	IKS	Indian Knowledge System	2	--	--	30	--	--	30	60	2
16461212	CC	NSS & Mechanical Defense	--	--	4#	--	--	60	--	60	2
16471213	Audit Course	Audit Course	3	–	–	45	--	--	--	--	--
Total			17	1	15	255	15	225	210	660	22

Note:

1) IKS and CC will be common to all Branch
2) BSC , ESC and corresponding lab is Department Specific
3) Questions based on self-learning must not be asked in internal assessment and End semester Exam
4) *IDEA Lab: The IDEA Lab fosters individual interdisciplinary projects through theme-based,

subject-integrated, experiential learning, assessed via standardized rubrics for innovation, application, and documentation.

5) # Students need to complete 60 hours throughout the semester as it is not possible to get 4hours per week due to the dynamic schedule of Govt. agencies. Notional Learning Hours: In higher education, Notional Learning Hours (NLH) indicates the estimated time that a typical learner, at a specific academic level, is expected to invest in order to achieve the set learning outcomes of a course or module. This time includes a range of structured and independent learning activities, each contributing to the development of knowledge and competencies within a module.

Self-Learning (SL): Self-learning is integrated into both theory and practical subjects, particularly where practical sessions have only one contact hour per week. It emphasizes student-driven efforts in preparing for assignments, practical's, and examinations. Additionally, self-learning includes topics that go beyond the prescribed syllabus to align with current industry trends and requirements. Assessment of self-learning will follow a formative approach. For theory subjects that include term work, 30% of the assignment questions and student presentations/discussions should be based on self-learning topics. In subjects without term work, the corresponding laboratory sessions will incorporate self-learning, carrying a weightage of 30%. This may involve lab work using the latest tools or preparing technical write-ups/research papers on advanced topics.

Exanimation Scheme – FE Semester-II

Course Code	Course Type	Course Name	Examination Scheme							
			IAT-1	IAT-2	IAT-1+IAT-2	End SemExam (ESE)	Exam Duration for Theory (in Hrs)	Term Work	Practical & Oral	Total
16111201	BSC	Differential Equations and Integral Calculus	20	20	40	60	2.5	25	–	125
16111202	BSC	Engineering Chemistry	20	20	40	60	2.5	--	--	100
16121203	ESC	Engineering Graphics	20	20	40	60	2.5	--	--	100
16211204	PCC	Basic Fluid Mechanics	20	20	40	60	2.5	--	--	100
16111205	BSCL	Engineering Chemistry Lab	--	--	--	--	--	25		25
16122206	ESCL	Engineering Graphics Lab	--	--	--	--	--	25	25	50
16122207	ESCL	Programming Lab (Python)						25	25	50
16122208	ESCL	IDEA LAB - 2(Innovation Design Engineering and Apply			--		--	50	50	100
16212209	PCCL	Basic Fluid Mechanics Lab			--		--	25	25	50
16412210	VSEC	Engineering Workshop II			--	--	--	25	--	25
16441211	IKS	Indian Knowledge System	20	20	40	60	2.5	--	--	100
16461212	CC	NSS/Mechanical Defense	--	--	--	--	--	25	–	25
Total			100	100	200	300	12.5	225	125	850

Note:

1) IKS and CC will be common to all Branch
2) BSC , ESC and corresponding lab is Department Specific

3) Questions based on self-learning must not be asked in internal assessment and End semester Exam
4) *IDEA Lab: The IDEA Lab fosters individual interdisciplinary projects through theme-based, subject-integrated, experiential learning, assessed via standardized rubrics for innovation, application, and documentation.
5) # Students need to complete 60 hours throughout the semester as it is not possible to get 4hours per week due to the dynamic schedule of Govt. agencies. Notional Learning Hours: In higher education, Notional Learning Hours (NLH) indicates the estimated time that a typical learner, at a specific academic level, is expected to invest in order to achieve the set learning outcomes of a course or module. This time includes a range of structured and independent learning activities, each contributing to the development of knowledge and competencies within a module.

Self-Learning (SL): Self-learning is integrated into both theory and practical subjects, particularly where practical sessions have only one contact hour per week. It emphasizes student-driven efforts in preparing for assignments, practical's, and examinations. Additionally, self-learning includes topics that go beyond the prescribed syllabus to align with current industry trends and requirements. Assessment of self-learning will follow a formative approach. For theory subjects that include term work, 30% of the assignment questions and student presentations/discussions should be based on self-learning topics. In subjects without term work, the corresponding laboratory sessions will incorporate self-learning, carrying a weightage of 30%. This may involve lab work using the latest tools or preparing technical write-ups/research papers on advanced topics.

Curriculum Structure – SE Semester-III

Course Code	Course Type	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
			L	T	P	L	T	P	SL	Notional Learning Hour	
16111301	PCC	Integral Transform and Statistical Techniques	2	1	--	30	15	--	45	90	3
16211302	PCC	Mechanics of Solids	3		--	45	--	–	45	90	3
16211303	PCC	Engineering Thermodynamics	3	–	--	45	--	–	45	90	3
16211304	PCC	Material Science	3	–	–	45	–	--	45	90	3
16212305	PCCL	Material Science Lab	–	–	2	–	–	30	--	30	1
16212306	PCCL	Machine Drawing GD&T	–	--	2	–	–	30	--	30	1
9951137WW	OE	(To be fill from OE bucket)	2	–	–	30	–	–	30	60	2
98431308	Entrepreneurship	Entrepreneurship Development	2	–	–	30	–	–	30	60	2
98451309	Value education course	Environmental Science	2	–	–	30	–	–	30	60	2
16612310	Community Engagement Project	IDEA LAB - 2(Innovation Design Engineering and Apply	1	--	2*	15	-	30	15	60	2
Total			18	01	06	270	15	90	285	660	22

Note:

1) Entrepreneurship and Value education course will be common to all Branch

2) BSC, ESC, PCC and corresponding lab is Department Specific

3) Questions based on self-learning must not be asked in internal assessment and End semester Exam

4) * IDEA Lab: The IDEA Lab fosters individual interdisciplinary projects through theme-based, subject-integrated, experiential learning, assessed via standardized rubrics for innovation, application, and

documentation.

5) Open Elective: To be selected from the bucket proposed by other institute of Rahul Education

6) Lecture should be conducted for the full class. Notional Learning Hours: In higher education, Notional Learning Hours (NLH) indicates the estimated time that a typical learner, at a specific academic level, is expected to invest in order to achieve the set learning outcomes of a course or module. This time includes a range of structured and independent learning activities, each contributing to the development of knowledge and competencies within a module

Self-Learning (SL): Self-learning is integrated into both theory and practical subjects, particularly where practical sessions have only one contact hour per week. It emphasizes student-driven efforts in preparing for assignments, practical's, and examinations. Additionally, self-learning includes topics that go beyond the prescribed syllabus to align with current industry trends and requirements. Assessment of self-learning will follow a formative approach. For theory subjects that include term work, 30% of the assignment questions and student presentations/discussions should be based on self-learning topics. In subjects without term work, the corresponding laboratory sessions will incorporate self-learning, carrying a weightage of 30%. This may involve lab work using the latest tools or preparing technical write-ups/research papers on advanced topics.

Examination Scheme – SE Semester-III

Course Code	Course Type	Course Name	Examination Scheme							Total
			In-Semester Assessment$			End Sem. Exam (ESE)	Exam Duration for Theory (in Hrs)	Term Work	Practical & Oral	
			IAT-1	IAT-2	IAT-1+IAT-2		End-Sem			
16111301	PCC	Integral Transform and Statistical Techniques	20	20	40	60	2.5	25	–	125
16211302	PCC	Mechanics of Solids	20	20	40	60	2.5	–	–	100
16211303	PCC	Engineering Thermodynamics	20	20	40	60	2.5	–	–	100
16211304	PCC	Material Science	20	20	40	60	2.5	–	–	100
16212305	PCCL	Material Science Lab	–	–	–	–	–	25	25	50
16212306	PCCL	Machine Drawing GD&T						25	25	50
9951137 WW	OE	(To be fill from OE bucket)						25	–	25
98431308	Entrepreneurship	Entrepreneurship Development						25	–	25
98451309	Value education course	Environmental Science	20	20	40	60	2.5	–	–	100
16612310	Communication Engineering Project	IDEA LAB - 2(Innovation Design Engineering and Apply	–	–	–	–	–	50	50	100
Total			100	100	200	300	12.5	175	100	775

Curriculum Structure – SE Semester-IV

Course Code	Course Type	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
			L	T	P	L	T	P	SL	Notional Learning Hour	
16111401	PCC	Sampling Theory And Optimization	2	1	–	30	15	--	45	90	3
16211402	PCC	Heat Transfer	3	–	--	45	--	--	45	90	3
16211403	PCC	Theory of Machines	3	--		45	--	--	45	90	3
16212404	PCCL	Theory of Machines Lab	–	–	2	--	--	30	--	30	1
16212405	PCCL	IDEA LAB - 2(Innovation Design Engineering and Apply	1	--	2*	15	--	30	15	60	2
16212406	VSEC	Heat Transfer Lab	–	--	2	--	--	30	--	30	1
9931147WW	MDM	Smart Manufacturing	3	–	–	45	--	--	45	90	3
9931248WW	MDML	Smart Manufacturing Lab	--	–	2	--	--	30	--	30	1
99511149WW	OE	(To be fill from OE bucket)	2	–	–	30	--	--	30	60	2
98451410	VEC	Design Thinking	2	–	–	30	--	--	30	60	2
98431411	Entrepreneurship	Business model thinking	2	–	–	30	--	--	30	60	2
		Audit Course	3	--	–	45	--	--			
Total			21	1	8	315	15	120	285	690	23

Note:

1) Entrepreneurship and VEC will be common to all Branch

2) BSC, ESC, PCC and corresponding lab is Department Specific

3) Questions based on self-learning must not be asked in internal assessment and End semester Exam

4) * IDEA Lab: The IDEA Lab fosters individual interdisciplinary projects through theme-based, subject-integrated, experiential learning, assessed via standardized rubrics for innovation, application, and documentation."

5) * Lecture should be conducted for the full class.

Notional Learning Hours: In higher education, Notional Learning Hours (NLH) indicates the estimated time that a typical learner, at a specific academic level, is expected to invest in order to achieve the set learning outcomes of a course or module. This time includes a range of structured and independent learning activities, each contributing to the development of knowledge and competencies within a module

Self-Learning (SL): Self-learning is integrated into both theory and practical subjects, particularly where practical sessions have only one contact hour per week. It emphasizes student-driven efforts in preparing for assignments, practical's, and examinations. Additionally, self-learning includes topics that go beyond the prescribed syllabus to align with current industry trends and requirements. Assessment of self-learning will follow a formative approach. For theory subjects that include term work, 30% of the assignment questions and student presentations/discussions should be based on self-learning topics. In subjects without term work, the corresponding laboratory sessions will incorporate self-learning, carrying a weightage of 30%. This may involve lab work using the latest tools or preparing technical write-ups/research papers on advanced topics.

Examination Scheme – SE Semester-IV

Course Code	Course Type	Course Name	Examination Scheme							Total
			In-Semester Assessment			End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)	Term Work	Practical & Oral	
			IAT-1	IAT-2	IAT-1+IAT-2		End- Sem			
16111401	PCC	Sampling Theory And Optimization	20	20	40	60	2.5	25	–	125
16211402	PCC	Heat Transfer	20	20	40	60	2.5	–	–	100
16211403	PCC	Theory of Machines	20	20	40	60	2.5	–	–	100
16212404	PCCL	Theory of Machines Lab	–	–	–	–	–	25	25	50
16212405	PCCL	IDEA LAB - 2(Innovation Design Engineering and Apply	–	–	–	–	–	50	50	100
16212406	VSEC	Heat Transfer Lab	–	–	–	–	–	25	25	50
9931147WW	MDM	Smart Manufacturing	20	20	40	60	2.5	–	–	100
9931248WW	MDML	Smart Manufacturing Lab	–	–	–	–	–	25	25	50
99511149WW	OE	(To be fill from OE bucket)	–	--	–	–	--	25	–	25
98451410	VEC	Design Thinking	20	20	40	60	2.5	–	–	100
98431411	Entrepreneurship	Business model thinking	–	--	–	–	--	25	–	25
98472412		Audit Course								
Total			100	100	200	300	12.5	200	125	825

Curriculum Structure – TE Semester-V

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	MEC 501	Mechanical Measurement and Controls	03	-	-	03	-	-	03
PCC	MEC 502	Thermal Engineering	03	-	-	03	-	-	03
PCC	MEC 503	Dynamics of Machinery	03	-	-	03	-	-	03
PCC	MEC 504	Finite Element Analysis	04	-	-	04	-	-	04
PCE	MEC 55X	Department Level Optional Course-1	03	-	-	03	-	-	03
PCCL	MEL 506	Thermal Engineering Lab	-	02	-	-	01	-	01
PCCL	MEL 507	Dynamics of Machinery Lab	-	02	-	-	01	-	01
PCCL	MEL 508	Finite Element Analysis Lab	-	02	-	-	01	-	01
PCCL	MEL 509	Professional Communication and Ethics	-	*02 +2	-	-	02	-	02
PCCL	MEL 510	Mini Project – 2A	-	04$	-	-	02	-	02
Total			15	14	-	15	07	-	22

Course Code	Department Level Optional Course – 1
1	Optimization Techniques
2	Statistical Technique

Examination Scheme – TE Semester-V

Course Code	Course Type	Course Name	Examination Scheme							
			In-Semester Assessment$			End Sem. Exam (ESE)	Exam Duration for Theory (in Hrs)	Term Work	Practical & Oral	Total
			IAT-1	IAT-2	IAT-1+IAT-2		End-Sem			
PCC	MEC 501	Mechanical Measurement and Controls	20	20	40	60	2.5			100
PCC	MEC 502	Thermal Engineering	20	20	40	60	2.5			100
PCC	MEC 503	Dynamics of Machinery	20	20	40	60	2.5			100
PCC	MEC 504	Finite Element Analysis	20	20	40	60	2.5			100
OE	MEC 55X	Department Level Optional Course-1	20	20	40	60	2.5			100
PCCL	MEL 506	Thermal Engineering Lab						25	25	50
PCCL	MEL 507	Dynamics of Machinery Lab						25	25	50
PCCL	MEL 508	Finite Element Analysis Lab						25	25	50
PCCL	MEL 509	Professional Communication and Ethics						25	25	50
PCCL	MEL 510	Mini Project – 2A						25	25	50
Total			100	100	200	300	12.5	125	100	750

Curriculum Structure – TE Semester-VI

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	MEC 601	Machine Design	03	-	-	03	-	-	03
PCC	MEC 602	Turbo Machinery	03	-	-	03	-	-	03
PCC	MEC 603	Heating, Ventilation, Air conditioning and Refrigeration	03	-	-	03	-	-	03
PCC	MEC 604	Automation and Artificial Intelligence	04	-	-	04	-	-	04
OE	MEC 605	Department Level Optional Course – 2	03	-	-	03	-	-	03
PCCL	MEL 606	Machine Design	-	02	-	-	01	-	01
PCCL	MEL 607	Turbo Machinery	-	02	-	-	01	-	01
PCCL	MEL 608	Heating, Ventilation, Air conditioning and Refrigeration	-	02	-	-	01	-	01
PCCL	MEL 609	Measurements and Automation	--	4	--	--	2	--	2
PCCL	MEL 610	Mini Project – 2 B	--	4$	--	--	2	--	2
Total			16	14	-	16	07	-	23

Course Code	Department Level Optional Course – 2
1	Metal Forming Technology
2	Press Tool Design

Examination Scheme – TY Semester-VI

Course Code	Course Type	Course Name	Examination Scheme							
			In-Semester Assessment$			End Sem. Exam (ESE)	Exam Duration for Theory (in Hrs)	Term Work	Practical & Oral	Total
			IAT-1	IAT-2	IAT-1+IAT-2		End-Sem			
PCC	MEC 601	Machine Design	20	20	40	60	2.5			100
PCC	MEC 602	Turbo Machinery	20	20	40	60	2.5			100
PCC	MEC 603	Heating, Ventilation, Air conditioning and Refrigeration	20	20	40	60	2.5			100
PCC	MEC 604	Automation and Artificial Intelligence	20	20	40	60	2.5			100
OE	MEC 605	Department Level Optional Course – 2	20	20	40	60	2.5			100
PCCL	MEL 606	Machine Design						25	25	50
PCCL	MEL 607	Turbo Machinery						25	--	25
PCCL	MEL 608	Heating, Ventilation, Air conditioning and Refrigeration						25	25	50
PCCL	MEL 609	Measurements and Automation						25	25	50
PCCL	MEL 610	Mini Project – 2 B						25	25	50
Total			100	100	200	300	12.5	125	100	725

Curriculum Structure – BE Semester-VII

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	MEC701	Design of Mechanical System	4	--	-	4	-	-	03
PCC	MEC702	Logistics and Supply Chain Management	3	--	-	3	-	-	03
PCE	MEC73X	Department Level Optional Course – 3	3	--	-	3	-	-	03
PCE	MEC74X	Department Level Optional Course – 4	3	--	-	3	-	-	03
OE	OEC75WW	Institute Level Optional Course – I*	3	--	-	3	-	-	03
PCCL	MEL706	Design of Mechanical System	--	2	-		01	-	01
PCCL	MEL707	Maintenance Engineering	--	2	-		01	-	01
PCCL	MEL708	Industrial Skills	--	2	--				
PCCL	MEL709	Major Project I		6			02	-	02
Total			16	12	-	16	5	-	21

Course Code	Department Level Optional Course – 3
1	Vehicle System
2	Renewable Energy Sources
Course Code	**Department Level Optional Course – 4**
1	Machinery Diagnostics
2	Advance Vibration
Course Code	**Institute Level Optional Course – I***
1	Disaster Management and Mitigation Measures
2	Management Information System

Examination Scheme – BE Semester-VII

Course Code	Course Type	Course Name	Examination Scheme							Total
			In-Semester Assessment$			End Sem. Exam (ESE)	Exam Duration for Theory (in Hrs)	Term Work	Practical & Oral	
			IAT-1	IAT-2	IAT-1+IAT-2		End-Sem			
PCC	MEC701	Design of Mechanical System	20	20	40	60	2.5			100
PCC	MEC702	Logistics and Supply Chain Management	20	20	40	60	2.5			100
PCE	MEC73X	Department Level Optional Course – 3	20	20	40	60	2.5			100
PCE	MEC74X	Department Level Optional Course – 4	20	20	40	60	2.5			100
OE	OEC75WW	Institute Level Optional Course – I*	20	20	40	60	2.5			100
PCCL	MEL706	Design of Mechanical System						25	25	50
PCCL	MEL707	Maintenance Engineering						25	25	50
PCCL	MEL708	Industrial Skills						50	--	50
Total			100	100	200	300	12.5	100	50	650

Curriculum Structure – BE Semester-VIII

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	MEC801	Operations Planning and Control	3	--	--	3		-	03
PCE	MEC82X	Department Level Optional Course – 5	3	--	--	3		-	03
PCE	MEC83X	Department Level Optional Course – 6	3	--	--	3		-	03
OE	OEC84WW	Institute Level Optional Course – 2*	3	--	--	3		-	03
PCCL	MEL805	Product Design and Development	--	2	--		1	-	01
PCCL	MEL806	Laboratory based on IoT	--	2	--		1	-	01
PCCL	MEP807	Major Project II	--	8#	--		4		04
OJT	OJT899	Internship / Apprenticeship					4		04
Total			12	16	-	12	10	-	22

Course Code	Department Level Optional Course – 5
1	Smart Materials
2	Composite Materials
Course Code	**Department Level Optional Course – 6**
1	Product Design and Development
2	Total Quality Management
Course Code	**Institute Level Optional Course – II***
1	Finance Management
2	Environmental Management

Examination Scheme – BE Semester-VIII

Course Code	Course Type	Course Name	Examination Scheme							Total
			In-Semester Assessment$			End Sem. Exam (ESE)	Exam Duration for Theory (in Hrs)	Term Work	Practical & Oral	
			IAT -1	IAT-2	IAT-1+IAT-2		End-Sem			
PCC	MEC801	Operations Planning and Control	20	20	40	60	2.5			100
PCE	MEC82X	Department Level Optional Course – 5	20	20	40	60	2.5			100
PCE	MEC83X	Department Level Optional Course – 6	20	20	40	60	2.5			100
OE	OEC84 WW	Institute Level Optional Course – 2*	20	20	40	60	2.5			100
PCCL	MEL805	Product Design and Development						25	25	50
PCCL	MEL806	Laboratory based on IoT						25	25	50
PCCL	MEP807	Major Project II						100	50	150
OJT	OJT899	Internship / Apprenticeship								
Total			80	80	160	240	10	150	100	650

Indicative list of Multidisciplinary Minors:

Course Category of Multidisciplinary Minor	Course Code	MDM-I (Semester IV)	MDM-II (Semester V)	MDM-III (Semester VI)	MDM-IV (Semester VI)
Communication Engineering	993114701	Introduction to Telecommunication Systems	Mobile & Wireless Technology for Defence Communication	Telecommunication for Defense Sector	Multidisciplinary Project
	993124802	Introduction to Telecommunication Systems Lab	Mobile & Wireless Technology for Defense Communication Lab	Telecommunication for Defense Sector Lab	Multidisciplinary Project Lab
Internet of Technology	993114703	IOT Sensor Technology	IOT System Design	Dynamic Paradigm in IOT Project	Multidisciplinary Project
	993124804	IOT Sensor Technology Lab	IOT System Design Lab	Dynamic Paradigm in IOT Project Lab	Multidisciplinary Project Lab
Electronics Engineering	993114705	Basic Electronics Circuits	Analog & Digital IC	VLSI and Embedded systems	Multidisciplinary Project
	993124806	Basic Electronics Circuits Lab	Analog & Digital IC Lab	Analog VLSI Lab	Multidisciplinary Project
Mechanical Engineering	993114707	Smart Manufacturing in Assembly Line	Industrial Automation	Cyber Physical System	Multidisciplinary Project
	993124808	Smart Manufacturing Lab	Industrial Automation Lab	Cyber Physical System Lab	Multidisciplinary Project
Sustainability & Environment	993114709	Renewable and Non Renewable Energy System	Sustainable urban planning development	Geo Informatics	Multidisciplinary Project
	993124810	Renewable and Non Renewable Energy System Lab	Sustainable urban planning development Lab	Geo Informatics Lab	Multidisciplinary Project
Information Technology	993114711	Agentic AI	Data Engineering	Web Engineering	Multidisciplinary Project

	993124812	Intelligent Agents Lab	Data Engineering Lab	Web Engineering Lab	Multidisciplinary Project
Cyber Security	993114713	Information Security	Cyber Security	Open Source Intelligence	Multidisciplinary Project
	993124714	Information Security Lab	Cyber Security Lab	Open Source Intelligence Lab	Multidisciplinary Project
Computer Engineering	993114715	Computational Thinking.	Applied Cryptography	Decentralized technology	Multidisciplinary Project
	993124716	Data Structure Lab	Data Security Lab	Blockchain Lab	Multidisciplinary Project
Artificial Intelligence	993114717	Foundations of Artificial Intelligence	Machine Learning for Engineers	Applied Deep Learning	Multidisciplinary Project
	993124818	Artificial Intelligence Lab	Machine Learning Lab	Deep Learning Lab	Multidisciplinary Project

MDM Sequels for EXTC:

- **Internet of Technology**
- **Electronics Engineering**
- **Mechanical Engineering**
- **Sustainability & Environment**
- **Information Technology**
- **Cyber Security**
- **Computer Engineering**
- **Artificial Intelligence**

MDM Sequels for ECS:

- **Communication Engineering**
- **Internet of Technology**
- **Mechanical Engineering**
- **Sustainability & Environment**
- **Information Technology**
- **Cyber Security**
- **Computer Engineering**
- **Artificial Intelligence**

MDM Sequels for Mechanical:

- **Communication Engineering**
- **Internet of Technology**
- **Electronics Engineering**

- **Sustainability & Environment**
- **Information Technology**
- **Cyber Security**
- **Computer Engineering**
- **Artificial Intelligence**

MDM Sequels for Civil:

- **Communication Engineering**
- **Internet of Technology**
- **Electronics Engineering**
- **Mechanical Engineering**
- **Information Technology**
- **Cyber Security**
- **Computer Engineering**
- **Artificial Intelligence**

MDM Sequels for IT:

- **Communication Engineering**
- **Internet of Technology**
- **Electronics Engineering**
- **Mechanical Engineering**
- **Sustainability & Environment**
- **Cyber Security**
- **Computer Engineering**
- **Artificial Intelligence**

MDM Sequels for CS:

- **Communication Engineering**
- **Internet of Technology**
- **Electronics Engineering**
- **Mechanical Engineering**
- **Sustainability & Environment**
- **Information Technology**
- **Cyber Security**
- **Artificial Intelligence**

Internal Assessment and End Semester Exam Question Paper Structure

Internal Assessment for 20 Marks Each:

Internal Assessment (IA) will consists of two compulsory Internal Assessment Test of 20 marks each. IAT-1 is to be conducted on three course outcomes of the syllabus and IAT-2 will be based on remaining three course outcomes. Duration of each test shall be one hour.
Summation of the two tests will be considered as IA marks.

End Semester Examination (60-Marks):

1. Question paper will comprise of total 06 questions, each carrying 10 marks
2. The questions for 10M will be based on each module of the syllabus.
3. All questions from Q No: 01 to Q No:06 will be compulsory and based on entire syllabus.
4. The option will be provided in the question itself like Q No:1 A OR Q no: 1 B Remaining questions will be in similar nature and selected from the respective module.
5. Total 06 questions need to be attempted.

1. F.E Syllabus

Preface:

SEM I

Theme: "Engineering Foundations for Sustainable Futures"
Aligned with **UNSDG 4 – Quality Education, UNSDG 7: Affordable and Clean Energy, UNSDG 9: Industry, Innovation, and Infrastructure**. **UNSDG 12 – Responsible Consumption and Production**

Keywords: **core technical proficiency**, **hands-on learning**, and **computational thinking**

The theme "Engineering Foundations for Sustainable Futures" is a powerful and relevant framework for engineering education, deeply intertwined with the United Nations Sustainable Development Goals.

UNSDG 12: – Responsible Consumption and Production

- **Comprehensive Skill Development**: Projects under SDG 12 encourage students to apply a range of technical skills including mechanical design, electronics, software development, environmental science, and data analysis. These hands-on, real-world challenges help cultivate problem-solving, project management, teamwork, and innovation skills vital to future engineers.
- **Relevance and Future-Proofing**: With increasing regulations and global attention on sustainability, engineers who understand and implement responsible production strategies are highly valued. These projects expose students to global sustainability frameworks and prepare them for careers in green technology, sustainable infrastructure, and circular product design.
- **Innovation and Creativity**: Solving the challenges of sustainable production often requires out- of-the-box thinking. Students are encouraged to innovate by designing biodegradable products, improving recycling mechanisms, and rethinking traditional manufacturing systems in eco- friendly ways.
- **Interdisciplinary Approach**: SDG 12-based projects blend concepts from materials science, mechanical and electrical engineering, environmental studies, design thinking, and digital tools. This integrated learning fosters collaboration across disciplines, encouraging holistic problem- solving approaches that mirror real-world scenarios.

UNSDG 7: Affordable and Clean Energy

- **Renewable Energy Technologies:** Core technical proficiency provides the fundamental knowledge for understanding and developing renewable energy sources like solar, wind, geothermal, and hydropower. Hands-on learning allows students to build and test components of these systems, while computational thinking enables them to optimize their efficiency and integration into grids.
- **Energy Efficiency and Conservation:** Students learn to design systems and processes that minimize energy consumption. This includes optimizing building designs, developing more efficient manufacturing processes, and creating smart grids.
- **Energy Storage Solutions:** The theme supports the development of advanced energy storage technologies, crucial for the reliability of renewable energy sources. This involves understanding materials science, electrochemical processes, and computational modeling for battery design and management.

- **Policy and Economic Considerations:** While primarily technical, the theme indirectly promotes an understanding of the economic and policy landscapes surrounding affordable and clean energy, encouraging engineers to design solutions that are not only technically sound but also economically viable and accessible.

UNSDG 9: Industry, Innovation, and Infrastructure

- **Sustainable Infrastructure Design:** The theme promotes the design and construction of infrastructure that is resilient, resource-efficient, and has a minimal environmental footprint. This includes green buildings, smart cities, sustainable transportation networks, and water management systems.
- **Industrial Transformation:** Engineers with a strong foundation in this theme can drive innovation in industries by developing sustainable manufacturing processes, promoting circular economy principles, and integrating renewable energy into industrial operations.
- **Technological Advancement:** Computational thinking, in particular, drives innovation by enabling the development of advanced materials, AI-powered systems for resource optimization, and sophisticated simulations for testing new technologies before large-scale deployment.
- **Resilient Systems:** The focus on foundational engineering principles ensures that the innovations and infrastructure developed are robust and resilient, capable of withstanding environmental stresses and adapting to changing conditions. This is crucial for long-term sustainability.
- **Access to Technology:** By fostering a strong engineering foundation, the theme indirectly contributes to making technology more accessible and affordable, promoting inclusive industrialization and innovation.

Problem Statement: (^ problem statement based on theme)

Problem Statement 1: Simple Greywater Recycling for Gardens

Redirect and treat wastewater from sinks or bathrooms for gardening. Reduce freshwater use in urban homes and colleges..

Problem Statement 2: Composting Machine for College Canteen

Challenges with waste collection and disposal. Build a Prototype mechanical composter that processes daily food waste into fertilizer.

Problem Statement 3: Low-Cost Modular Bridge for Rural Roads

Design a scalable bridge model using bamboo or recycled plastic.

Problem Statement 4: Mini Wind Turbine for Urban Homes
Design a compact wind turbine for use on balconies or rooftops.

Problem Statement 5: Urban Vertical Farming Unit
Create a compact hydroponic or vertical garden for city apartments.

Problem Statement 6: Renewable Energy Air Purifier for smoking zones.

Monitor key air pollutants in smoking zones, providing clean air with a purification system based on renewable energy sources.

F.E SEM I

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
16111101	Linear Algebra and Calculus	2	1	--	30	15	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
16111101	Linear Algebra and Calculus	20	20	40	60	2	25	--	125

Rationale:

In Mechanical Engineering, matrices and systems of linear equations are essential tools for solving problems in structural analysis, thermal systems, and robotics, where multiple interdependent variables must be handled efficiently. Eigenvalues and eigenvectors are crucial for understanding natural frequencies and modes of vibration in mechanical systems such as beams, shafts, and automotive components. Similarity and diagonalization simplify the analysis of dynamic systems, enabling faster and more accurate simulations of mechanical structures and machinery. Partial differentiation is widely used in thermodynamics and fluid mechanics to study changes in variables like pressure, temperature, and volume in multivariable systems. Finally, analytic functions in complex variables support applications in vibration analysis and heat transfer, particularly in solving Laplace's and Poisson's equations under boundary conditions. Together, these mathematical concepts form the analytical backbone for modeling, analyzing, and optimizing real-world mechanical engineering systems.

R-2025- Mechanical Engineering

Course Objectives:

1. To understand matrix operations for modeling mechanical systems like trusses and linkages.
2. To learn to solve linear systems that arise in statics, thermal systems, and fluid mechanics.
3. To understand Eigen concepts for studying vibrations and dynamic behavior of mechanical structures.
4. To study diagonalization for simplifying coupled mechanical systems and dynamic analysis.
5. To understand partial derivatives for evaluating multivariable thermodynamic and stress functions.
6. To understand analytic functions for solving potential problems in heat and fluid flow.

Course Outcomes:

1**.** Students will be able to apply matrix algebra and use SCILAB to analyze equilibrium and load distribution in mechanical components

2. Students will be able to solve linear systems and use SCILAB to model heat conduction, force balance, and fluid networks in mechanical systems

3. Students will be able to analyze mechanical vibrations and use SCILAB to determine natural frequencies and modes using eigenvalue techniques.

4. Students will be able to diagonalizable matrices and use SCILAB to decouple system equations and evaluate mechanical system stability.

5. Students will be able to use partial differentiation and use SCILAB to analyze and optimize processes in thermodynamics and elasticity.

6. Students will be able to apply analytic functions and use SCILAB to model ideal fluid flow and solve 2D steady-state heat conduction problems

Prerequisite:

1. Addition, multiplication, transpose, and inverse of a matrix**.**

2. Review of Complex Numbers-Algebra of Complex Numbers, Cartesian, polar and exponential form of complex number.

R-2025- Mechanical Engineering

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Matrices	Types of Matrices (Symmetric, Skew- symmetric, Hermitian, Skew-Hermitian, unitary, orthogonal matrices and properties of matrices).	05	CO1
		Rank of a matrix using Echelon form, reduction to normal form and PAQ form.		
		Application of matrices to Coding and De-coding		
		Self-learning Topics: 1. PAQ form for rectangular matrices. 2. Reduction to normal form. 3. Theorems on sum of symmetric and skew symmetric matrices and similar theorems. 4. Properties of transpose, conjugate of matrices	08	
II	System of Linear Equations	System of Linear homogeneous and non–homogeneous equations, their consistency and solutions using rank.	05	CO2
		Linear dependence and independence of vectors. Linear combination of vectors		
		Solution of a system of linear algebraic equations, by (i) Gauss Jacobi Iteration Method, (ii) Gauss Seidel Iteration Method.		
		Self-learning Topics: 1. Vector Spaces 2. Linear Transformations. 3. Rank -Nullity theorems.	07	

III	Eigen values and Eigen vectors	Eigenvalues & eigenvectors of all types of matrices (symmetric, skew symmetric, orthogonal, triangular) and its properties (without proof).	05	CO3
		Cayley-Hamilton Theorem (without proof), verification and reduction of higher degree polynomials		
		Self-learning Topics: 1. Quadratic forms. 2. Reduction to quadratic forms 3. Rank, signature and index of a quadratic forms	08	
IV	Similarity and diagonalization of matrix	Similar matrices, diagonalizable matrices, orthogonally diagonalizable matrices and functions of square matrix.	05	CO4
		Minimal polynomial, Derogatory and non-derogatory matrices.		
		Singular value decomposition (SVD)		
		Self-learning Topics: 1. Functions of Square Matrix 2. Orthogonally diagonalization.	07	
V	Partial Differentiation	Function of two and three variables, Partial derivatives of first and higher order. Differentiation of composite function.	05	CO5
		Maxima and Minima of a function of two independent variables.		
		Lagrange's Multiplier method with one condition.		
		Self-learning Topics: 1. Euler's Theorem on Homogeneous functions with two independent variables. 2. Euler's Theorem on Homogeneous functions with three independent variables.	07	

		3. Deductions from Euler's Theorem. 4. Total differentials 5. Implicit Functions		
VI	Complex Variables – Differentiation	Circular functions of complex number and Hyperbolic functions. Analytic function, necessary and sufficient conditions for f(z) to be analytic (without proof),		
		Cauchy-Riemann equations in Cartesian coordinates (without proof, Polar form not included)	05	CO6
		Milne-Thomson method to determine analytic function f(z) when real (u)or imaginary part (v) is given.		
		Harmonic function, Harmonic conjugate, and orthogonal trajectories.		
		Self-learning Topics: 1. Expansion of $\sin^n\theta$, $\cos^n\theta$ in terms of sines and cosines of multiples of θ and Expansion of sinnθ, cosnθ in powers of sinθ, cosθ. 2. Powers and Roots of a complex number. 3. Logarithm of Complex Number 4. Inverse Hyperbolic Functions. Separation of real and imaginary parts of all types of Functions.	07	

Text Books:

1. Grewal B. S.: "Higher Engineering Mathematics", Khanna Publishers, 44th Ed., 2021.

2. Kreyszig E.: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed., 2018.

3. Dass H. K.: "Higher Engineering Mathematics", S Chand & Company Ltd, 12th Ed., 2004.

4. Narayan S.: "Differential Calculus", S.Chand Publications, 30th Ed., 2005.

References:

1. Strang G.: "Linear Algebra and its Applications", Cengage Publications, 4th Ed. 2022.
2. Stewart J.: "Multivariable Calculus" Cengage Publications, 7th Ed., 2019.
3. Jain M.K., Iyengar SRK, Jain R K,: "Numerical Methods for Scientific and Engineering Computation", New Age International Publishers, 6th Ed., 2007.
4. Bali N.P and Goyal M.: "A Textbook of Engineering Mathematics" Laxmi Publications, 10th Ed., 2022.
5. Williams G.: "Linear Algebra with Applications", Jones Bartlett Publishers Inc., 6th Ed., 2017.
6. Wylie C. R, Barrett L.C..: "Advanced Engineering Mathematics" McGraw Hill Book Co., New York, 6th Ed., 2017.
7. Ramana B.V.: "Higher Engineering Mathematics", Tata McGraw-Hill Publishing Company Limited, 1st Ed., 2006.
8. Gupta C.B, Sing S.R and Mukesh Kumar: "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education, 2015.
9. Lay D. C: "Linear Algebra and its Applications", Pearson Publishers, 4th Ed., 2018.
10. Pal S. & Bhunia S. C.: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016

Online References:

Sr. No.	Website Name
1.	https://www.math.ucdavis.edu/~daddel/linear_algebra_appl/Applications/applications.html
2.	https://onlinelibrary.wiley.com/doi/10.1155/2016/4854759
3.	https://archive.nptel.ac.in/courses/111/108/111108066/
4.	https://archive.nptel.ac.in/courses/111/104/111104092/

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test.

Term work (TW) for 25 marks:

1. Batch-wise tutorials are to be conducted.

2. Students must be encouraged to write SCILAB Programs in tutorial class only. Each Student has to write **at least 5 SCILAB tutorials** (including print out) and **at least 10** class tutorials on entire syllabus.

3. SCILAB Tutorials will be based on entire syllabus.

The distribution of Term Work marks will be as follows –

1. Regularity and active involvement (Theory and Tutorial) 05 marks

2. Class Tutorials on entire syllabus 10 marks

3. SCILAB Tutorials 10 marks

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
1611102	Applied Physics	2	--	--	--	30	–	30	60	2

Course Code	Course Name	Theory					Term work	Practical	Tutorial	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)				
		IAT 1	IAT 2	IAT1 +IAT 2						
1611102	Applied Physics	20	20	40	60	2.5	--	--	--	100

R-2025- Mechanical Engineering

Rationale:

1 Engineering Physics provides a strong grounding in fundamental concepts like mechanics, electromagnetism, thermodynamics, and optics, which are essential for understanding the scientific basis of all engineering disciplines.
2. The syllabus supports key subjects in all branches—such as strength of materials in civil and mechanical, circuits in electrical and electronics, and semiconductor physics in computer and IT—ensuring a smooth transition to branch-specific learning.
3. Physics fosters logical thinking, mathematical modelling, and problem-solving skills that are crucial for engineering analysis, system design, and innovation in every branch of engineering.
4. Topics like quantum mechanics, nanoscience, and wave phenomena prepare students for future technologies and interdisciplinary fields such as AI, robotics, renewable energy, and smart infrastructure, relevant across all engineering domains.

Course Objectives:

1. To build a foundation of quantum mechanics needed for modern technology.
2. To demonstrate principles of interference in thin film and diffraction..
3. To provide students with a basic understanding of laser operation basics of Optical fiber and its use in communication technology.
4. To familiarize students with the generation and applications of ultrasonic waves and the principles of architectural acoustics for effective sound control in engineering environments.
5. To introduce the basic principles of sensors and familiarize learners with their role and applications in modern technological systems.
6. To introduce the fundamental concepts of nanoscience and nanotechnology, enabling students to understand nanoscale phenomena

Course Outcomes:

1. Learners will be able to RELATE the foundations of quantum mechanics with the development of modern technology
2. Learners will be able to DEVELOP understanding of interference and diffraction; connect it to few engineering applications.
3. Learners will be able to ILLUSTRATE and APPLY the use of laser and OFC in engineering applications

4. Learners will be able to EXPLAIN the working of ultrasonic wave generators and apply acoustic principles to analyze and design acoustically efficient spaces.
5. Learners will be able to IDENTIFY the fundamentals of sensors and their applications in Advanced Technology.
6. Learners will be able to DESCRIBE the significance of nanoscience and nanotechnology, its applications.

Prerequisite: (For Theory **Course)**

1. Basic concepts of optics, including reflection, refraction, and interference using wave front analysis.
2. Application of Huygens' Principle and Snell's law in understanding light propagation.
3. Introduction to modern physics: dual nature of radiation, photoelectric effect, and matter waves.
4. Davisson–Germer experiment demonstrating wave nature of electrons.
5. Fundamentals of semiconductors: intrinsic and extrinsic types, electrical conductivity and resistivity.
6. Essential mathematical tools: vector algebra and partial differentiation used in physical analysis.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	PREREQUISITE	Basic knowledge of optics and atomic structure, Wavefront and Huygens principle, reflection and refraction, Interference by division of wavefront, Refractive index of a material, Snell's law, Dual nature of radiation, Photoelectric effect, Matter waves, Davisson-Germer experiment. Intrinsic and extrinsic semiconductors, electrical resistivity and conductivity concepts,Basic understanding of wave motion, sound waves, oscillations, magnetism, and electric fields is	–	–

		essential to grasp concepts like ultrasonic wave generation and acoustics.		
I	QUANTUM PHYSICS	Introduction (Matter waves, De Broglie hypothesis, Wave Packet). Concept of Phase velocity and group velocity and relation with particle velocity. Heisenberg Uncertainty Principle. Wave function; Physical interpretation of wave function. Schrodinger's time dependent wave equation; time independent wave equation; Particle trapped in one dimensional infinite potential well. Basics of Quantum Computing. Concept of Qubits, Quantum Superposition Quantum Entanglement.	06	CO 1
		Self-learning Topics: Quantum Tunneling and real-life examples Operators in Quantum Mechanics (basic idea) Quantum States and Measurement concept Basic Quantum Gates (NOT, Hadamard, CNOT) Quantum Teleportation (concept only) Quantum Cryptography and secure communication	06	
II	OPTICS FOR ENGINEERS	Thin Film Interference: Introduction (division of amplitude & Stoke's relation) Interference in thin film of constant thickness in reflected light, Formation of colors in thin film; Interference in Wedge shaped film in reflected light; Formation of Newton's rings; Applications (Anti Reflecting & High reflecting films) Diffraction: Introduction to Fraunhofer diffraction at single slit, Amplitude equation of	05	CO 2

		double slit, Diffraction Grating (N slits), Determination of wavelength of light using plane transmission grating and numerical.		
		Self-learning Topics: Concept of Antireflecting coating, Highly reflecting films, Uses of Thin films, Measurement of optical flatness. Determination of refractive index of liquids using interference, Determination of wavelength of light using plane transmission grating and numerical,.	05	
III	LASERS, AND FIBER OPTIC SYSTEM	Laser: Spontaneous emission and Stimulated emission; Metastable state, Resonant cavity, Population inversion, three & four level lasers, types of pumping, Semiconductor Laser. Fiber optics: Structure of an optical fiber, Types: Single mode & Multimode, Step index & Graded index.	06	CO 3
		Self-learning Topics: Attenuation, Losses in Optical fiber due to Physics structure and Transmission of signal Application: Optical fibre Transmission, Holography, Barcode reader, LiDAR, Memory reading and writing applications.	06	
IV	SOUND AND ACOUSTICS	Ultrasonic Wave generation; Magnetostriction Oscillator; Piezoelectric Oscillator; Applications of ultrasonic: Eco sounding; NDT; ultrasonic cleaning(cavitation) ACOUSTICS: Conditions of good acoustics; Reflection of sound (reverberation and echo);	05	CO 4

		absorption of sound; absorption coefficient; Sabine's formula;		
		Self-learning Topics: Medical Imaging using Ultrasound (basic concept) Noise Pollution and Acoustic Insulation Application: Designing quiet spaces, sound proof rooms, urban noise control Design of Auditoriums (practical acoustic considerations) Application: Theater and hall design for clear sound quality	05	
V	PHYSICS OF SENSORS	Ultrasonic sensors: Ultrasonic transducer as distance meter, Strain gauges for stress measurement, LVDT for displacement sensing. Accelerometers for vibration and seismic monitoring.	03	CO 5
		Self-learning Topics: Thermocouples and RTDs (PT100) for temperature measurement.	03	
VI	NANOSCIENCE AND NANOTECHNOLOGY	Introduction to nano-science and nanotechnology, Surface to volume ratio, Two main approaches in nanotechnology -Bottom up technique and top down technique; Important tools in nanotechnology such as Scanning Electron Microscope, Transmission Electron Microscope, Atomic Force Microscope. Nano materials:	05	CO 6
		Self-learning Topics: Methods to synthesize nanomaterials (Ball milling, Sputtering, Vapour deposition, sol gel), properties and applications of nanomaterials.	05	

		Application:Lithography, Single Electron Transfer (SET), Spin Valves.		

Text Books:

1. A Text book of Engineering Physics -Dr. M. N. Avadhanulu, Dr. P. G. Kshirsagar, S. Chand, Revised Edition 2014
2. Modern Engineering Physics - A. S. Vasudeva, S. Chand, Revised Edition 2013
3. Engineering Physics D. K Bhattacharya,PoonamTandon, Oxford Higher Education, 1st Edition 2015-16
4. Engineering Physics -R. K. Gaur,S. L. Gupta, DhanpatRai Publications, 2012
5. Engineering Physics -V. Rajendran, McGraw Hill Educations, 2017
6. A Textbook of Nanoscience and Nanotechnology, T. Pradeep Tata McGraw Hill Education Pvt. Ltd., 2012

References:

1. Concepts of Modern Physics - ArtherBeiser, ShobhitMahajan, S. Choudhury, McGraw Hill, 7th Edition 2017
2. Fundamentals of optics - Francis A. Jenkins, Harvey E. White, McGraw Hill Publication, India, 4th Edition
3. Fundamentals of Physics, Halliday and Resnick, Wiley publication
4. Nanotechnology- Principles & Practices- Sulabha K. Kulkarni

Online References:

Sr. No.	Website Name
1.	1. https://archive.nptel.ac.in/courses/115/102/115102124/
2.	2. https://archive.nptel.ac.in/courses/115/102/115102025/
3.	3. https://archive.nptel.ac.in/courses/115/105/115105132/

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) Notional Learning Hour/30
16121103	**Engineering Mechanics**	3	-	-	45	-	-	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration(in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
16121103	**Engineering Mechanics**	20	20	40	60	2.5	--	--	100

Rationale:

Engineering mechanics is a branch of science that deals with the behaviour of solid bodies when subjected to external forces or loads and the effects of these forces on the bodies. Though traditionally software-focused, Computer and IT engineers increasingly interact with physical systems through areas like robotics, virtual reality, gaming, digital twin technology, and simulation. Engineering Mechanics introduces the physical principles of force, motion, and equilibrium, which are essential for the development of realistic simulation engines, AI-based mechanical system models, and integration of software with hardware systems. This subject helps build computational models of mechanical phenomena and enhances interdisciplinary competence for modern applications.

Course Objectives

1	To acquaint with basic principles of Centroid and Moment of Inertia and its real-life significance
2	To familiarize with the concepts of force, moment, couple, resultant and system of coplanar and non-coplanar forces.
3	To familiarize with the concepts loads, beams, equilibrium conditions, friction and their real-life applications.
4	To understand the motion parameters required for quantification of Kinematics of Particle and Rigid body.
5	To understand the combination of force and motion parameters required for quantification of Kinetics of rigid body.
6	To acquaint with the basics of Robot kinematics

Course Outcomes

1 Demonstrate the understanding of Centroid and MI and locate the same.
2 Determine the resultant and equivalent force-couple system for a given system of forces.
3 Illustrate the concept of loads, supports, beams, conditions of equilibrium and apply the same in real life application to specific type of friction, estimate required force to overcome friction, and apply the equilibrium for trusses.
4 Determine the position, velocity, and acceleration of particle and rigid body using principles of kinematics for rectilinear, curvilinear and general plane motion.
5 Apply the principles of force and acceleration, work-energy and impulse- momentum to particles in motion.
6 Establish the relation between robot joints and parameters

Prerequisite: Student shall have passed HSC (Higher Secondary Certificate) along with basic understanding of physics and mathematics in following topics:-

1. **Basic Vector Algebra**
   – Understanding of vector addition, subtraction, scalar and vector products.
   – Ability to resolve vectors into components.
2. **Fundamentals of Classical Physics**
   – Concepts of force, motion, Newton's laws, equilibrium, and gravity.
   – Understanding of mass, weight, friction, and types of motion.
3. **Basic Trigonometry and Geometry**
   – Familiarity with sine, cosine, tangent functions.
   – Knowledge of angles, triangles, and coordinate systems.
4. **Problem-Solving and Logical Reasoning Skills**
   – Ability to approach real-world physical problems logically.
   – Basic analytical thinking and spatial reasoning.

Detailed Syllabus

Module no.	Module Name	Detailed content	Teaching hours	CO
0	**Prerequisite**	Statics, Dynamics, Kinetics, Kinematics, Rigid body, Deformable body, applying trigonometric functions, resolution of a vector (Force vector), Law of triangle, Polygon law of forces, Newton's laws of motion Velocity, acceleration, displacement, Uniform velocity and accelerated motion, Law of conservation of Energy, Law of conservation of Momentum, work-energy principle, impulse and momentum principle, and Coefficient of restitution		
1	**Centroid and Moment of Inertia**	i. Characteristics, and real-life significance for Centroid ii. Centroids of primary geometrical shapes and plane laminas	06	CO1

		iii. MI for primary geometrical shapes and plane laminas **Self-learning topic:** - Explore Center of gravity of simple solid objects - Apply parallel and perpendicular axis theorem for MI with simple geometrical shapes	06	
2	**Force and System of Forces**	i. Principle of transmissibility, Moment of force about a point and concept of couple ii. Classification of force systems iii. Resultant of coplanar system of forces and Varignon's Theorem iv. Resultant of non-coplanar system of forces **Self-learning topic:** - Exploring force and a couple system and real-life application of a force and a couple system - Resultant of non-coplanar parallel and general system of forces	07 07	CO2
3	**Equilibrium and Application of Equilibrium**	i. Conditions of equilibrium for system of forces and free body diagrams, Types of beams, loads, and support and its reaction ii. Equilibrium of beams, rollers, and system of bodies iii. Fundamentals of truss structures, Laws of friction. Cone of friction. angle of repose, and angle of friction iv. Application of equilibrium with friction on blocks on horizontal and inclined planes and ladders v. Application of equilibrium with trusses structures (Numerical on Method of joints and Method of section) **Self-learning topic:** - Equilibrium of connected bodies (beam and sphere), two force and three force members - Equilibrium of non-coplanar system of forces - Application of equilibrium with friction - Wedge and block - Exploring the concepts of trusses and friction in real life problems	15 15	CO3

4	**Kinematics of particles and rigid bodies**	i. Motion along plane curved path, Variable acceleration for rectilinear motion ii. Introduction to General plane motion, problem based on Instantaneous centre (ICR) method for general plane motion (up to 2 linkage mechanism and roller) **Self-learning topic:** - Application of motion graph for real-life problems - ICR for rollers, wheels and three links problems - ICR for system of rigid bodies	07 07	CO4
5	**Kinetics of particles**	- Introduction to D'Alembert's Principle (DAP), inertia force, dynamic equilibrium, Work done by active forces, impact and collision - Problems on DAP (single and double block), and WEP (single block) **Self-learning topic:** - Application of WEP to the real-life problems - Explore the concept of impact and collision for rigid bodies	06 06	CO5
6	**Introduction to Robot Kinematics**	- Fundamental of Robot Mechanics, Degree of Freedom, D-H Parameters, robot kinematics (Forward) - Homogeneous transformation (limited to 2 DOF Serial robot) **Self-learning topic:** - Derive and Analyze - Manual derivation of forward kinematics using D-H parameters - Explore online simulation tools such as MATLAB Robotics Toolbox Online and refer https://kinematicsplayground.org/ - Solve 2 numerical problems involving: Assigning D-H parameters and finding of end-effector pose using transformation matrices	04 04	CO 6

Text Books:

1. Engineering Mechanics by A K Tayal, Umesh Publication.
2. Engineering Mechanics by Kumar, Tata McGraw Hill
3. Engineering Mechanics by Beer &Johnston, Tata McGraw Hill

References:

1. Engineering Mechanics by R. C. Hibbeler.
2. Engineering Mechanics by F. L. Singer, Harper& Raw Publication
3. Engineering Mechanics by Macklin & Nelson, Tata McGraw Hill

Online References:

Sr. No.	Website Name
1	https://archive.nptel.ac.in/courses/112/106/112106286/
2	https://archive.nptel.ac.in/courses/112/106/112106180/

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) Notional Learning Hour/30
16121104	**Basic Electrical and Electronics Engineering**	2		--	30	-	--	30	60	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
16121104	**Basic Electrical and Electronics Engineering**	20	20	40	60	2.5	--	--	100

Rationale: This course equips Mechanical and Civil Engineering students with essential knowledge of electrical and electronic systems that are increasingly integral to modern infrastructure. From energy-efficient HVAC and automated construction equipment to smart buildings and sustainable power systems, understanding electrical circuits, machines, and controls enables engineers to design, operate, and maintain advanced infrastructure. The subject aligns with NEP 2020 goals by fostering interdisciplinary skills and promoting sustainable and intelligent engineering practices in line with UNSDGs.

Course Objectives:

1. To provide a foundation in DC and AC electrical circuit behavior applied in industrial systems.
2. To introduce transformer operation and efficiency for energy management.
3. To understand electric motors used in construction, HVAC, automation, and tools.
4. To explain diode and transistor applications in sensors and smart infrastructure.
5. To foster engineering decision-making involving electrical safety and sustainable power use.
6. To encourage interdisciplinary learning and practical problem-solving aligned with NEP 2020 goals.

Course Outcomes:

By the end of the course, students will be able to:
1. **Apply** basic laws (Ohm's law, Kirchhoff's laws) and theorems (Thevenin, Norton, Superposition) to analyse electrical circuits used in buildings and machines.
2. **Analyze** the behaviour of AC circuits, resonance, and power factor to improve energy efficiency in infrastructure systems.
3. **Explain** the operation of transformers and their applications in power distribution systems used in construction sites, elevators, and HVAC systems.
4. **Illustrate** the working of electrical machines (DC/AC motors, BLDC) in elevators, cranes, pumps, and other mechanical equipment.
5. **Evaluate** the role of special purpose diodes (Zener, LED) and transistors in lighting, instrumentation, and automation in smart buildings and factories.
6. **Demonstrate** use of transistors in switching and monitoring systems.

Pre-requisite: Fundamentals of Physics and Mathematics

Detailed Syllabus:

Sr. No.	Module Name	Detail Topics	Hours	CO Mapping
0	**Prerequisite**	Resistance, inductance, capacitance, series and parallel connections of resistance, concepts of Voltage, current, power and energy and its units. Magnetic circuits, MMF, Magnetic field strength, Reluctance.		
1	**DC Circuits and Energy Optimization Techniques**	• Kirchhoff's Laws, Source transformation, Star-delta Transformation, • Mesh and Nodal Analysis, • Network theorems: Superposition, Thevenin's, Norton, Maximum Power Transfer	**10**	**CO1**

		Self-Learning: ● **Application of Thevenin's & Norton's theorems** in troubleshooting electrical systems in cranes, pumps, and automated gates ● **Mesh and Nodal Analysis** applications in renewable energy installations for buildings (solar + DC microgrids) ● **Maximum Power Transfer applications** in solar panel circuits for mechanical ventilation and green buildings		
2	**AC Circuits and Power Quality in Infrastructure**	● AC signal characteristics: RMS, phasors ● Series/Parallel RLC circuits ● Real, reactive, apparent power and resonance ● Introduction to three-phase voltages (only star/delta theory)	**12**	**CO2**
		Self-Learning: ● **Power factor improvement techniques** used in HVAC systems and elevators ● **Energy-efficient design** of electrical distribution in large mechanical workshops and construction sites ● **Three-phase motor selection and balancing** in cranes, hoists, and conveyor systems ● RLC circuit applications	12	
3	**Single-Phase Transformers in Building and Utility Systems**	● Working principle, types, ideal vs practical transformer ● Losses, efficiency, application in SMPS, UPS	**04**	**CO3**
		Self-Learning: ● **Safety codes and guidelines** for transformer installations at industrial and construction sites ● Role of transformers in solar PV installations ● **Isolation transformers** for sensitive instruments	04	
4	**Electric Machines in Construction and Mechanical Systems**	● Overview of DC Motors, 1-Φ & 3-Φ Induction motors ● Introduction to **BLDC motors** used in robotics, drones, printers	**05**	**CO4**
		Self-Learning: ● **Energy-efficient motor selection** for HVAC, lifts, and pumps (impact on operating costs) ● Recent trends in smart motor monitoring	05	

		• **Motor maintenance strategies** (predictive vs preventive maintenance)		
5	**Diodes in Energy Management and Smart Lighting**	• Zener Diode: Voltage regulation • LED: Principles and display usage • Clipping, clamping circuits (brief intro)	**04**	**CO5**
		Self-Learning: • Solar-powered LED lighting • **Low-voltage DC lighting systems** for sustainable buildings • **Zener diode-based voltage protection** for sensitive sensors	**04**	
6	**Transistors for Automation and Control in Engineering Systems**	• BJT and FET (intro only), Common emitter configuration • Transistors as switches and basic amplifiers • Applications in logic gates, switching regulators	**04**	**CO6**
		Self-Learning: • **Transistors in sensor interfacing** • Applications of BJTs and FETs in robotics and automation in mechanical workshops • **Design of basic logic circuits** for automation of construction machinery		

Text Books:

1. V. N. Mittal and Arvind Mittal "Basic Electrical Engineering" Tata McGraw Hill, (Revised Edition)
2. Vincent Del Toro "Electrical Engineering Fundamentals", PHI Second edition, 2011
3. Edward Hughes "Hughes Electrical and Electronic Technology", Pearson Education (Tenth edition)
4. D P Kothari and I J Nagrath "Theory and Problems of Basic Electrical Engineering", PHI 13th edition 2011.
5. M. Naidu,S. Kamakshaiah "Introduction to Electrical Engineering" McGraw-Hill Education, 2004.
6. B.R Patil "Basic Electrical Engineering" Oxford Higher Education.
7. Electronic Devices and Circuit Theory" by Robert L. Boylestad and Louis Nashelsky

References:

1. B.L. Theraja "Electrical Engineering "Vol-I and II
2. S.N. Singh, "Basic Electrical Engineering" PHI , 2011Book

Online Resources:

Sr. No.	Website Name
1	https://www.allaboutcircuits.com/
2	https://nptel.ac.in/courses/108/105/108105053/
3	https://www.electronics-tutorials.ws/
4	https://www.edx.org/course/circuits-and-electronics-1-basic-circuit-analysis
5	https://www.falstad.com/circuit/

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
16121105	C and C++ Programming	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Practical / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration in Hrs.			
		IAT-1	IAT-2	IAT-1 + IAT-2					
16121105	C and C++ Programming	20	20	40	60	2.5	--	--	100

Rationale:

The C and C++ Programming course serves as a foundational pillar for first-year engineering students across all branches by developing essential problem-solving and programming skills. It introduces students to both structured and object-oriented programming paradigms, fostering logical thinking and algorithmic design. As C is widely used in system-level programming and C++ forms the basis for modern software development, this course ensures students gain proficiency in writing efficient, modular, and scalable code. Its relevance spans all engineering disciplines, supporting applications in simulation, automation, modeling, and control systems. By laying the groundwork for advanced subjects like data structures, algorithms, and embedded

systems, the course prepares students for future academic and professional challenges in an increasingly digital and automated world.

Course Objectives:

1 **To introduce** the fundamentals of programming using C and C++, focusing on syntax, semantics, and program structure for developing simple, efficient solutions.
2 **To develop** the ability to apply control structures, functions, arrays, and strings in solving computational and real-world engineering problems.
3 **To enable** students to understand and implement user-defined data types such as structures, unions, and enumerations for effective data management.
4 **To build** foundational knowledge of pointers, memory management, and file handling to facilitate low-level programming and system-level applications.
5 **To provide** a conceptual and practical understanding of object-oriented programming features in C++, including classes, objects, inheritance, polymorphism, and abstraction.
6 **To prepare** students for advanced computing courses by enhancing their analytical thinking, debugging skills, and ability to write modular, maintainable, and reusable code.

Course Outcomes:

Upon successful completion of the course, the learner will be able to:

1. **Understand and apply** the basic concepts of C programming, including algorithm development, structured programming, data types, operators, control structures, and input/output operations, to develop simple programs.
2. **Apply and analyze** the concepts of functions, arrays, and strings in C to solve computational problems using modular and structured programming techniques.
3. **Apply and analyze** the use of pointers, structures, and file handling techniques to manage memory efficiently and perform structured data operations in C programming.
4. **Understand and apply** the fundamental concepts of object-oriented programming in C++, including classes, objects, encapsulation, constructors, and member functions to design modular programs.
5. **Analyze and apply** advanced object-oriented programming concepts such as polymorphism, inheritance, virtual functions, and abstraction in C++ to develop flexible and reusable software components.

6. **Understand and evaluate** best programming practices, debugging techniques, and industry standards like MISRA guidelines, and **relate** C/C++ programming to real-world applications and emerging technologies.

Prerequisite: Nil.

Detailed Syllabus:

M. No.	Module Name	Detail Topics	Hours	CO Mapping
0	**Prerequisite**	• Basic familiarity with **fundamental mathematical** and **logical reasoning skills**. • **Understanding of basic computer operations** – such as using a keyboard, mouse, operating systems, and file handling. • **Logical thinking and problem-solving ability** – including flowcharting, algorithmic thinking, and basic decision-making. • **Basic English comprehension skills** – to read and write code, understand syntax, and follow programming logic.	**--**	**--**
1	**Fundamentals of C Programming**	• Introduction to Programming, algorithms and Flowcharts • Program Development Life Cycle (PDLC) - Structure of a C Program, Compilation, Execution • Concepts of Structured Programming in C • Data Types, Program Statements, Token, Identifiers, Keywords, Constants, Assignment, Declaration and Initialization, Variables, Operators and Expressions, Lvalue and Rvalues, • Input/Output Functions, Type Conversion and Typecasting • Control Structures: if, else, switch-case, loops (for, while, do-while), break, continue, goto	**8**	**CO1**

		Self-Learning Topics: • Write-up on history and evolution of programming languages • Practicing Non-Formatted Input & Output functions – getchar( ), putchar( ), getch( ), getche( ), putch( ), gets( ), puts( ) • Practicing Formatted Input & Output functions – printf( ) - % Format specifiers, formatting the output, escape sequences, Runtime adjustment and precision – Input Function scanf() – format specifiers, formatted input. • Preprocessor Directives in C • Implement pattern generation programs and logic puzzles • Research: Role of C in Embedded Systems • Practicing program development logic using Combines Multiple Control Statements: Number guessing game, ATM simulation program, Login system with 3 attempts limit, **Magic** number finder, Menu-driven bank management functions	**8**	
2	**Functions, Arrays, and Strings**	• **Functions:** Prototype Declaration, Definition, Function Calling, Passing Parameters to the Function, Scope of Variables, Call by Value. • **Storage Classes:** auto, static, register, extern • Recursive Functions, Recursion Vs Iteration • **Arrays**: 1D, 2D Arrays – Declaration, Initialization, Accessing Array Elements, Operations on Arrays, Applications • **Strings**: Declaration, Initialization, String Operations, Array of Strings, String manipulation Functions in string.h	**8**	**CO2**

		Self-Learning Topics: • Sorting an array, Binary searching • Declaration and Initialization of a Multidimensional Array • Matrix addition, multiplication • Arrays of strings: Two-dimensional character array • Passing Arrays to Functions • Character manipulation in the String using character functions in <ctype.h> • Implement recursive solutions (e.g., Fibonacci, Tower of Hanoi) • Comparison of recursion and iteration (mini presentation) • Industry application: Use of arrays/strings in data processing	**8**	
3	**Pointers, and Structures**	• **Pointers:** Basics, address operator (&), Declaring & initializing Pointer Variables, Indirection Operator and Dereferencing, Pointer Expressions and Pointer Arithmetic, Types of Pointers, Pointer to Pointers, Pointers and Arrays, Call. by value vs Call by address. • **Dynamic Memory Allocation** (malloc, calloc, realloc, free) • **Structures and Unions**, Declaring Structures and Structure Variables, Accessing the members of a structure, Initialization of Structures, typedef, Nested Structures, Arrays of Structures,	**7**	**CO3**
		Self-Learning Topics: • Call by address using pointers, returning more than one value from a function, returning pointer from a function, structures and pointers, passing structure to function • Structure versus Union, Enumeration types • Processing binary files	**7**	

		• Write mini programs for file encryption/decryption • Technical write-up: Memory leaks and how to avoid them • Tools: Memory debugging using Valgrind (demonstration/presentation)		
4	**Introduction to Object-Oriented Programming (C++)**	• Differences between Procedural and Object-Oriented Programming • Introduction to C++, Structure of a C++ Program • Classes and Objects, Standard input and output stream objects, Access Specifiers, Data hiding and Encapsulation, Array of Objects • Constructors and Destructors • Friend Functions, Inline Functions	**7**	**CO4**
		Self-Learning Topics: • Explore syntax differences between C and C++ • Implement class-based programs (Employee Management System, Account Management banking system, Addition of Complex Numbers, student management) • Defining the member functions outside the class • Research: Applications of OOP in industry tools (e.g., game development, simulations)	**7**	
5	**Advanced OOP Concepts (C++)**	• **Inheritance:** Creating a Parent-Child relationship between Classes, Types of Inheritance, Implementing Multilevel and Hybrid Inheritance • **Polymorphism:** Introduction of Polymorphism, Types of Polymorphism • **Compile time Polymorphism:** Function overloading, operator overloading, Rules for operator overloading	**8**	**CO5**

		• **Run time polymorphism:** Virtual functions, rules for virtual functions, pure virtual function.		
		Self-Learning Topics: • Working of Constructors with Multiple Inheritance Creating a "String" data type – An example using Operator and function overloading • Create inheritance-based applications (e.g., employee hierarchy system) • Mini project proposal based on OOP concepts • Read and summarize advanced topics like Templates or Exception Handling	**8**	
6	**Industry Applications and Programming Practices**	• Best Practices in Programming: Modularization, Comments, Code Reusability • Debugging Techniques, Error Handling • Applications in Embedded & Real-Time Systems • Introduction to Competitive Programming – Objectives, how it works, Benefits, platforms • Overview of Software Development Life Cycle (SDLC) • MISRA C and MISRA C++ Safe Coding Rules • Role of C/C++ in current technologies (AI, IoT, Game Development, System Software)	**7**	**CO6**
		Self-Learning Topics: • Research paper or technical write-up on advanced use of C/C++ (e.g., real-time systems, kernel dev) • Online platform practice (e.g., HackerRank, Codeforces, CodeChef, etc.) • Seminar/presentation on any emerging tech using C/C++	**7**	

Text Books

1. "Programming in C", by Pradeep Dey and Manas Ghosh, Oxford University Press.
2. “Object Oriented Programming with C++” by E. Balagurusamy, McGraw Hill Education**.**
3. "Basics of Computer Science", by Behrouz Forouzan, Cengage Learning.
4. "Programming Techniques through C", by M. G. Venkateshmurthy, Pearson Publications.
5. "Programming in ANSI C", by E. Balagurusamy, Tata McGraw-Hill Education.
6. "Let Us C", by Yashavant Kanetkar, BPB Publications.

Reference Books

1. "The C Programming Language" by Brian W. Kernighan and Dennis M. Ritchie,Prentice Hall.
2. “Programming: Principles and Practice Using C++” by Bjarne Stroustrup, Addison-Wesley
3. "C Programming: A Modern Approach" by K. N. King, W. W. Norton & Company.
4. "C Primer Plus" by Stephen Prata, Addison-Wesley Professional.
5. "Programming in C" by Stephen G. Kochan, Addison-Wesley Professional

Online Resources:

Sr. No.	Website Name
1	Learn C - This website offers a free, interactive tutorial to learn C programming, covering both basic and advanced topics.
2	Codecademy - Codecademy provides a comprehensive, interactive course for learning C, complete with real-world projects and skill paths.
3	Coursera - Coursera, in collaboration with Duke University, offers a specialization in C programming, including hands-on projects and a certificate upon completion.
4	edX - This course, offered by edX, covers C programming with a focus on Linux, including professional certification.

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30
16112106	Applied Physics Lab	--	--	1	--	--	1	–	15	0.5

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT1 +IAT 2				
16112106	**Applied Physics Lab**	--	--	--	--	25		25

Lab Objectives:

1. To BUILD a foundation of quantum mechanics needed for understanding and developing modern technology.
2. To DEMONSTRATE the principles of interference in thin films and relate them to optical phenomena.
3. To INTRODUCE the fundamentals of lasers and optical fibers along with their applications in communication technology.

4. To UNDERSTAND the working principle of an ultrasonic distance meter and to MEASURE distances using ultrasonic wave propagation.

5. To UNDERSTAND the operation of a Linear Variable Differential Transformer (LVDT) and to USE it for linear displacement measurement.

6. To EXPLAIN the basic operating principles of Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM), and to RECOGNIZE their applications in nanoscale material characterization.

Lab Outcomes:

LO1: Learners will be able to RELATE the foundations of quantum mechanics with the development of modern technology.

LO2: Learners will be able to DETERMINE the wavelength of light and EXPLAIN the interference phenomenon.

LO3: Learners will be able to ILLUSTRATE the use of lasers in applications and APPLY the fundamentals of fiber optics in modern communication technology.

LO4: Learners will be able to OPERATE an ultrasonic sensor to measure distance accurately and EXPLAIN its working based on the time-of-flight principle of sound waves.

LO5: Students will be able to INTERPRET voltage variation from the LVDT in response to physical displacement.

LO6: Learners will be able to EXPLAIN the working mechanisms of SEM and TEM and INTERPRET their role in analyzing surface morphology and internal structure of nanomaterials.

List of Experiments. (Minimum five experiments required)

Sr No	List of Experiments	Hrs	LO
01	Determination of Number of Lines in Diffraction Grating using He-Ne Laser	01	LO2
02	Determination of Radius of Curvature of Lens Using Newton's ring Set Up.	01	LO2
03	Determination of 'h' using LED/photocell	01	LO1
04	Determination of Divergence of LASER	01	LO3
05	Determination of Numerical of Aperture of OFC	01	LO3
06	Measurement LVDT for displacement sensing.	01	LO5

07	Determine RTDs (PT100) for temperature measurement.	**01**	**LO5**
08	Measurement of Distance using Ultrasonic Distance Meter.	**01**	**LO4**
09	Learning Basic operations of Scanning Electron Microscope and Transmission Electron Microscope	**01**	**LO6**

Text Books and References:

1. Ajoy Ghatak – ***Optics***
Excellent explanation of diffraction, laser interference, and grating equations.
2. C.L. Arora – ***B.Sc. Practical Physics***
Practical procedure and observation format for the experiment.
3. Jenkins & White – *Fundamentals of Optics*
4. Gerd Keiser – *Optical Fiber Communications*
5. R.S. Sedha – ***Applied Electronics***
6. Digital CMOS Design by Sung-Mo Kang

Online Resources:

Sr. No.	Website Name
1.	IEEE Xplore / Research Gate
2.	https://www.electronics-tutorials.ws/diode/diode_2.html
3.	https://circuitdigest.com.
4.	https://www.vlab.co.in/
5.	https://www.AMRITHA.vlab.co.in/

Assessment:

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 10 Marks Project + 5 Marks (Attendance)

Project work: The project is to be completed within one semester. Students must execute the project as per the plan submitted at the beginning of the semester. The project outcome can be a working model, a simulation model, or a study report leading to the anticipated conclusion. Evaluation will be based on the quality of work and adherence to the submitted plan. A proper assessment rubric will be used for awarding marks.

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) Notional Learning Hour/30
16122107	**Engineering Mechanics**	-	-	2	-	-	30	-	30	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration(in Hrs)			
		IAT 1	IAT 2	Total.					
16122107	**Engineering Mechanics**	--	--	--	--	--	25	25	50

Lab Objectives:

1. To acquaint with basic principles of Centroid and its real-life significance
2. To familiarize with the concepts of force, moment, couple, resultant and system of coplanar and non-coplanar forces.
3. To familiarize with the concepts loads, beams, equilibrium conditions, friction and their real-life applications.
4. To understand the motion parameters required for quantification of Kinematics of Particle and Rigid body.
5. To understand the combination of force and motion parameters required for quantification of Kinetics of rigid body.
6. To acquaint with the basics of Robot kinematics

Lab Outcomes:

1. Demonstrate the understanding of Centroid locate the same.
2. Determine the resultant and equivalent force-couple system for a given system of forces.
3. Illustrate the concept of loads, supports, beams, conditions of equilibrium, and friction and apply the same in two dimensional systems with the help of FBD.
4. Determine the position, velocity, and acceleration of particle and rigid body using principles of kinematics for rectilinear, curvilinear, and general plane motion.
5. Apply the principles of force and acceleration, work-energy and impulse- momentum to particles in motion.
6. Establish the relation between robot joints and parameters

List of Experiments:

Minimum six experiments from the following list of which a minimum one should be from dynamics.

Sr. No.	List of Experiments	Hrs	CO mapping
1	Verification of Polygon law of coplanar forces (Universal force table apparatus)	02	CO2
2	Verification of the Principle of Moments (Bell crank lever)	02	CO2
3	Determination of Centroid of plane lamina made up of standard geometrical shapes	02	CO1
4	Determination of support reactions of a Simply Supported Beam.	02	CO3
5	Determination of coefficient of friction using inclined plane	02	CO3
6	Verification of the equations of equilibrium for non-concurrent non-parallel (General) force system.	02	CO3
7	Kinematics of particles. (Uniform motion of a particle, Projectile motion, motion under gravity)	02	CO4
8	Collision of elastic bodies (Law of conservation of momentum).	02	CO5
9	Kinetics of particles. (collision of bodies)	02	CO5

Sr No	List of Assignments / Tutorials	Hrs	CO mapping
01	Centroid and MI of composite plane laminas (6 Numerical)	01	CO1
02	Resultant of coplanar and non-coplanar system of forces (6 Numerical)	01	CO2
03	Equilibrium of beam, rollers, bodies on inclined plane with friction and ladders with friction (7 Numerical).	03	CO3
04	Kinematics of particles and rigid bodies (7 Numerical)	03	CO4
05	Kinetics of particles (5 Numerical)	01	CO5
06	Homogeneous transformation, and Direct Kinematics of robot (5 Numerical)	02	CO6
07	Resultant of Co-planar system of forces for concurrent system of forces using C programming language.	02	CO1
08	Equilibrium of beam for support reactions using C programming language	02	CO3

Assessment:

Term Work: Term Work shall consist of at least 06 practicals based on the above list. Also, Term work Journal must include all the assignments listed above.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
16122108	**Basic Electrical and Electronics Engineering Lab**	-	-	2	-	-	30	-	30	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
16122108	**Basic Electrical and Electronics Engineering Lab**	-	-	-	-	-	25	25	50

Pre-requisite: Fundamentals of Physics and Mathematics

Lab Objectives:
Lab course aims to:

1. To **demonstrate** safe handling and measurement of electrical quantities using real-world instruments (voltmeter, ammeter, multimeter).
2. To **experiment** with DC and AC circuits and evaluate their behavior in energy-efficient systems.
3. To **visualize** the construction and operation of transformers and motors used in smart infrastructure and mechanical systems.

4. To **analyze** the application of diodes and transistors in lighting, control, and automation systems.
5. To **develop** a practical understanding of electrical systems integrated into buildings, machinery, and public infrastructure.

Lab Outcomes:

After successful completion of the course, students will be able to:

LO1: **Operate** and interpret electrical measuring instruments used in field applications and industry-grade machinery.

LO2: **Construct** and test basic DC and AC circuits and interpret the behavior of resistive, inductive, and capacitive loads..

LO3: **Demonstrate** the working of transformers and assess their role in decentralized and sustainable power distribution.

LO4: **Inspect** the construction and function of motors commonly used in HVAC, lifts, cranes, and water pumping systems.

LO5: **Use** diodes (Zener, LED) and transistors (BJT, FET) in control circuits for energy-efficient lighting and automation.

LO6: **Apply** safety protocols in handling and testing electrical systems in real-life civil/mechanical engineering contexts.

List of Experiments:

Sr No	List of Experiments	Hrs.	LO Mapping
1	Introduction to lab safety, measuring instruments (voltmeter, ammeter, DMM, oscilloscope).	2	**LO1**
2	Verification of mesh and nodal analysis using resistive networks.	2	**LO1**
3	Verification of Superposition, Thevenin's and Norton's theorems in DC circuits.	2	**LO1**
4	Analysis of single-phase RLC circuit to determine impedance and phase angle.	2	**LO2**
5	Observe three-phase voltage relationships in star and delta connections using simulation tools.	2	**LO2**
6	Demonstration of a cut-out section and working of a single-phase transformer.	2	**LO3**
7	To visualize and understand motor types used in mechanical systems	2	**LO4**
8	To study regulation capability of Zener diodes for stable power supply.	2	**LO5**
9	To explore LED behavior and suggest efficient lighting systems	2	**LO5**
10	To demonstrate transistor use in control and amplification.	2	**LO6**

11	Construct a common emitter amplifier and measure gain using a signal generator.	2	**LO6**
12	Optional: Design a Simple Relay-Based Automation Circuit	2	**LO6**

Online Resources:

Sr. No.	Website Name
1	All About Circuits (https://www.allaboutcircuits.com)
2	Circuit Lab (https://www.circuitlab.com)
3	Tinkercad (https://www.tinkercad.com)

Suggested assignments:

Sr. No.	List of Assignments(Any 6)	Hours
1	Solve numerical problems related to Mesh and Nodal analysis; include a task to simulate power-saving networks using simulation tools like Tinkercad/CircuitLab.	2
2	Assign real-world cases (like mobile chargers, IoT sensors) to relate theory with efficiency and power optimization.	2
3	Research and report on transformer use in smart grids and renewable energy systems. Include a simple design analysis of a power adapter.	2
4	Study use-cases of motors in electric vehicles, industry automation, and BLDC motors in smart homes. Include a comparative table of energy efficiency.	2
5	Assignment on Zener and LED diodes.	2
6	Explain BJT and FET in switching and amplification	2
7	**Case Study**: "Electrical Systems in Sustainable Campuses"	2
8	**Research Brief**: "Electronics Waste and Sustainability"	2

Assessment:

- **Term Work:** Term Work shall consist of at least 08 to 10 practical based on the above list. Also, Term work Journal must include at least 6 assignments.
- **Term Work Marks:** 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)
- **Practical & Oral Exam:** An Oral & Practical exam will be held based on the above syllabus.

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30)
16121105	C and C++ Programming Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT1 +IAT 2				
16121105	C and C++ Programming Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To introduce students to the fundamental programming constructs of C and provide hands-on experience with writing, compiling, debugging, and executing simple programs using an IDE.
2. To enable students to develop modular and efficient C programs by exploring functions, recursion, and arrays, enhancing their understanding of data management.
3. To familiarize students with advanced C programming concepts such as structures, pointers, dynamic memory allocation, for effective data storage and manipulation.
4. To provide comprehensive exposure to object-oriented programming in C++ focusing on classes, objects, constructors, destructors.

5. To deepen understanding of advanced object-oriented concepts in C++ including inheritance, polymorphism, virtual functions, and abstract classes for designing flexible software solutions.
6. To guide students in designing and implementing an object-oriented system in C++ that integrates key programming concepts for practical application.

Lab Outcomes: At the end of the course, the student will be able to

1. **Analyze and apply** fundamental programming constructs in C using Code::Blocks IDE to develop, compile, debug, and execute programs that implement input/output operations, operators, and control flow structures such as branching, looping, and nested decisions.
2. **Apply and evaluate** the use of functions, recursion, and arrays (including strings) in C programming to design modular and efficient programs that demonstrate data management and manipulation.
3. **Analyze and implement** advanced C programming concepts including structures, pointers with dynamic memory allocation, manage complex data efficiently in real-world applications.
4. **Apply and analyze** core object-oriented programming concepts in C++ including classes, objects, constructors/destructors, and implement polymorphism to develop reusable and efficient code.
5. **Analyze and implement** advanced object-oriented programming concepts in C++ including various inheritance types, virtual functions for runtime polymorphism, and abstract classes with pure virtual functions to create flexible and extensible software designs.
6. **Design, implement, and evaluate** a C++ object-oriented program that models an object-oriented system by applying advanced concepts for efficient data handling and processing.

R-2025- Mechanical Engineering

Suggested list of Experiments:

Sr No	List of Experiments	Hrs.
01	To understand the structure and features of the Code::Blocks Integrated Development Environment (IDE) and to use it effectively for writing, compiling, debugging, and executing C and C++ programs, which will serve as the foundational tool for all further experiments in the lab.	2
02	a) Program to demonstrate operations of Data Input and Output – getchar( ), putchar( ), scanf( ), printf( ), gets( ), puts( ) b) Program to demonstrate Operators-Arithmetic, Relational and logical, Assignment, Unary, Conditional, Bitwise, Comma, other operators.	2
03	Program to demonstrate Branching - If statement, If-else Statement, Multiway decision.	2
04	Program to demonstrate Nested control structure- Switch statement, Continue statement, Break statement, goto statement	2
05	Program to demonstrate Looping – for and nested for loop	2
06	Program to demonstrate Looping – while, do-while	2
07	a) Implement an iterative function for factorial/ Fibonacci etc. b) Implement a recursive function for factorial/ Fibonacci etc.	2
08	Program to demonstrate Array 1D	2
09	Program to demonstrate Array 2D	2
10	Program to demonstrate String and arrays of string.	2
11	Program to demonstrate Structure: Write a program to store and display information of a student/employee etc. using structures a) Define a structure, b) Read and store details, c) Display the stored information.	2
12	Program to demonstrate call by value and call by reference.	2
13	Program to demonstrate the use of classes and objects, constructors and destructors in C++	2
14	Program to demonstrate Single, multilevel, and hybrid inheritance using classes	2
15	Create a system that stores and displays student records including name, roll number, marks for 3 subjects, and computes total marks, average, and grade. Implement the following: 1. A base class Person with attributes: name, roll_no 2. A derived class Student with: Subject marks (e.g., marks[3]) 3. Member functions to input and display data 4. Functions to calculate total, average, and assign grade 5. Use constructors for initialization and destructors to display a message upon object destruction. 6. Use function overloading for displaying summary (e.g., detailed vs	2

	short view). 7. Implement operator overloading (e.g., == to compare two students by roll number or marks). 8. Use virtual function in a base class ResultCalculator and override in Student class. 9. Use an array of objects to manage multiple student records.	

Sr No	List of Assignments / Tutorials	Hrs
01	Flowcharts for programs, input/output operations, operators, and control flow structures such as branching, looping, and nested decisions	2
02	Use of functions, recursion, storage classes, and arrays (including strings) in C programming	2
03	Structures, pointers with dynamic memory allocation	2
04	Core object-oriented programming concepts in C++	2
05	Advanced object-oriented programming concepts in C++ including various inheritance types, virtual functions for runtime polymorphism, and abstract classes with pure virtual functions	2
06	C++ object-oriented program that models an object-oriented system by applying advanced concepts for efficient data handling and processing	2

Text Books

1. "Programming in C", by Pradeep Dey and Manas Ghosh, Oxford University Press.
2. "Object Oriented Programming with C++" by E. Balagurusamy, McGraw Hill Education**.**
3. "Basics of Computer Science", by Behrouz Forouzan, Cengage Learning.
4. "Programming Techniques through C", by M. G. Venkateshmurthy, Pearson Publications.
5. "Programming in ANSI C", by E. Balagurusamy, Tata McGraw-Hill Education.
6. "Let Us C", by Yashavant Kanetkar, BPB Publications.

Reference Books

1. "The C Programming Language" by Brian W. Kernighan and Dennis M. Ritchie,Prentice Hall.
2. “Programming: Principles and Practice Using C++” by Bjarne Stroustrup, Addison-Wesley
3. "C Programming: A Modern Approach" by K. N. King, W. W. Norton & Company.
4. "C Primer Plus" by Stephen Prata, Addison-Wesley Professional.
5. "Programming in C" by Stephen G. Kochan, Addison-Wesley Professional

Online Resources:

Sr. No.	Website Name
1	Learn C - This website offers a free, interactive tutorial to learn C programming, covering both basic and advanced topics.
2	Codecademy - Codecademy provides a comprehensive, interactive course for learning C, complete with real-world projects and skill paths.
3	Coursera - Coursera, in collaboration with Duke University, offers a specialization in C programming, including hands-on projects and a certificate upon completion.
4	edX - This course, offered by edX, covers C programming with a focus on Linux, including professional certification.

Assessment:

- **Term Work:** Term Work shall consist of at least 10 to 12 practicals’ based on the above list. Also, Term work Journal must include at least 2 assignments.

- **Term Work Marks:** 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

- **Practical & Oral Exam:** An Oral & Practical exam will be held based on the above syllabus.

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30)
16612110	**IDEA LAB - (Innovation Design Engineering and Apply)**	1	--	2	15	--	30	15	60	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT1 + IAT 2				
16612110	**IDEA LAB - 1(Innovation Design Engineering and Apply)**	--	--	--	--	50	50	100

Rationale:

Aligned with the National Education Policy (NEP) 2020, the institution emphasizes experiential, interdisciplinary, and project-based learning through the IDEA Lab—a central hub for hands-on innovation.

To strengthen the undergraduate research ecosystem, the institution has adopted a theme-based academic model aligned with UN SGD. Each semester features six curated problem statements based on local need and aligned with core subjects in the same semester, enabling students to apply classroom knowledge to real-world challenges. Every student selects one problem and develops an individual, subject-integrated solution—enhancing both academic understanding and research skills.

The IDEA Lab supports this initiative with facilities for design thinking, prototyping, and product development. Students maintain a project logbook throughout the semester to track their progress and reflections.

To ensure academic accountability, a two-tier assessment framework is implemented:

- Project Assessment based on standardized IDEA Lab rubrics.
- Subject-Based Term Work Assessment focused on the application of same-semester subject knowledge in the project.

Lab Objectives:

1. To promote experiential and project-based learning that bridges theoretical knowledge with real-world problem-solving.
2. To encourage interdisciplinary integration by enabling students to apply concepts from multiple subjects within a single cohesive project.
3. To develop innovation and design thinking skills through hands-on activities and iterative solution development.
4. To foster critical thinking and creativity by engaging students in open-ended problems with multiple solution pathways.
5. To enhance communication, collaboration, and documentation skills essential for professional engineering practice.
6. To build an entrepreneurial and research mindset by guiding students to develop scalable, socially-relevant, and technically viable prototype

Lab Outcomes: Student will be able to

1. Recall and articulate key concepts from core and allied subjects relevant to the assigned project.
2. Explain the interdisciplinary nature of the problem and the role of each subject in addressing it.
3. Apply appropriate tools, techniques, and theoretical knowledge to develop project components.
4. Analyze problem constraints and user requirements to structure a feasible and efficient solution.
5. Evaluate multiple design options and justify the chosen solution based on technical and practical considerations.
6. Create a functional prototype or solution that demonstrates innovation, utility, and integration of interdisciplinary knowledge

1) Guidelines for IDEA Project

a) Project Guidelines (Interdisciplinary Project Execution in IDEA Lab)

- Each student works on an individual interdisciplinary project aligned with the semester theme.
- Faculty in-charges for the IDEA Lab are assigned according to the complexity of the project and the capacity of the respective departments.
- Faculty in-charges mentor both the academic and technical aspects, and track weekly progress.
- Project assessment will be rubric-based, ensuring depth, innovation, documentation, and ownership.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- Faculty in-charges must attend relevant FDPs to ensure uniformity in mentoring and

evaluation.

b) Guidelines for same semester Subject Concepts Applied within the Project

- Termwork for each subject will partially reflect how well a student applies subject-specific concepts in their interdisciplinary project.
- Internal assessment panel will collaborate to align project components with subject learning outcomes.

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c) Role of Faculty In-Charges in IDEA Lab Projects

Faculty in-charges play a pivotal role in the success of interdisciplinary, theme-based projects under the IDEA Lab. Their responsibilities extend beyond technical supervision to include academic alignment, innovation facilitation, and active student engagement. Their key roles include:

1. **Motivating and Inspiring Students**
   - Encourage students to take ownership of their learning and projects.
   - Cultivate a mindset of curiosity, exploration, and social relevance.
   - Foster an environment where students feel empowered to take creative risks.
2. **Conducting Brainstorming and Ideation Sessions**
   - Organize structured brainstorming sessions at the start of the semester to help students define their problem statements and solution pathways.
   - Promote collaborative thinking, design exploration, and interdisciplinary integration.
3. **Arranging Guest Lectures and Expert Talks**
   - Identify and invite industry experts, researchers, and innovators for guest lectures aligned with the semester's theme or subject areas.
   - Facilitate exposure to real-world challenges, current trends, and future opportunities.
4. **Ensuring Uniqueness and Originality of Projects**
   - Actively review proposed ideas to ensure **no duplication of solutions** across students.
   - Encourage students to explore novel approaches, technologies, and perspectives.
5. **Promoting Discussion and Collaborative Learning**
   - Create platforms for students to present, discuss, and receive peer and mentor feedback.
   - Facilitate idea refinement through regular discussions and group engagement.

6. **Aligning Subject Content Beyond Syllabus**
    - Faculty in-charges must **align subject content beyond the syllabus of the same semester** with the **IDEA Lab theme and assigned problem statements**.
    - This ensures relevance, depth, and meaningful interdisciplinary integration.
7. **Same Semester Faculty Requirement**
    - Faculty in-charges must be teaching subjects in the **same semester** as the students' project to ensure seamless academic integration and contextual understanding.
8. **Monitoring and Documentation**
    - Oversee project logbook maintenance, milestone tracking, and submission of progress reports.
    - Provide ongoing feedback and ensure project alignment with learning outcomes.
9. **Coordination with Subject Faculty**
    - Work in collaboration with other subject faculty to help students embed theoretical and practical aspects of their coursework into the project.
    - Facilitate subject-term mapping and contribute to termwork assessment based on evidence.

2) Implementation Strategy

a) Project Implementation in IDEA Lab

Aspect	Implementation Strategy
Faculty in-charges	**Faculty in-charges assigned based on project nature and department capacity.**
Mentoring Role	**Faculty in-charges oversee academic/technical development, interdisciplinary integration, and timely documentation.**
Capacity Building	**Faculty in-charges undergo workshops on design thinking, innovation, assessment rubrics, and outcome-based mentoring.**
Assessment Contribution	**Faculty in-charges contribute to 25 marks allocated for the IDEA Lab project termwork. The remaining assessments are conducted by the external examiner.**
Recognition & Incentives	**Faculty in-charges receive workload credits or are formally acknowledged in performance reviews.**

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b) Implementation of Subject-Term Work Mapping within Projects

Aspect	Implementation Strategy
Mapping Subject Outcomes	**Faculty in-charges align their content beyond syllabus with the student's project by coordinating with the assigned project guide.**
Independent Evaluation	**Internal assessment panel evaluate students based on their application of subject-specific concepts within the project. This contributes to a** separate 25 marks allocated for termwork based on subject **application.**
Evidence Sources	**Evaluation is supported by project logbooks, subject-specific deliverables (e.g., tools, simulations, models), and review presentation inputs.**
Outcome Assurance	**Ensures practical demonstration of subject understanding and its integration into the interdisciplinary solution.**

Implementation Notes:

- Guide faculty assess their course's contribution using specific evidence such as:
  - Logbooks
  - Subject-specific outputs (e.g., simulations, designs)
  - Paper publications or review presentations

2) Guidelines for Assessment

Two-tier rubrics are applied independently to evaluate subject concept application and innovation within the project.

a) Assessment of IDEA Lab Projects (Individual Interdisciplinary Projects) (25 Marks)

Presentation-Based Assessment Structure (Total: 25 Marks)

Assessment Month	Weightage	Marks
Month 1 (Formative 1)	20%	5 marks
Month 2 (Formative 2)	40%	10 marks
Month 3 (Formative 3)	40%	10 marks

Rubric-Based Evaluation Criteria

Criteria	**Month 1 (5)**	**Month 2 (10)**	**Month 3 (10)**
Problem Understanding	Connects problem to subjects	Defines interdisciplinary scope	Demonstrates deep conceptual grasp
Subject Knowledge Application	Identifies relevant concepts	Applies principles in design	Integrates multiple subject areas correctly
Innovation & Design Thinking	Proposes creative idea	Develops and tests feasible solution	Final solution shows originality and utility
Documentation & Presentation	Logbook initiated, plan presented	Mid-design log and visuals	Final report and demo completed
Progress & Ownership	Meets deadlines, shows planning	Demonstrates self-motivation	Completes project independently with reflection

b) Term Work Assessment of Subject Concepts Applied in Projects (25 Marks)

Applicable to All Subjects Integrated with Interdisciplinary Projects

To reflect meaningful application of subject knowledge, each subject will be assessed through the following rubric:

Criteria	**Marks**	**Description**
Subject Knowledge Application	8	Depth and accuracy of concept integration into the project
Practical Design or Tool Usage	5	Use of subject-specific hardware/software/simulation/tools
Documentation	4	Quality and clarity of subject-related logs and reports
Viva/Presentation	4	Ability to explain subject's relevance and role in the project
Continuous Engagement	4	Evidence of consistent participation via logbooks and feedback

c) Total Assessment Structure

Component	Marks	Assessed By
Termwork – Project Execution	25 Marks	Project Guide
Termwork – Application of Subject Concepts	25 Marks	IDEA Lab Panel
Viva Voce (Final Evaluation)	50 Marks	External Examiner

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30)
16412111	Engineering Workshop I	--	--	2	--	--	30	15	45	1.5

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT1 +IAT 2				
16412111	Engineering Workshop I	--	--	--	--	25	—-	25

Lab Objectives:

1. To understand and apply the fundamental safety practices, rules, and precautions necessary for working in an engineering workshop environment.
2. To perform basic carpentry operations such as measuring, marking, cutting, chiseling, planning, and joining.
3. The objective is to enable students to understand the properties of sheet metal, practice precision in fabrication, and ensure adherence to safety procedures throughout the process.
4. To develop foundational skills in computer hardware assembly, maintenance, and troubleshooting, and managing computer networks.
5. To explore and develop proficiency in using Google Workspace tools and to create and publish a functional website using Google Sites.
6. To develop practical skills in using Microsoft Excel and to study and execute AI-powered features in Microsoft Excel.
7. To learn the basic concepts and perform steps of PCB fabrication in electronic circuits.

Lab Outcomes: At the end of the course, the student will be able to

1. Understand and follow standard safety rules and operating procedures for tools and machinery.
2. Able to Create basic carpentry joints (e.g., lap joint, mortise and tenon joint, dovetail joint) with proper fit and finish
3. Able to perform bending and folding operations to form the sides of a square tray with correct angles and dimensions.
4. Able to assembling and disassembling a personal computer and trouble shoot common hardware issues.
5. Able to navigate and utilize core google workspace and integrate google workspace tools into a google sites.
6. Able to use basic to advance excel function **and** to use AI-powered features in Excel
7. Able to understand basic components and demonstrate the process of PCB fabrication.

Detailed Syllabus

Sr No	Name of Module	Detailed content	Hours	Lo
	Safety and Precautions	Lab safety rules and personal safety rules.	**2**	**LO1**
1	**Fabrications**	Introduction to carpentry sections ● Introduction to carpentry tools, types of woods etc. ● TEE LAP joint experiment Introduction to Sheet metal section ● Introduction to sheet metal, materials and procedure etc. ● Square Tray Experiments.	**4** **4**	**LO2** **LO3**
		Self-Learning Tool Handling Techniques To study about the types of wood To study about different job in sheet metal To gain knowledge of tools and techniques used in Sheet metal process https://youtu.be/eoiwdcqHT8o?feature=shared https://youtu.be/jH8nSv-pNuw?feature=shared	**3**	
2	**Hardware and Networking**	Introduction to Computer Hardware ● Computer Fundamentals	**2**	**LO4** **LO5**

		Introduction to computers Types of computer Components of computer Input/output devices Storage devices ● Computer Hardware Motherboard architecture Processor types and features RAM types and installation Power supply and units Assembling a computer BIOS/UEFI Configuration Common Troubleshooting issues Installation of LINUX/WIN 11 (DUAL) VM WARE (Installation) Bootable PD (Installation) Google Workspace and Google Sites ● Introduction to google Workspace ● Gmail, Email etiquette, labels, filters ● Google Drive : Upload, organize, share ● Google Docs/slides:Collaborate in real time, insert images, comments and tables. ● Google Forms ● Getting Start with Google Sites ● Building basic website ● Creating Multiple pages Microsoft Excel For Engineers and integrate with AI ● Excel interface, data entry, formatting basics ● Formulas and fabrication ● Charts and graphs ● Data sorting and filtering ● Getting started with Excel ● Data Analysis and visualization ● AI in Excel	**2** **2** **2**	**LO6**
		Self-Learning **1.** Study and Report on Motherboard Components and Layout **2.** Create a Maintenance Plan for a Personal Computer	**6**	

		3. Research BIOS/UEFI Functions and Configuration Options (Provide screenshots and describe real-world use cases. **4.** Design a Small Office/Home Office **5.** Create and Share a Collaborative Google Doc **6.** Organize Files and Folders in Google Drive Design a Mini-Website for a School Club, Event, or Business Idea		
3	**Introduction to PCB**	Electronic Components and tools for measuring and debugging electronics circuits. ● Active and Passive components ● Breadboard to built simple circuits. ● Soldering Practices. ● Reading and interpreting circuit diagrams ● Multimeter ● Oscilloscope 8050 and DS0 ● Function generator ● Logic Probe/logic analyzer (demo) PCB Design and fabrication ● Wiring system ● Go-down wiring ● House Wiring ● Staircase wiring ● Introduction To PCB design Software ● Drawing a simple schematic PCB layout and routing techniques	**6** **6**	**LO7**
		Self-learning 1. Component Identification and Research (real –life example). 2. Resistor Color Code Practice (learn the resistor color code system) 3. Datasheet Study (Download the datasheet for any 1 component and identify write configuration) 4. Breadboard Familiarization (Watch a tutorial or read a guide on how a breadboard works.)	**6**	

Reference Books

1. A Course in Workshop Technology Vol. 1: Manufacturing Processes by B. S. Raghuwanshi
2. Elements of Workshop Technology Vol. 1: Manufacturing Processes by S. K. Hajra Choudhury & A. K. Hajra Choudhury
3. Complete PCB Design using or CAD Capture and PCB Editor by Kraig Mitzner.
4. Computer Hardware and Networking by Rajiv Chopra.
5. Google Sheets for Beginners: A Practical Guide to Mastering Google Sheets by Nathan George.
6. Google Workspace User Guide by Oliver Kent.

Online Resources

Sr No	Reference
1	https://onlinecourses.swayam2.ac.in/cec25_cs10/preview Computer Fundamentals, By Prof. Sanjay Tanwani.
2	https://onlinecourses.swayam2.ac.in/nou25_cs01/preview -CIT-001: Fundamentals of Computer Systems, By Dr. Mangala Prasad Mishra
3	https://onlinecourses.swayam2.ac.in/aic20_sp59/preview -ESim - EDA tool for circuit design, simulation, analysis and PCB design, By Prof Kannan Moudgalya
4	https://onlinecourses.nptel.ac.in/noc25_ee163/preview -Electronic Systems Design: Hands-on Circuits and PCB Design with CAD, By Prof. Ankur Gupta
5	https://onlinecourses.swayam2.ac.in/imb25_mg206/preview Excel for Finance - From Basics to Advanced, By Dr. Premalatha K P

Suggested list of Experiments:

Sr No	List of Experiments	Hrs.
01	Safety and precaution	2
02	TEE LAP Joint	4
03	Square tray	4
04	PCB Design and Fabrication	6

05	Assembling and dissembling of computer .(Demonstration)	2
06	To solve Common Troubleshooting problem solving.	2
07	Installation of LINUX/WIN 11 (DUAL) (Demonstration)	2
08	To create a google form for simple survey or quiz.	2
09	To create grade sheets or expense tracker	2

Assessment for Term Work (25 marks)

- **Term Work Marks:** 25 Marks (Total marks)
- **Job and Manual**:- 20 Marks
- **Regularity and active involvement:-** 5 Marks

R-2025Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C)
		L	T	P	L	T	P	SL	Notional Learning Hour	(Notional Learning Hour/30
98461112	Universal Human Values	2	-	-	30		-	30	60	2

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
98461112	Universal Human Values	-	-	-	-	-	25	-	25

Rationale: The goal of the education system is to cultivate well-rounded individuals who are capable of rational thinking and action, as well as empathy and compassion. It strives to nurture ethical values and principles, shaping responsible citizens who can contribute to creating an inclusive, equitable, and diverse society, as envisioned by our Constitution. Education should focus not only on intellectual growth but also on developing social, ethical, and emotional intelligence. Ultimately, education is essential for unlocking human potential and fostering a just and fair society. A fair combination of holistic and multidisciplinary education would develop human beings wide intellectual, deep aesthetic, social, physical, emotional, and moral in an integrated manner. UHV courses are intended to help students to develop a holistic, humane world vision for adopting fair technological advancements. The modules structured to be discussed are universal, rational, and verifiable, hence leads to harmony.

R-2025Mechanical Engineering

Course Objectives:

1. To develop a holistic perspective based on self-exploration about them (human being),
2. To understand the meaning of harmony in relationship family with reverence and compassion
3. To explore a wide range of social networking ensuring mutual happiness and prosperity
4. To identify the urge to establish global peace and harmony to make the world a better place to live.
5. To understand the threats posed by human activities to biodiversity, and provide solutions
6. To develop understanding in implementing technologies to serve mankind.

Course Outcomes:

After successful completion of the course learner will be able:

1. Identify innate humanistic virtues and abilities as fundamentals to work as an individual.
2. Explore solutions to behavioral conflicts through family, a society in miniature with empathy.
3. Develop understanding to maintain human-human relationship for mutual happiness for building great teams.
4. Adapt for global pursuits in a peaceful co-existence with the entire mankind for global society uplift.
5. Acquire awareness of maintenance and conservation of biodiversity to provide sustainable solutions.
6. Evaluate the knowledge of 'Real Self ' augmenting universal human order to develop holistic technologies and creating congenial work environments.

Prerequisite: There is no prerequisite for this course.

R-2025Mechanical Engineering

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	There is no prerequisite for this course.		
I	Holistic Growth of Individual	Understanding the Human Being: Body, mind, and self – their roles and needs, Distinction between the self (conscious entity) and the body, Importance of self-reflection and self-awareness Developing clarity about personal goals and values, Emotional intelligence: managing thoughts and feelings. Lifestyle choices that support well-being Integrating knowledge with ethics and values **Self-Learning Topics**: Analyze yourself thoroughly and discover your personality traits: Behavioral, Habitual and Acquired traits and record the significance of the traits in handling diverse situations in your past and present life.	4 4	CO1
II	Self-Harmony & Family Values	Prosperity - a right identification of needs and fulfillment through right means What is *naturally acceptable* (permanent, universal) vs. what is acquired or conditioned. Family - a space for value cultivation and emotional support, Mutual fulfillment addressing Common Family Issues: Balancing individuality and togetherness, Misunderstandings due to Assumptions, Generational gaps and communication barriers. Trust empathy, and open communication in family relationships. Family as a Basic Unit of Society, Joint versus nuclear family structures and their social impact. **Self-learning Topics**: Importance of Respect and. Compassion in families, relations, neighborhood, how family harmony helps to progress and attain a worthy and respectable social and financial status. Togetherness and advancement, Conflict and resolution	4 4	CO2
III	Social Equilibrium	Human-Human relationship, Respecting others and their perspectives, Understanding the difference between *intention* and *competence.* Vision of a universal human order (Sarvabhauma Vyavastha) based on trust and mutual prosperity. Promotion of dialogue, cooperation, and peaceful coexistence. Individuals and groups work together for common goals and shared well-being. Visualizing a universal harmonious order in	5	

		society- Undivided Society, Universal Order from self to community Mutual Prosperity. Support and Empower marginalized communities **Self-Learning Topic:** A positive and unbiased Mediation and dialogue, and its importance Different communities' views for creating better communities & societies. Incidents happening around you which urgently require social equilibrium as a vision.	5	CO3
IV	Shared Values of Mankind	Values accepted and upheld by all human beings regardless of background, peaceful coexistence and global harmony. Role in addressing global challenges like conflict, inequality, and environmental crises, Philosophical and spiritual traditions worldwide. Human rights frameworks (e.g., Universal Declaration of Human Rights). Sensitizing individual towards Contemporary World Issues **Self Learning Topic:** India's relationships with other countries. Promoting peace and harmony hence preventing conflict situations. Conflict situations throughout the world where India as a one who maintained its integrity by following its traditional, philosophical and ethical standard.	6 6	CO4
IV	Human-Nature Relationship	Humans as caretakers of the Earth, not conquerors. Ethical choices like wildlife conservation, habitat preservation, and reducing pollution. Promoting humane treatment in agriculture, research, entertainment, and daily life. Sustainable living: reducing waste, recycling, and using renewable energy. Educating communities about the importance of biodiversity and ecosystem health. **Self-Learning Topics**: Practices adopted in ancient India for preserving the environment, Importance of rivers, trees, water mentioned in Indian scriptures and culture. Modern technologies/practices favoring ecosystem preservation. (Past Practices Vs, Present Practice)	6 6	CO5
VI	Integrating universal	Meaningful and Purposeful Work: Encouraging dignity in all types of jobs. Human creativity and contribution to society. Equal opportunities without discrimination. Prioritizing human well-being over mere profit.		

	human values in the workplace	Technical education is enriched with ethics and human-centric values. Ethical behavior includes not exploiting others for personal gain—whether as employers or consumers. Ability to identify and develop appropriate technologies and management patterns for production systems. Case studies of typical holistic technologies, management models and production systems. **Self-Learning Topics:** Contemporary workplace scenario Confronting challenges like globalization, technological advancement/disruption cultural diversity, workplace prejudice .unconscious bias. Hampering output and how universal human values helps erasing these complexities.	5 5	CO6

References:

1. Gaur, R. R., Sangal, R., & Bagaria, G. P. (2009). *A Foundation Course in Human Values and Professional Ethics*. New Delhi: Excel Books.
2. Ravindran, P. S. (2007). *Essence of Human Values and Professional Ethics*. Chennai: Sri Ramakrishna Math.
3. Gaur, R. R. (2011). *Human Values and Professional Ethics*. New Delhi: Dhanpat Rai Publishing Company.
4. Chitkara, M. G. (2002). *Education and Human Values*. New Delhi: A.P.H. Publishing Corporation.
5. Martin, M. W., & Schinzinger, R. (2005). *Ethics in Engineering* (4th ed.). New York: McGraw-Hill.
6. Gandhi, M. K. (1927). *The Story of My Experiments with Truth*. Ahmedabad: Navajivan Publishing House.
7. Vivekananda, S. (Compilation). (2001). *I and My Nation*. Kolkata: Advaita Ashrama.
8. AICTE (2020). *Towards a Holistic Development: A Collection of Good Practices in UHV*. New Delhi: All India Council for Technical Education.

Online References:

Sr. No.	Website Name
1.	https://uhv.org.in/

R-2025Mechanical Engineering

Term Work: 25 Marks

Assignments – 20 Marks

Attendance 5 Marks

Conduct Group Speaking Activities to explore and comprehend the basic human and global society issues.

(In group speaking activity, especially, conduct discussions on Contemporary World Issues, Contemporary workplace challenges enabling students to think and suggest solutions on humanitarian ground)

List of Assignments (Answer the questions about in 500 words)

1. Explain the process, content, and natural outcome of self-exploration with a neat diagram and two examples from your life.

2. Analyze the impact of compassion on mental health. Describe the role of family in the development of an individual.

3. Describe the concept of an undivided society and the universal order and explain how both these can help to create a world family.

4. What do we mean by holistic technologies, management models, and production systems? How are these useful for mankind?

5. Explain the concept of co-existence in nature. How can this understanding help in addressing environmental issues?

6. Design a program to promote respect in the workplace where people treat each other with respect and have equal opportunities for growth.

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C)
		L	T	P	L	T	P	SL	Notional Learning Hour	(Notional Learning Hour/30)
16421113	Strategic Communication & Management Skills	1	--	--	15	--	--	15	30	1

		Theory					Term Work	Pract Exam	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
16421113	Strategic Communication and Management Skills	20	20	40	40	1	-	-	80

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R-2025- Mechanical Engineering

Rationale:

The course has been redesigned specifically for mechanical and civil engineering students, equipping them with strategic oral and written communication skills necessary for today's enterprise and entrepreneurial environment. Students will learn to simplify complex engineering concepts and messages, understand key communication models. These skills are essential for mechanically and civilly focused professionals to confidently interact with project stakeholders, clients, and public audiences, while also reinforcing their organization's brand image and reputation through transparent and effective communication. The curriculum strengthens all four LSRW competencies—Listening, Speaking, Reading, and Writing—ensuring engineers communicate with clarity, confidence, and flair in professional contexts.

Course Objectives - The learners should be able to:

1. Effectively explore the dynamics of communication and navigate professional arenas
2. Competently acquire active listening skills by comprehending physical and digital content
3. Critically analyse communication barriers, audience and purpose to speak proficiently
4. Minutely comprehend extensive texts, technical and non-technical, to execute relevant tasks
5. Efficiently organize and create purposeful technical writing for professional transactions
6. Impact fully relate with other agencies with ethical standards to deliver synergistic solutions.

Course Outcomes - The learners will be able to:

1. Explore and adapt the dynamics of communication to navigate diverse professional arenas.
2. Acquire active listening skills by practicing different Speech Acts physically and digitally.
3. Analyse communication barriers, methods, audience and purposes for mastering eloquent and persuasive speaking.
4. Synthesize extensive technical and non-technical texts for reflective learning through reading and summarization.
5. Design digital, ethical technical and business content for professional transactions.
6. Advocate technical excellence and interpersonal acumen to disseminate relevant sustainable community solutions.

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R-2025- Mechanical Engineering

Prerequisite: Basic knowledge of English language

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic knowledge of English language.		
I	Communication Dynamics	Foundations of Communication Dynamics: Objectives Linear vs. Transactional Models Encoding, Decoding, and Feedback, Interpersonal Communication in Groups: Verba interaction : Meetings & Presentations, Teleconferences & Calls and Non-Verba Interactions: Proxemics, Haptics Oculesics Kinesics Digital Interaction: virtual teams, vide calls Formal and Informal communication Communication Channels . Barriers: Physical Semantic Psychological & Emotional Barriers Cultural & Contextual Barriers Silos mentality Hierarchical layers, Rigid policies, unclear channels, and outdated tech. **Self Learning Topics** Communication at Workplace &Outer Agencies Internal communications Regular email updates, Video conferencing and face to face sessions External Communication craft compelling narratives, multichannel fluency,Open dialogues, Trust and Transparency	5 5	CO1

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II	Active Listening	Active Listening: Discussions, and note-taking techniques. -book listening, Understanding colleagues' and clients during meetings Types of Listening Comprehensive Listening , Critical Listening and Reflective /Empathetic **Self-Learning Topics:** Listening kryptonite : Thought Distractions Semantic Jargons information overload, speaker pace, Pseudo listening & Interruptions Time Pressure, Fatigue/Emotions	2 2	CO2
III	Conversational Proficiencies	Technical Communication Skills Technical Discussion, delivering technical oral presentations inside and outside organizations Q&A, Design Review meetings, team coordination, troubleshooting and site visits **Self Learning Topics:** Mentoring and peer support , conflict resolutions and feedback conversations Grooming and Self Development: Interpersonal Engagement, Field and site interaction, Foster collaborations	2 2	CO3

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IV	Text Interpretation Expertise	Reading Proficiency Intensive Reading, ExtensiveReadingSkimming,Scanning,SQ5R Method *(Survey, Question, Reading, Recording, Recall, Review and Revise)*Industry Related Articles and Report, .Summarizing text to Graphic Organizers (GO) Cause and effect diagram, sequence chart and flow charts, Hierarchy or Tree Diagrams Problem–Solution Charts , Mind Maps Leveraging Online Resources Technical Reports ,Articles, Manuals, Product design specifications ,Tender documents, Infrastructure project reports **Self-Learning**: Manufacturing process flow descriptions, Technical proposals and feasibility reports, Professional and Industry News	2 2	CO4
V	Technical & Managerial Skills	Seven Cs of Business Writing Completeness, Conciseness, Consideration, Concreteness, Clarity, Courtesy, Correctness. Format & Types of Formal Letters : Cover Letter, Inquiry Letter Quotation/Order Letters Grievance Letter Short And Long Reports/ Proposals and business Cases Technical Manuals & Operating Guide Standard Operating Procedures (SOP) Tender notices **Self-Learning** : Studio Activities Content Creation for Social Media and e-Commerce Platforms Blogs, Vlog Keynote speeches Podcast titles Landing pages	3 3	CO5

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VI	Community Communication and Ethics	Communicating clearly with non-technical users and stakeholders Building supportive networks Promoting innovation and problem-solving Participating in user groups or tech meetups Gain encouragement and advice on technical or career challenges. Disaster management , Training of local public ,Rural Tech Projects Communication Transparency and Honesty Accountability Avoiding Misuse of Information Uphold **ethical standards** in all written, verbal, and digital communication. **Self-Learning** ethical decisions in materials sourcing or manufacturing, Client demo, Communicating during production failures, safety incidents, or delays	1 1	CO6

References:

1. Communication Skills by Sanjay Kumar & Pushp Lata
2. Business Communication with Writing Improvement Exercises. Hemphill, McCormick &Hemphill
3. Business Communication: Building Critical Skills by Locker, Kitty O. Kaczmarek, Stephen Kyo
4. Effective Business Communication by Herta Murphy
5. Technical Communication: Principles and Practice by Raman and Sharma
6. Effective Technical Communication: A Guide for Scientists and Engineers by Rizvi
7. Oxford Guide to Effective Writing & Speaking by John Seely
8. English Grammar by Raymond Murphy
9. Word Power Made Easy by Norman Lewis

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Online References:

Sr. No.	Website Name
1.	https://bbclearningenglish.org
2.	https://www.bbc.co.uk/learningenglish
3.	https://www.anmconsultants.com/role-communication-indian-corporate-culture/
4.	https://venngage.com/blog/white-paper-examples/

Assessment

IAT -I 20 marks

IAT-II 20 Marks

IAT -I - Independent Speaking Activity, where a student will deliver a three mins. Prepared speech on a Technical topic related to his program and a two mins. Impromptu speech on general topics.

IAT -II - Group speaking activity, Effective presentations on well-known company case studies, Industry reports and articles . Group members limit, 4-5 students in each group.

End Semester Exam will be of 40 marks. It will be a written exam that will cover all six modules
Question Paper will comprise a total of five questions each carrying 10 marks. Q.1 will be compulsory and should cover the maximum contents of the syllabus. Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)

A total of four questions need to be answered.

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Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C)
		L	T	P	L	T	P	SL	Notional Learning Hour	(Notional Learning Hour/30)
16422114	Strategic Communication and Management Skills LAB	-	-	2		-	30	-	30	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
16422114	Strategic Communication and Management Skills LAB	-	-	-	-	-	25	-	25

Lab Objectives: The learners should be able to:

1. Effectively explore the dynamics of communication for academic and professional excellence in diverse settings.
2. Positively acquire active listening skills through Speech Acts in different modes.
3. Thoroughly analyse communication barriers, audience and purpose to speak effectively at the workplace.
4. Minutely demonstrate technical and non-technical text to comprehend and discern the exact purposes.
5. Efficiently organize and create purposeful technical and business writings.
6. Successfully manage teams and individual tasks by applying ethical standards to execute the tasks.

Lab Outcomes: The learners will be able to:

1. Apply communication principles for excellence in academic and professional excellence in diverse setting.
2. Test listening capabilities for advanced listening strategies in physical and digital mode.
3. Evaluate and present ideas precisely to the audience in a confident way.
4. Demonstrate reflective learning through practicing extensive technical and non-technical texts.
5. Design digital technical and business write ups for professional and business transactions
6. Implement technical and managerial skills for future entrepreneurial prospects by confronting local communities and industries problems.

DETAILED SYLLABUS

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Basic knowledge of English language and ICT enabled media		

I	Communication Dynamics	Application of Communication Dynamics .Key Components of Strategic Communication, Shannon- Weaver Model at workplace. Strategic communication: Project Collaboration Platforms,Industry Reports, and Articles ,News Letter, Brand messaging paid media	4	LO1
II	Active Listening	Comprehensive Listening and Applications: Technical or Business podcasts, Youtube lecture on academic stuff/ processes/ procedures/ Development Plans Critical Listening: Cross disciplinary Listening (manufacturing, quality control marketing), Listening for safety: safety instructions and protocols. Warnings or risk factors Listening in Team Meetings: team updates and deadlines.	4	LO2
III	Conversational Proficiencies	Conversational Activities -I Self Introduction, Prepared Speech on Technical Topics and Impromptu Speech on General Topics Conversational Activities-II Simulation in communication:Role Play Activity for Client Interaction, Negotiation and Persuasion, Safety Communication Conversational Activities -III customer Communication, Cross-Cultural communication, Marketing & Brand Communication Handling Q&A in Presentation	8	LO3

IV	Text Interpretation Expertise	Prepare Diagram Organizers on: Summarising text to Graphic Organisers (GO) Cause and effect diagram, sequence chart and flow charts, Hierarchy or Tree Diagrams Problem–Solution Charts , Mind Maps Summarising text in point form after,Tender documents, Infrastructure project reports Manufacturing process flow descriptions, Professional and Industry News	4	LO4
V	Technical Writing Skills	Technical content: Technical Blog Short And Long Reports (PPT using Canva) Installation GuidesWriting Cover Letter, Inquiry Letter Quotation/Order Letters Grievance Letter Short Technical Manuals & Tender notices, Safety Signage Text Studio Activities: Content Creation for Social Media CMS - Wordpress to create, manage and publish content. e-Commerce Platforms Blogs, Vlog Podcast titles, Landing pages Social media posts	6	LO5

VI	Community Communicatio n and Management Skills	Local Area Visit, Field Visits. Local Manufacturing projects partnership with local groups , stem education Free workshop for residents of sustainable practices Surveys Feedback Analysis and Report Writing ,Providing solutions for Technical issues	4	LO6

Reference Books:

1. Communication Skills by Sanjay Kumar & Pushp Lata

2. Business Communication with Writing Improvement Exercises. Hemphill, McCormick & Hemphill

3. Business Communication: Building Critical Skills by Locker, Kitty O. Kaczmarek, Stephen Kyo

4. Effective Business Communication by Herta Murphy

5. Technical Communication: Principles and Practice by Raman and Sharma

6. Effective Technical Communication: A Guide for Scientists and Engineers by Rizvi

7. Oxford Guide to Effective Writing & Speaking by John Seely

8. English Grammar by Raymond Murphy

9. Word Power Made Easy by Norman Lewis

Online Resources:

Sr. No.	Website Name
1.	https://bbclearningenglish.org
2.	https://www.bbc.co.uk/learningenglish
3.	https://www.anmconsultants.com/role-communication-indian-corporate-culture/

R-2025- Mechanical Engineering

List of Experiments.

Sr. No	Name of Experiment	Hours
1.	Prepare a case study on strategic Communication in Select Indian Companies: Siemens ,Caterpillar Inc. Bosch AECOM, Jacobs Engineering Group	02
2	Listening Skill Activity Sheet containing minimum three types of listening activities from Lab Syllabus.	02
3	A. Continuous Evaluation of at least three types of the activities from Lab Syllabus for proficiency in oral communication/presentation	02
4.	a. Summary report and Graphic Organizers for the relevant scenario or situation b. Powerpoint / Slide Preparation on Industry Cases studies available online.	02
5.	Three Types of Letter Writing in prescribed format (Full Block) along with impressive email messaging Technical Writing , Manuals , Safety Instructions Digital Content Creation from Lab syllabus (Minimum two activities for writing skills should be done with documentation).	02
6.	Conduct field visits and local area visits Government and non-Government bodies, manufacturing plants, Green Building Projects ,Construction sites and ensure the implementation of your subject completely or partially for the smooth functioning. Conduct a Survey or get a feedback from outside agencies regarding the future inputs for synergistic solutions	02

Term Work - 25

Experiments/Practicals

10 experiments from all six modules will be conducted using a language lab , open source and must be documented well for final submission as a part of term work at term end. **20 marks**

Attendance -5 Marks

Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING
An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

F.E SEM II

SEM 2

Theme: "**Building Resilient and Resource-Efficient Systems for Sustainable Development**"

Aligned with **UNSDG 6- Clean Water and Sanitation, UNSDG 7: Affordable and Clean Energy, and UNSDG 11: Sustainable Cities and Communities**

Keywords: **core technical competence, practical experience, and computational thinking**

The theme " **Building Resilient and Resource-Efficient Systems for Sustainable Development** " is a powerful and relevant framework for core technical thinking in order to equip students with a solid foundation in engineering, deeply intertwined with the United Nations Sustainable Development Goals.

UNSDG 6- Clean Water and Sanitation

- **Comprehensive Skill Development:** The theme directly supports quality education by fostering a holistic set of skills: foundational knowledge, practical application, and analytical thinking. This goes beyond rote memorization, encouraging deep understanding and the ability to apply learning to complex real-world challenges.
- **Relevance and Future-Proofing:** By focusing on "sustainable futures," the curriculum becomes highly relevant to global challenges. It equips students with the skills needed to address critical issues like climate change, resource scarcity, and equitable access to resources, making their education future-proof and impactful.
- **Innovation and Creativity:** Hands-on learning and computational thinking encourage innovative problem-solving and creative design. Students are empowered to not just understand existing solutions but to develop new ones that are more sustainable and efficient.
- **Interdisciplinary Approach:** Addressing sustainable futures often requires interdisciplinary collaboration. A strong engineering foundation, coupled with an understanding of sustainability principles, prepares students to work across disciplines to find integrated solutions.

UNSDG 7: Affordable and Clean Energy

- **Comprehensive Skill Development:** To advance affordable and clean energy, individuals must be trained in a range of competencies including renewable energy technologies (solar, wind, bioenergy), energy efficiency strategies, smart grid systems, and sustainable infrastructure planning. Additionally, soft skills like project management, stakeholder engagement, and policy advocacy are crucial to drive implementation and scale-up of clean energy initiatives.
- **Relevance and Future-Proofing:** As the global energy landscape shifts towards sustainability, skill development must anticipate the rising demand for green jobs. Programs should integrate real-time industry needs and prepare individuals for evolving roles in energy storage, electric mobility, carbon-neutral systems, and energy equity. Future-proofing means equipping the workforce with adaptive learning strategies to remain resilient amid rapid technological and regulatory changes.
- **Innovation and Creativity:** Solving energy access challenges, especially in off-grid and underserved areas, requires innovative thinking. Creative solutions like decentralized renewable systems, energy-as-a-service models, and clean-tech startups are vital. Encouraging innovation enables the design of context-specific technologies that are affordable, scalable, and sustainable.

- **Interdisciplinary Approach:** Achieving SDG 7 demands collaboration across engineering, environmental science, economics, social policy, and data science. Energy solutions must integrate technical design with policy frameworks, community behavior, and financial models. This interdisciplinary approach ensures more inclusive and effective energy systems that consider environmental, social, and economic dimensions.

UNSDG 11: Sustainable Cities and Communities

- **Comprehensive Skill Development:** Creating sustainable cities requires a diverse set of skills across urban planning, sustainable architecture, green infrastructure, transportation systems, waste management, and disaster resilience. Additionally, skills in stakeholder engagement, data analysis, and community participation are essential to ensure that development is inclusive, equitable, and responsive to local needs.
- **Relevance and Future-Proofing:** Urban populations are growing rapidly, and cities must adapt to challenges such as climate change, migration, housing shortages, and infrastructure strain. Equipping professionals and citizens with future-oriented skills—like smart city technologies, climate-resilient design, and circular economy principles—ensures urban systems remain livable and resilient in the face of uncertainty and change.
- **Innovation and Creativity:** Sustainable urban development thrives on innovative approaches to housing, mobility, public space, and resource use. Solutions like green roofs, community-driven urban farming, micro-mobility, and digital urban management tools rely on creative thinking to reimagine how cities can function more sustainably while enhancing quality of life.
- **Interdisciplinary Approach:** Sustainable cities are shaped at the intersection of multiple fields: urban planning, engineering, public health, environmental science, economics, and social policy. An interdisciplinary approach allows for holistic planning that integrates infrastructure, environment, governance, and culture—ensuring urban development is both human-centered and ecologically sound.

Problem Statement 1: Rainwater Harvesting and Distribution System for Drought Resilience

A semi-arid community frequently faces water shortages due to erratic rainfall and dwindling groundwater.

Problem Statement 2: Waterlogging at Andheri subway in Mumbai:

Urban disruptions: Closures lead to severe local traffic congestion, spilling onto main roads like Western Express Highway and causing widespread delays.

Problem Statement 3: Bridges are vulnerable to the monsoon

The bridge, narrow and overloaded with two-wheelers and pedestrians, should show warning signs of deterioration, sensor deployment, materials upgrades, and emergency protocols

Problem Statement 4: Uttarakhand's infrastructure is highly vulnerable to natural disasters, requiring resilient development.

A riverbank in a flood-prone area is experiencing severe erosion, threatening nearby agricultural land and infrastructure.

Problem Statement 5: Alternative energy-efficient arrangement for rural areas.

An Alternative energy-efficient arrangement is required for rural areas. A small stream or river, capable of providing electricity for basic needs in a remote location, for frequent power cuts.

Problem Statement 6: Increase of Asthma Patients due to Air Pollution in Urban Areas

Low-cost, automated air quality monitoring stations for an urban area, focusing on key pollutants (e.g., PM2.5, NO2, SO2)for high pollution levels, aiding in public health and environmental management.

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
16111201	Differential Equations and Integral Calculus	2	1	--	30	15	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
16111201	Differential Equations and Integral Calculus	20	20	40	60	2.5	25	--	125

Rationale:

In a first-year Mechanical Engineering course, a solid understanding of advanced calculus and differential equations is essential for building problem-solving skills required in core engineering subjects. Higher-order linear differential equations are fundamental in modeling dynamic mechanical systems such as vibrations of beams, spring-mass-damper systems, and control systems in automation. Double and triple integrals are widely used to calculate areas, volumes, mass, and center of gravity—important in designing machine components, tanks, and structural elements. Vector calculus, including concepts like gradient, divergence, and curl, is crucial for understanding fluid flow, heat transfer, and force fields, which form the basis of thermodynamics and fluid mechanics. Complex integration supports the solution of certain real-world boundary value problems and is also applicable in the analysis of stress and strain in rotating machinery. Numerical methods such as root-finding algorithms, interpolation, and numerical integration are indispensable for solving engineering problems that cannot be addressed analytically—such as simulating heat conduction in materials or estimating stress in irregular geometries. These

mathematical tools equip first-year mechanical engineering students with the analytical foundation necessary to tackle complex engineering problems in higher semesters.

Course Objectives:

1. To introduce higher-order linear differential equations for modeling dynamic systems like mechanical vibrations.
2. To explain the use of double integrals in computing physical quantities over planar regions.
3. To demonstrate the application of triple integrals for 3D volume and mass calculations.
4. To introduce vector operators (gradient, divergence, curl) used in physical field analysis.
5. To teach complex integration methods for evaluating integrals in harmonic and fluid systems.
6. To present numerical techniques for solving engineering problems where analytical solutions are difficult.

Course Outcomes:

1. Students will be able to solve and interpret differential equations and use SCILAB in systems such as spring mass-damper models.
2. Students will evaluate double integrals and use SCILAB to calculate areas, mass, and centroids in mechanical components.
3. Students will apply triple integrals and use SCILAB to determine volumes and mass distributions in mechanical parts like castings or tanks.
4. Students will analyze heat flow, fluid motion, and force fields using concepts of vector calculus.
5. Students will solve and interpret problems involving oscillatory systems and wave analysis using complex integration.
6. Students will use numerical methods and use SCILAB to approximate solutions in applications like heat conduction and stress analysis.

R-2025- Mechanical Engineering

Prerequisite:

1. Basics of integration and it's properties**.**

2**.** Linear differential equations

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Differential Equation	Exact differential Equations, Equations reducible to exact form by using integrating factors.	05	CO1
		Equation reducible to linear form, Bernoulli's equation.		
		Linear Differential Equation with constant coefficient-complementary function, particular integrals of differential equation of the type f(D)y = X where X is e^{ax} , sin(ax + b), cos(ax +b), x^m.		
		Self-learning topics: 1. Method of variation of parameter 2. Particular integrals for $e^{ax}V$ and xV. 3. Cauchy's homogeneous linear differential equation. 4. Legendre's differential equation. 5. Applications of first order and first degree and also Higher order differential equation.	08	
II	Multiple Integral-I	Beta and Gamma functions and its properties.	05	CO2
		Double integration-definition, Evaluation of Double Integrals.(Cartesian & Polar)		
		Change the order of integration (No Evaluation)		

		Self-learning topics: 1. Rectification of curves. (Cartesian, Polar and Parametric) 2. Application of double integrals to compute Area and Mass of lamina.	07	
III	Multiple Integral-II	Evaluation of double integrals by changing to polar coordinates	05	CO3
		Evaluation of integrals over the given region (Cartesian and polar).		
		Triple integration definition and evaluation (Cartesian, cylindrical and spherical polar coordinates).		
		Self-learning topics: 1. Application of triple integrals to compute volume. 2. Triple integrals over a volume bounded by a plane. 3. Triple integrals over a volume bounded by a paraboloid. 4. Triple integrals over a volume bounded by a cone. 5. Triple integrals over a volume bounded by an ellipsoid.	07	
IV	Vector Calculus	Scalar and vector fields. Differentiation of vectors	05	CO4
		Directional derivative, Gradient, divergence and curl		
		Scalar potential function		
		Self-learning topics: 1. Line integrals – definition and problems. 2. Green's theorem in a plane, 3. Stokes' theorem (without Proof) 4. Gauss' Divergence theorem (without proof) and problems (only evaluation). 5. Angle between surfaces.	07	

V	Complex Integration	Cauchy's Integral theorem and formula,	05	CO5
		Taylor's series and Laurent's series - radius of convergence		
		Singularities and Poles, Cauchy Residue theorem.		
		Self-learning topics: 1. Line Integral in cartesian and parametric form. 2. Application of Residue Theorem to evaluate real integrations. 3. Conformal Mappings.	08	
VI	Numerical Methods	Numerical integration-by (a) Trapezoidal (b) Simpson's 1/3rd (c) Simpson's 3/8th rule (all without proof)	05	CO6
		Interpolation by Newton's and Lagrange polynomials		
		Numerical solutions of transcendental equations by Newton Raphson method and Regula –Falsi method.		
		Self-learning topics: 1. Indeterminate forms, L- Hospital Rule, 2. Gauss Elimination Method, Gauss Jordan Method. 3. Maclaurin Series 4. Numerical solution of ordinary differential equation using (a) Euler's method (b) Modified Euler method, (c) Runge-Kutta fourth order method	08	

Text Books:

1. Grewal B. S.: "Higher Engineering Mathematics", Khanna Publishers, 44th Ed., 2021.

2. Kreyszig E.: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed., 2018.

3. Dass H. K.: "Higher Engineering Mathematics", S Chand & Company Ltd, 12th Ed., 2004.

4. Narayan S.: "Differential Calculus", S.Chand Publications, 30th Ed., 2005.

References:

1. Stewart J.: "Multivariable Calculus" Cengage Publications, 7th Ed., 2019.
2. Jain M.K., Iyengar SRK, Jain R K,: "Numerical Methods for Scientific and Engineering Computation", New Age International Publishers, 6th Ed., 2007.
3. Bali N.P and Goyal M.: "A Textbook of Engineering Mathematics" Laxmi Publications, 10th Ed., 2022.
4. Wylie C. R, Barrett L.C..: "Advanced Engineering Mathematics" McGraw Hill Book Co., New York, 6th Ed., 2017.
5. Ramana B.V.: "Higher Engineering Mathematics", Tata McGraw-Hill Publishing Company Limited, 1st Ed., 2006.
6. Gupta C.B, Sing S.R and Mukesh Kumar: "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education, 2015.
7. Pal S. & Bhunia S. C.: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/111/105/111105122/
2.	https://www.youtube.com/watch?v=T6jHXD78dBI
3.	https://www.youtube.com/watch?v=KgItZSst2sU
4.	https://www.youtube.com/watch?v=w_KiHgultbM

Assessment:

R-2025- Mechanical Engineering

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test.

Term work(TW) for 25 marks:

1. Batch-wise tutorials are to be conducted.

2. Students must be encouraged to write SCILAB Programs in tutorial class only. Each Student has to write **at least 05 SCILAB tutorials** (including print out) and **at least 10** class tutorials on entire syllabus.

3. SCILAB Tutorials will be based on entire syllabus

The distribution of Term Work marks will be as follows –

1. Regularity and active involvement (Theory and Tutorial) 05 marks

2. Class Tutorials on entire syllabus 10 marks

3. SCILAB Tutorials 10 marks

R-2025 Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C)
		L	T	P	L	T	P	SL	Notional Learning Hour	(Notional Learning Hour/30)
16111202	Engineering Chemistry	2	--	--	30	--	--	30	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
16111202	**Engineering Chemistry**	15	15	30	45	2	--	--	75

R-2025 Mechanical Engineering

Rationale:

1. Chemical science has contributed in many ways to most of the Engineering branches where "engineering chemistry" is the modern approach to learn impact of Technology on habitat and can be common to all Core Groups,
2. "Engineering Chemistry" can be prerequisites to impact of corrosion on metals as many civil engineering materials is the important area of concern.
3. "Conventional and Non-Conventional Energy Study" is the matter of general approach to all but especially to Mechanical group as energy issue is the most recent concern even for designing the energy efficient IC engine.
4. Chemical science has contributed in many ways to most of the Engineering branches where "Engineering Materials" such as water, polymers, fuel, lubricants and cement, can be prerequisites to many subjects of all core groups from the perspective of applications as a build material for structural as well as mountainous component

Course Objectives:

1. To study effect of hardness of water on various materials used in civil structures and machine design.
2. To introduce important properties of polymers as engineering material.
3. To study the effect of corrosion by different mechanisms on metals and methods of corrosion control
4. To study energy efficacies of various conventional and non-conventional source of energy.
5. To study mechanism and various lubricants used in engineering applications.
6. To recognize importance of alloys and can apply the phase rule on it to study the effect of temperature and composition
7. To recognize the composition, properties and functions of various cements used in civil engineering.

Course Outcomes:

Student will be able to –

1. Determine the hardness of water and various method of water hardness removal.
2. Use the polymers for specific engineering applications on the basis of the properties.
3. Understand the causes of corrosion and apply different methods to minimize corrosion.
4. Determine the quality of fuel and quantitative estimation of fuel.
5. Understand the role of lubricants in corrosion prevention.
6. Understand the various alloys and to interpret various phase transformations of alloy using thermodynamics.
7. identify different types of cement and their specific role as structural materials for engineering applications

Prerequisite:

1. Knowledge about basic concept of hardness of water.
2. Knowledge of basic properties of polymers
3. Knowledge of concepts of Electrochemistry.
4. Knowledge of basic difference in Conventional and non-conventional energy sources.
5. Knowledge of basic mechanism and use of lubricant.
6. Knowledge of basic properties of metals and nonmetals and purpose of making alloys
7. Knowledge of Constituents of Cement and their functions.

R-2025 Mechanical Engineering

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Knowledge about basic concept of hardness of water, properties of polymers, concepts of Electrochemistry, basic difference in Conventional and non-conventional energy sources, mechanism and use of lubricant, properties of metals and nonmetals and purpose of making alloys, Constituents of Cement and their functions.		
I	Water	1. Impurities in water, Hardness of water 2. Determination of hardness of water by EDTA method and numerical problems, 3. softening method of water and numerical based on it –i) Ion exchange process ii) electro dialysis iii) reverse osmosis iv) ultrafiltration.	05	CO1

		4. Definition, significance and numerical problems based on BOD and COD.		
		Self-learning Topics: **1.** Industrial applications of water treatment in power plants and manufacturing. **2.** Comparative study of water purification technologies (e.g., UV vs RO). **3.** Municipal water treatment plants. Environmental impact of untreated water discharge. **4.** Latest advancements in membrane filtration (e.g., nano filtration).	05	
II	Introduction to polymers.	**1.** Macro-molecular science, basic concept of polymers, Chemical bonding in polymers, Classification of Polymers. **2.** Properties of Polymers:- i) Molecular weight - Number average molecular weight,	05	CO2

		Weight average molecular weight, Numerical, ii) Crystallinity - Crystalline and amorphous polymers – Glass transition temperature, iii) Mechanical Properties: Hardness, tensile strength, creep, fatigue, impact resistance (introduction), iv) Electrical properties: dielectric strength, insulation resistance, surface resistivity (Introduction), v) Optical properties: refractive index, transmittance, photoelectric property, colour **3.** Advanced polymers: i) Intelligent (smart) polymers ii) Biopolymers		
		Self-learning Topics: **1.** Applications of smart polymers in medical and aerospace industries. **2.** Recycling of polymers: techniques and challenges.	05	

		3. 3D printing and polymer materials. **4.** Use of biopolymers in packaging. **5.** Role of polymer composites in automotive design.		
III	Corrosion	**1.** Introduction: Definition, Types of Corrosion – i) Dry or Atmospheric Corrosion, ii) Wet or Electrochemical corrosion (In Acidic medium, In Neutral medium) **2.** Factors affecting rate of corrosion: i) Position of metal in galvanic series, ii) Purity of Metal, iii) Nature of Corrosion product, iv) Temperature, v) pH of medium, vi) concentration of medium, vii) moisture, viii) Relative Cathodic and Anodic area, ix) overvoltage **3.** Methods to control corrosion: i) Selection of metal, ii) Proper Designing, iii) Cathodic protection, iv) Use of Corrosion	05	CO3

		Inhibitors, v) Metallic Coating- metal cladding, galvanization, tinning, metal spraying.		
		Self-learning Topics: **1.** Corrosion failures in historical structures. **2.** Protective coatings used in marine and oil industries. **3.** Cathodic protection systems used in pipelines. **4.** Advanced corrosion monitoring techniques. **5.** Corrosion management in reinforced concrete structures.	05	
IV	Fuels	**1.** Introduction**:** i) Definition, Characteristics of good fuel. ii) Calorific value: Definition, Types, Determination, Dulong's formula, Numerical) iii) Solid fuel: Coal: - Analysis of coal – Proximate analysis, Ultimate analysis, Numerical, Combustion of coal – Numerical	05	CO4

		iv) liquid fuel: petroleum oil-composition, mining and refining of petroleum. **2.** Petroleum products: i) refining of petroleum, ii) advantages of unleaded petrol, iii) MTBE: its uses, advantages and disadvantages iv) power alcohol, v) knocking in petroleum products, antiknocking agents, octane number of petrol, Diesel: cetane number. **3.** Green fuel for sustainable development: Synthesis and Advantages of i) Biodiesel, ii) Ethanol		
		Self-learning Topics: **1.** Biofuel usage in Indian Railways or airlines. **2.** Life cycle assessment of fossil vs. alternative fuels. **3.** Energy policies promoting ethanol and biodiesel.	05	

		4. Innovations in fuel cell technology. **5.** Environmental impacts of coal combustion.		
V	Lubricants and Alloys	Lubricants: **1.** Introduction- definition, mechanism and classification of lubricants, **2.** Types of lubricants: solid lubricants- graphite and molybdenum disulphide, semisolid lubricant, liquid lubricant, additives in blended oils, **3.** Important properties of lubricants- definition and significance of –viscosity, viscosity index, flash point and fire point, Claude point and pour point, oiliness, emulsification, acid value and numerical, saponification and numerical Alloys:	06	CO5, CO6

		1. Ferrous alloys – i) Plain-carbon steels ii) Heat and Shock resisting steels iii) Stainless steels iv) Effect of the alloying element- Ni, Cr, Co, Mn, Mo, W and V. **2.** Non Ferrous alloys: A) Aluminum alloys – Composition, properties and uses of i) Duralumin, ii) Magnalium B) Copper alloys – Composition, properties and uses of a) Brass – i) Dutch Metal ii) German Silver b) Bronze – i) Gun metal ii) Nickel bronze. C) Alloys of Pb – Composition, properties and Uses of i) Wood's metal ii) Tinman's solder. **3.** Numerical: i) based on Composition, ii) based on density iii) based on weight of an alloy.		

		Self-learning Topics: **1.** Lubricant selection for heavy machinery. **2.** Nano-lubricants and their industrial relevance. **3.** Smart lubricants and real-time condition monitoring. **4.** Applications of specific non-ferrous alloys in aerospace. **5.** Advances in high-performance alloys (e.g., Inconel, Titanium alloys).	06	
VI	Important Engineering materials	**1.** Introduction, **2.** Manufacturing of Portland cement, **3.** Chemical composition and constituent of Portland cement, **4.** Setting and hardening of Portland cement, concrete, RCC **5.** Decay process of cement.	04	CO7

		Self-learning Topics: **1.** Use of green cement and eco-concrete in construction. **2.** Failure analysis of concrete structures. **3.** Cementitious materials in 3D printed buildings. **4.** Sustainable alternatives to Portland cement. **5.** Chemical admixtures in concrete and their mechanism.	04	

References:

1. Engineering Chemistry, Jain and Jain, Dhanpat Rai Publication
2. A textbook of Engineering Chemistry, S. S. Dara, S. Chand and Company
3. Polymer science: Vasant Gowarikar, Wiley Estern Ltd, new Delhi
4. Green Chemistry: V. K. Ahluwalia
5. Textbook of Polymer science: F.W. Billmeyer
6. Fundamentals of Polymer science & Engineering- Anilkumar & S K Gupta, Tata McGraw Hill, New Delhi
7. Engineering Chemistry, O. G. Palana, Tata McGraw Hill Publication
8. Environmental Chemistry, A. K. De, Tenth edition, New Age International,
9. P. W. Atkins, Physical Chemistry, Oxford University Press, 7th edition. 5. J. D. Lee Concise Inorganic Chemistry, Oxford University Press, 5 th edition

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/103/106/105106205/
2.	https://courses.nptel.ac.in/noc20ch41/preview
3.	https://www.researchgate.net/
4.	https://www.sciencedirect.com/topics/engineering/polymer-material
5..	https://www.sciencedirect.com/topics/chemistry/nanomaterial

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) Notional Learning Hour/30
16112203	**Engineering Graphics**	2	-	-	30	-	-	-	30	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration(in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
16112203	**Engineering Graphics**	20	20	40	60	2.5	--	--	100

Rationale:

Engineering Graphics develops spatial visualization and technical drawing skills essential for modern computing applications. It bridges the gap between digital systems and the physical world, supporting areas like embedded systems, IoT, and robotics. The course enhances understanding of 3D modeling, essential for AR/VR, digital twins, and simulation-based tools. It prepares students to work effectively in interdisciplinary teams involving hardware-software integration. Concepts like projections and solid modeling are foundational for CAD software, PCB design, and interface development. It supports UI/UX development for 3D applications, gaming, and visualization platforms. Engineering graphics aids in documenting and communicating design ideas clearly and accurately. Overall, it fosters analytical thinking and design communication, crucial for innovation in intelligent computing systems.

Course Objectives

1	To impart and inculcate proper understanding of the theory of projection.
2	To impart the knowledge to read and interpret a drawing.
3	To improve the visualization skill.
4	To enable students to represent three-dimensional objects on a two-dimensional surface in a way that accurately conveys their shape, size, and orientation.
5	To acquaint students with representing internal features of a three-dimensional object by way of section that accurately conveys their internal orientation.

Course Outcomes

1	Apply basic concepts of geometrical constructions to create engineering curves.
2	Apply the basic principles of projections in Projection of Lines and Planes
3	Apply the basic principles of projections in Projection of Solids.
4	Apply the basic principles of sectional views in Section of solids.
5	Apply the basic principles of projections in converting pictorial views into orthographic Views.
6	Apply the basic principles of projections in converting orthographic views into isometric drawing.

Detailed Syllabus

Module no.	Module Name	Detailed content	Teaching hours	CO
	Pre-requisite	To draw basic geometric shapes like circle, pentagon, hexagon, and square with different orientation. Divide a line, circle, etc. into equal number of parts.	01	
1	**Introduction to Engineering Drawing and Engineering curves**	**1.1** Introduction to Engineering Graphics and its significance in Engineering domain. **1.2** Types of Lines, Dimensioning Systems as per IS conventions. **1.3 Engineering Curves**: Basic construction of Conics, Cycloid, Involutes and Helix (cylinder only). **Self-learning topic:** - Explore the concepts of eccentricity, focus, vertex, axis, directrix - Explore other conics - ellipse, parabola and hyperbola using directrix-focus method	03 03	CO1
2	**Projections of Points, Lines and Planes**	**2.1 Projections of points** in all four quadrants as well as lying on the planes. **2.2 Projections of lines** inclined to both the reference planes (Excluding Traces of lines). Simple application-based problems on projection of lines. **2.3 Projection of planes** (only standard geometrical shapes like square, triangle, pentagon, circle, etc.) inclined to one of the reference planes only. **Self-learning topic:** - Explore the projection of lines for mixed quadrants - Explore the projection of planes for planes inclined to both the reference planes	05 05	CO2
3	**Projections of Solids**	**3.1** Projections of solids with the axis inclined to one reference plane include prism and cylinder **3.2** Projections of solids with the axis inclined to both reference planes include pyramid, and cone (Use change of position or Auxiliary plane method) **Self-learning topic:** - Explore the cuboid and tetrahedron solids inclined to one or both the reference planes.	06 06	CO3

		- Explore the applications of solid projection in machine components, structure, and packaging and manufacturing.		
4	**Sections of Solids and Development of Surfaces**	**Sections of Solids** Sections of Prism, Pyramid, Cylinder, & Cone cut by plane perpendicular to only one reference plane. Use change of position or Auxiliary plane method. **Self-learning topics:** - Explore the development of lateral surface for regular solids - Prism, Pyramid, Cylinder, & Cone - Explore the real-life application of solids cut with section planes inclined to one plane.	04 04	CO4
5	**Orthographic and Sectional Orthographic Projections**	Fundamental concepts of orthographic and sectional orthographic projections like Positioning of quadrants, observer, horizontal, vertical and profile plane, symbol etc., Different orthographic views, First and Third angle method of projection, different section (cutting) plane, its representation, importance of sectional views, rib and web in section. Views of simple machine parts as per the first angle projection method recommended by I.S. for Orthographic and Sectional Orthographic projection **Self-learning topics:** - Explore the third angle method of projection for orthographic views. - Explore half sectional and offset sectional views - Practice simple machine components with half section and offset section	06 06	CO5
6	**Isometric Views**	Introduction to isometric projections and Fundamental concepts of Isometric projection - isometric and non-isometric lines, axes, and planes. Concept of isometric scale. Difference between isometric projection and isometric views. Conversion of orthographic views to isometric views **Self-learning topics:** - Explore the concepts of isometric scale and isometric projection - Practice isometric projection of simple objects using isometric scale - Explore the isometric views and projections of holes and slots on an inclined plane	05 05	CO6

Text Books:

1. N.D. Bhatt, "Engineering Drawing (Plane and solid geometry)", Charotar Publishing House Pvt. Ltd.
2. N.D. Bhatt & V.M. Panchal, "Machine Drawing", Charotar Publishing House Pvt. Ltd.

References:

1. Narayana, K.L. & P Kannaiah (2008), Textbook on Engineering Drawing, Scitech Publisher.
2. Prof. Sham Tickoo (Purdue University) & Gaurav Verma, "(CAD Soft Technologies).
3. Auto CAD 2012 (For engineers and Designers)", Dreamtech Press New Delhi.
4. Dhananjay A Jolhe, "Engineering Drawing" Tata McGraw Hill.

Online References:

Sr. No.	Website Name
1	https://archive.nptel.ac.in/courses/112/105/112105294/
2	https://nptel.ac.in/courses/112103019
3	https://archive.nptel.ac.in/courses/112/102/112102304/

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30
16211204	Basic Fluid mechanics	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
16211204	Basic Fluid mechanics	20	20	40	60	2.5	--	--	100

Rationale:

Fluid Mechanics is a fundamental subject in the field of Civil and Mechanical Engineering as it forms the foundation for understanding the behavior and movement of fluids—liquids and gases—through various systems. This syllabus has been designed to help students grasp basic fluid properties, static and dynamic fluid behavior, and the principles governing real-life engineering applications such as water supply, hydraulic machines, and cooling systems. It incorporates

sustainability and innovation to reflect modern engineering challenges like climate resilience, water conservation, and clean energy.

Course Objectives:

1. To introduce students to the fundamental properties.
2. To enable students to understand and apply fundamental principles of fluid behavior, pressure, and fluid motion to analyze basic flow systems and fluid-related engineering problems.
3. To introduce students to the applications of fluid mechanics in engineering systems, emphasizing how fluids function in infrastructure, machinery, and energy systems across civil and mechanical disciplines.
4. To introduce students to innovative and sustainable applications of fluid mechanics in civil and mechanical engineering through real-world systems, emerging technologies, and smart solutions.
5. To study the basic difference between incompressible and compressible flow, Propagation of pressure waves and stagnation points.
6. To introduce students to the sustainable use of fluid systems in engineering, highlighting their role in climate-resilient infrastructure, efficient water and energy systems, and modern smart technologies.

Course Outcomes:
After completing this course, students will be able to:

1	Identify and describe fundamental fluid properties.
2	Explain the behavior of fluids under static and dynamic conditions, and apply basic fluid mechanics principles to pressure measurement, flow visualization, and fluid force estimation.
3	Explain the role of fluids in engineering systems and differentiate between static and dynamic fluid behavior in civil and mechanical applications.
4	Illustrate how fluid mechanics principles are applied in innovative civil and mechanical engineering solutions related to water systems, automation, energy, and smart technologies.
5	Explain the compressible flow, propagation of pressure waves and stagnation properties.

6 Describe and apply fluid mechanics concepts to analyze sustainable engineering solutions like greywater recycling, buoyant foundations, and smart fluid-based energy systems.

Prerequisite: Mathematics and Physics

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Basic algebra and physics, Units and dimensions, Algebraic manipulation of equations, Differentiation, Integration of simple functions	-	-
I	**Basics of Fluids**	Difference between solids, liquids, and gases; Definition of fluid and fluid mechanics; Physical properties of fluids: density, specific weight, specific volume, relative density and viscosity. Newton's law of viscosity, classification of fluids, Real-life Applications ; Units and measurement	8	CO1
		Self-learning Topics: Temperature effect on fluid viscosity, Measurement of fluid properties, Fluids in daily life and machines, Units and conversion practice, fluid in cars and properties, 10 fluids used at home and their classification	8	
II	**Fluid Behavior and Flow Systems**	Basic concept of pressure, Pressure head, Types of pressure, Hydrostatic law, pressure measurement	8	CO2

		Total pressure and Centre of pressure on plane surfaces, Conditions of flotation, Applications Velocity and acceleration, Streamline, path line, streak line – flow visualization, Flow classification Bernoulli's equation (concept only)		
		Self-learning Topics: Pressure head use in dams/reservoirs, streamlines & vortex, Flow Nets & Seepage, TEL/HGL in Pipelines	8	
III	**Fluids in Engineering**	Role of fluids in engineering infrastructure and machinery, Difference between static and dynamic fluid systems, Fluids in Civil Engineering Applications: Water Supply Systems, Hydraulic Structures, Storm water Management, Sewage and Wastewater Handling, Soil and Groundwater Flow Fluids in Mechanical Engineering Applications: Internal Combustion Engines, Pumps and Compressors, Heat Exchangers, Hydraulic and Pneumatic Systems, Refrigeration and Air Conditioning (HVAC)	8	CO3
		Self-learning Topics: water supply systems work in buildings and cities, Hydraulic systems in construction and transport, Cooling systems using fluids	8	

IV	**Fluids and Innovation in Engineering**	Civil Engineering Innovations Using Fluids: Smart water systems, Urban flood mitigation, Sustainable water harvesting and reuse Mechanical Engineering Innovations Using Fluids: Hydraulic automation, Energy innovations, Fuel & coolant efficiency AI-enabled water meters, Zero-energy cooling using water/air flow	8	CO4
		Self-learning Topics: flowchart of a smart water pipeline, maps of flood-prone areas, hydraulic arms/lifts: identification of components and fluid role, smart fluids-based systems for improvement of urban and mechanical performance	8	
V	**Compressible Flow**	Basic equation of flow (elementary study), velocity of sound or pressure wave in a fluid, Mach number, propagation of pressure waves, area-velocity relationship, Stagnation properties.	6	CO5
		Self-learning Topics: Mach number for subsonic/supersonic flows, speed of sound in air and water, stagnation properties using online simulators	6	
VI	**Fluids and Sustainable Future**	Role of fluid systems in climate resilience, water conservation, and clean energy, Greywater recycling in buildings, Flood proof structures using	7	CO6

		buoyant foundations, Smart HVAC systems and district cooling, Fluid-based solar water heaters, Real-time monitoring of fluid systems, Smart irrigation using weather prediction		
		Self-learning Topics: Extreme Rainfall: Case Studies in Indian Cities, Smart Drainage Systems, Green Infrastructure for Urban Flood Management	7	

Text Books:

1. Hydraulics & Fluid Mechanics by Dr. P. N. Modi and Dr. S. M. Seth, Standard Book House.
2. Fluid Mechanics by Dr. A. K. Jain, Khanna Publishers.
3. Fluid Mechanics and Fluid Machinery by R. K. Bansal, Laxmi Publications.
4. A Textbook of Fluid Mechanics and Hydraulic Machines, Rajput, R. K, S. Chand Publishing

References:

1. Fluid Mechanics and Hydraulic Machines by McGraw Hill Education (India).
2. Fluid Mechanics by Yunus Cengel, Jhon Cimbala, Tata MacGraw Hill, New Delhi.
3. Fluid Mechanics by R. J. Garde, A. J Mirajgaonkar, SCITECH Publication.
4. Fluid Mechanics by Streeter & Wylie, Tata McGraw Hill.
5. Fluid Mechanics by K. Subramanya, McGraw Hill.
6. Fluid Mechanics by Frank White, McGraw Hill.

Online References:

Sr. No.	Website Name
1.	NPTEL – https://nptel.ac.in
2.	ASCE Sustainable Infrastructure Resources – https://www.asce.org

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30)
16112205	Engineering Chemistry Lab	--	--	1	--	--	15	--	15	0.5

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT1 +IAT 2				
16112205	Engineering Chemistry Lab	--	--	--	--	25	-	25

Lab Objectives:

1. To apply knowledge acquired during the theory class in carrying out the experiments for qualitative and quantitative determination.
2. To analyze experimental results and write laboratory report.

Lab Outcomes: After completion of experiment, the learners will be able to

1. Estimate the type of water hardness and calculate it.
2. Synthesize UF/PF resin at laboratory level.
3. Learn the effect of various factors on the rate of corrosion.
4. Understand the significance of proximate analysis of coal and determine quality of coal sample.
5. Understand causes of the detoriation of lubricant and its extent.
6. Learn volumetric quantitative analytical techniques to determine % of elements from alloy samples.
7. Learn various instrumental quantitative analytical techniques to determine % of elements from alloy samples.

List of Experiments:

Sr No	List of Experiments	Hrs
01	Determination of Total, Temporary and Permanent hardness of water by EDTA method	**01**
02	Synthesis of Urea formaldehyde Resin.	**01**
03	Synthesis of Phenol formaldehyde resin.	**01**
04	To compare rate of corrosion of various metals in acidic medium.	**01**
05	Determination of moisture content of coal.	**01**

06	Estimation of acid content in the given lubricant oil.	**01**
07	Estimation of saponification value the given lubricant oil.	**01**
08	Determination of % purity of iron.	**01**
09	Determination of Sn from solders volumetrically.	**01**
10	Determination of unknown concentration of Cu in the given sample by colorimetry	**01**

List of Assignments:

Sr No	List of Assignments	Hrs
01	Numerical on determination of hardness of water	**01**
02	Green Solvents: - characteristics and applications of Supercritical solvents and ionic liquids Green Fuels:- Synthesis and Advantages of i) Biodiesel, ii) Ethanol Calculation of % Atom economy of the given chemical reaction	**01**
03	Numerical based on calorific value determination, proximate and ultimate analysis of coal, Acid value and Saponification value in the given lubricants.	**01**
04	Concept, of Smart polymers: some examples of smart polymers with their properties and uses. Note on Liquid Crystal polymers	**01**
05	Composition, Properties of any 4 alloys	**01**
06	Note on Portland cement	**01**

References:

1. Engineering Chemistry, Jain and Jain, Dhanpat Rai Publication
2. A textbook of Engineering Chemistry, S. S. Dara, S. Chand and Company
3. Polymer science: Vasant Gowarikar, Wiley Estern Ltd, new Delhi
4. Green Chemistry: V. K. Ahluwalia
5. Textbook of Polymer science : F.W. Billmeyer
6. Fundamentals of Polymer science & Engineering- Anilkumar & S K Gupta, Tata McGraw Hill, New Delhi
7. Engineering Chemistry, O. G. Palana, Tata McGraw Hill Publication
8. Environmental Chemistry, A. K. De, Tenth edition, New Age International,
9. P. W. Atkins, Physical Chemistry, Oxford University Press, 7th edition. 5. J. D. Lee Concise Inorganic Chemistry ,Oxford University Press, 5 th edition.
10.

Online Resources:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/103/106/105106205/
2.	https://courses.nptel.ac.in/noc20ch41/preview
3.	https://www.researchgate.net/
4.	https://www.sciencedirect.com/topics/engineering/polymer-material
5.	https://www.sciencedirect.com/topics/chemistry/nanomaterial

Assessment:

Term Work: Term Work shall consist of at least 10 practical based on the above list. Also, Term work Journal must include at least 6 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
16122206	**Engineering Graphics**	-	-	2	-	-	30	-	30	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration(in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
16122206	**Engineering Graphics**	--	--	--	--	--	25	25	50

Lab Objectives:

1. To impart and inculcate proper understanding of the theory of projection.
2. To impart the knowledge to read and interpret a drawing.
3. To improve the visualization skill.
4. To enable students to represent three-dimensional objects on a two-dimensional surface in a way that accurately conveys their shape, size, and orientation.
5. To acquaint students with representing internal features of a three-dimensional object by way of section that accurately conveys their internal orientation.
6. To impart basic AutoCAD skills.

Lab Outcomes:

1. Apply the concepts of Draw, Modify and basic concepts of ACAD to draw basic geometries and diagrams of simple engineering parts.
2. Apply the concepts of layers, and dimensions to create engineering drawing for a part drawing.
3. Create, Annotate, Edit and Plot drawings using basic AutoCAD commands and features.
4. Apply the basic principles of projections in 2D drawings using a CAD software.
5. Apply basic AutoCAD skills to draw different views of a 3D object.

6 Apply basic AutoCAD skills to draw the isometric view from the given two views.

List of Experiments:

Component: 01 – ACAD Print outs (activities to be completed in the CAD Laboratory - All printouts to be the part of Term Work.)

Sr. No.	List of Experiments	Hrs	CO mapping
1	Redrawing simple machine parts as given (05 problems)	04	CO1, CO2, and CO3
2	Orthographic projections (with and without section) (05 problems)	04	CO4 and CO5
3	Isometric Drawing – 3 problems.	04	CO6

Component: 02 – Drawing Sheets

01	Two problems on Engineering Curves	02	CO1
02	Two problems each on Projection of Lines and Planes	02	CO2
03	Two problems on Projection of Solids	02	CO3
04	Two problems on Section of Solids with DLS	02	CO4
05	Two problems each on Orthographic and Sectional Orthographic projection	02	CO5
06	Two problems on Isometric projection	02	CO6

Component: 03 – A3 size Sketch book

Sr No	List of Assignments	Hrs	CO mapping
01	Engineering Curves. (2 problems)	01	CO1
02	Projection of Lines and Planes (2 problems each)	02	CO2
03	Projection of solids. (2 problems)	02	CO3
04	Section of solids (2 problems)	02	CO4
05	Sectional Orthographic and Orthographic Projections (2 problems each)	04	CO5
06	Isometric Drawing. (3 problems)	03	CO6

Assessment:

Term Work: Term Work shall include all the drawings, assignments, and printouts listed above.

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Drawing sheets and ACAD printouts) + 10 Marks (Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: Practical exam on ACAD will be held based on the above syllabus.

R-2025- FE Mechanical and Civil

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30)
16122207	Programming Lab (Python)	--	--	4	--	--	60	--	60	2

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term work	Practical/ Oral	Tut.	Total
		Internal assessment			End Sem. Exam				
		IAT- 1	IAT-2	IAT-1 + IAT-2					
16122207	Programming Lab (Python)	--	--	--	--	25	25	--	50

Lab Objectives:

1. To familiarize learners with Python's basic syntax, variables, data types, operators, and input/output functions.
2. To reinforce the understanding and application of conditional statements, loops, and functions in Python programming.
3. To instill learners on file handling, exception management, and Python packaging.
4. To introduce object-oriented programming principles and their application in Python.
5. To explore advanced topics such as regular expressions, pattern matching, and GUI development.
6. To introduce and demonstrate the use of popular Python libraries for data handling.

Lab Outcomes: After completion of experiment, the learners will be able to

1. Demonstrate the proficiency in basic python programming or Create and perform various operations on data structures like list, tuple dictionaries and strings.
2. Apply Control Flow and Functions for efficient coding to solve problems.
3. Demonstrate proficiency in handling file operations, managing exceptions, and developing Python packages and executable files for modular programming.
4. Illustrate the concept of Object-Oriented Programming used in python.
5. Design Graphical User Interface (GUI) applications, utilizing appropriate Python libraries to create user-friendly interfaces.
6. Investigate and apply popular python libraries to conduct efficient data handling tasks.

Prerequisite:

1. Logical Thinking & Problem Solving: Ability to break down problems into smaller parts. Basic understanding of flowcharts or algorithmic thinking.
2. Mathematical Reasoning: Basic arithmetic operations (addition, subtraction, multiplication, division).
3. Understanding of variables, functions, and formulas (from school-level math).
4. Analytical Skills: Ability to spot patterns, debugs issues, and evaluates outputs.

Text Books:

1. Core Python Programming, Dr. R. Nageswara Rao, Second Edition, Dreamtech Press.

2. Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox Publication.

3. Python Programming, Anurag Gupta and G. P. Biswas, First Edition,McGraw-Hill Education.References:

1. Learn Python the Hard Way, Zed Shaw, Third Edition, Addison-Wesley.
2. Python Projects, Laura Cassell,Alan Gauld, First Edition, Wrox Publication.
3. Introduction to computing and problem-solving using python, Balagurusamy, First Edition, McGraw Hill Education.

Online Resources:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106106145
2.	https://onlinecourses.swayam2.ac.in/cec22_cs20/preview
3.	https://www.researchgate.net/
4.	https://www.sciencedirect.com/science/article/pii/S2666920X24001127
5.	https://www.sciencedirect.com/search?qs=python%20programming

Suggested List of Experiments: (Expected Minimum 15 Experiments to be performed)

Sr No	List of Experiments	Hrs
01	To understand the structure and features of the Code::Blocks Integrated Development Environment (IDE) and to use it effectively for writing, compiling, debugging, and executing python programs, which will serve as the foundational tool for all further experiments in the lab.	**02**
02	Personalized Greeting Generator* - Write a python code to generate Personalized Greeting.	**02**
03	Calculating Areas of Geometric Figures* - Write a python program to calculate areas of any geometric figures like circle, rectangle and triangle.	**02**
04	Calculating Gross Salary of an Employee*: Write a Python program to calculate the gross salary of an employee. The program should prompt the user for the basic salary (BS) and then compute the dearness allowance (DA) as 70% of BS, the travel allowance (TA) as 30% of BS, and the house rent allowance (HRA) as 10% of BS. Finally, it should calculate the gross salary as the sum of BS, DA, TA, and HRA and display the result.	**02**
05	Task List Manager*: Develop a Python program to manage a task list using lists and tuples, including adding, removing, updating, and sorting tasks.	**02**
06	Student Record Keeper *: Write a Python program to create, update, and manipulate a dictionary of student records, including their grades and attendance.	**02**

07	Triangle Pattern Generator Using Loops: Write a Python program to print a triangle pattern (give any), emphasizing the transition from C to Python syntax.	**02**
08	Number Type Identifier*: Develop a Python program that takes a numerical input and identifies whether it is even or odd, utilizing conditional statements and loops.	**02**
09	**Grade Evaluator:** Develop a Python program that takes marks and evaluates grade using if-elif-else	**02**
10	**Fibonacci Sequence Generator:** Write a Python program to generate the first N terms of the Fibonacci series using loops.	**02**
11	Multiplication Table Generator: Write a Python program to take a numerical input from the user and generate its multiplication table using loops.	**02**
12	Extracting Words from Text File *: Develop a Python program that reads a text file and prints words of specified lengths (e.g., three, four, five, etc.) found within the file.	**02**
13	Basic Exception Handling*: Write a Python program that takes two numbers as input and performs division. Implement exception handling to manage division by zero and invalid input errors gracefully.	**02**
14	Online ATM System: Develop classes for ATM. Include methods for withdraw, deposit and check balance.	**02**
15	Password Strength Checker: Write a Python script that prompts the user to enter a password. Use regular expressions to validate the password based on these criteria: At least 8 characters long, Contains at least one uppercase letter, one lowercase letter, one digit, and one special character.	**02**

Assessment: List of Assignments (Any 4)

Sr No	List of Assignments / Tutorials	Hrs
01	Write a Python program to find the largest of three numbers using if-else.	**02**
02	Create a calculator using Python functions (Addition, Subtraction, Multiplication, Division).	**02**
03	Write a program to check whether a number is prime or not.	**02**
04	Develop a program to generate Fibonacci series using **for** and **while** loops.	**02**
05	Create a menu-driven program using functions for basic mathematical operations.	**02**
06	Write a program to sort a list using Bubble Sort and explain each step.	**02**
07	Create a Python program using lists to manage student records (Add, Delete, Search).	**02**
08	Write a Python program using dictionaries to store and display employee details.	**02**
09	Create a Python script to read and write data from/to a text file.	**02**
10	Write short notes on NumPy, Pandas, and Matplotlib with small sample codes.	**02**

Term Work: Term Work shall consist of at least 12 to 15 practicals based on the above list. Also, Term work Journal must include at least 4 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30)
16122208	**IDEA LAB - (Innovation Design Engineering and Apply)**	1	--	2	15	--	30	15	60	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of 2 Tests				
16122208	**IDEA LAB - 1(Innovation Design Engineering and Apply)**	--	--	--	--	50	50	100

Rationale :

Aligned with the National Education Policy (NEP) 2020, the institution emphasizes experiential, interdisciplinary, and project-based learning through the IDEA Lab—a central hub for hands-on innovation.

To strengthen the undergraduate research ecosystem, the institution has adopted a theme-based academic model aligned with UN SGD. Each semester features six curated problem statements based on local need and aligned with core subjects in the same semester, enabling students to apply classroom knowledge to real-world challenges. Every student selects one problem and develops an individual, subject-integrated solution—enhancing both academic understanding and research skills.

The IDEA Lab supports this initiative with facilities for design thinking, prototyping, and product development. Students maintain a project logbook throughout the semester to track their progress and reflections.

To ensure academic accountability, a two-tier assessment framework is implemented:

- Project Assessment based on standardized IDEA Lab rubrics.

- Subject-Based Term Work Assessment focused on the application of same-semester subject knowledge in the project.

Lab Objectives:

1. To promote experiential and project-based learning that bridges theoretical knowledge with real-world problem-solving.
2. To encourage interdisciplinary integration by enabling students to apply concepts from multiple subjects within a single cohesive project.
3. To develop innovation and design thinking skills through hands-on activities and iterative solution development.
4. To foster critical thinking and creativity by engaging students in open-ended problems with multiple solution pathways.
5. To enhance communication, collaboration, and documentation skills essential for professional engineering practice.
6. To build an entrepreneurial and research mindset by guiding students to develop scalable, socially-relevant, and technically viable prototype

Lab Outcomes: Student will be able to

1. Recall and articulate key concepts from core and allied subjects relevant to the assigned project.
2. Explain the interdisciplinary nature of the problem and the role of each subject in addressing it.
3. Apply appropriate tools, techniques, and theoretical knowledge to develop project components.
4. Analyze problem constraints and user requirements to structure a feasible and efficient solution.
5. Evaluate multiple design options and justify the chosen solution based on technical and practical considerations.
6. Create a functional prototype or solution that demonstrates innovation, utility, and integration of interdisciplinary knowledge

1) Guidelines for IDEA Project

a) Project Guidelines (Interdisciplinary Project Execution in IDEA Lab)

- Each student works on an individual interdisciplinary project aligned with the semester theme.
- Faculty in-charges for the IDEA Lab are assigned according to the complexity of the project and the capacity of the respective departments.
- Faculty in-charges mentor both the academic and technical aspects, and track weekly progress.
- Project assessment will be rubric-based, ensuring depth, innovation, documentation, and ownership.
- Students shall convert the best solution into working model using various components of

their domain areas and demonstrate.

- Faculty in-charges must attend relevant FDPs to ensure uniformity in mentoring and evaluation.

b) Guidelines for same semester Subject Concepts Applied within the Project

- Termwork for each subject will partially reflect how well a student applies subject-specific concepts in their interdisciplinary project.
- Internal assessment panel will collaborate to align project components with subject learning outcomes.

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c) Role of Faculty In-Charges in IDEA Lab Projects

Faculty in-charges play a pivotal role in the success of interdisciplinary, theme-based projects under the IDEA Lab. Their responsibilities extend beyond technical supervision to include academic alignment, innovation facilitation, and active student engagement. Their key roles include:

1. **Motivating and Inspiring Students**
   - Encourage students to take ownership of their learning and projects.
   - Cultivate a mindset of curiosity, exploration, and social relevance.
   - Foster an environment where students feel empowered to take creative risks.
2. **Conducting Brainstorming and Ideation Sessions**
   - Organize structured brainstorming sessions at the start of the semester to help students define their problem statements and solution pathways.
   - Promote collaborative thinking, design exploration, and interdisciplinary integration.
3. **Arranging Guest Lectures and Expert Talks**
   - Identify and invite industry experts, researchers, and innovators for guest lectures aligned with the semester's theme or subject areas.
   - Facilitate exposure to real-world challenges, current trends, and future opportunities.
4. **Ensuring Uniqueness and Originality of Projects**

- Actively review proposed ideas to ensure **no duplication of solutions** across students.
- Encourage students to explore novel approaches, technologies, and perspectives.

5. **Promoting Discussion and Collaborative Learning**
   - Create platforms for students to present, discuss, and receive peer and mentor feedback.
   - Facilitate idea refinement through regular discussions and group engagement.
6. **Aligning Subject Content Beyond Syllabus**
   - Faculty in-charges must **align subject content beyond the syllabus of the same semester** with the **IDEA Lab theme and assigned problem statements**.
   - This ensures relevance, depth, and meaningful interdisciplinary integration.
7. **Same Semester Faculty Requirement**
   - Faculty in-charges must be teaching subjects in the **same semester** as the students' project to ensure seamless academic integration and contextual understanding.
8. **Monitoring and Documentation**
   - Oversee project logbook maintenance, milestone tracking, and submission of progress reports.
   - Provide ongoing feedback and ensure project alignment with learning outcomes.
9. **Coordination with Subject Faculty**
   - Work in collaboration with other subject faculty to help students embed theoretical and practical aspects of their coursework into the project.
   - Facilitate subject-term mapping and contribute to termwork assessment based on evidence.

2) Implementation Strategy

a) Project Implementation in IDEA Lab

Aspect	Implementation Strategy
Faculty in-charges	**Faculty in-charges assigned based on project nature and department capacity.**
Mentoring Role	**Faculty in-charges oversee academic/technical development, interdisciplinary integration, and timely documentation.**
Capacity Building	**Faculty in-charges undergo workshops on design thinking, innovation, assessment rubrics, and outcome-based mentoring.**

Aspect	Implementation Strategy
Assessment Contribution	**Faculty in-charges contribute to 25 marks allocated for the IDEA Lab project termwork. The remaining assessments are conducted by the external examiner.**
Recognition & Incentives	**Faculty in-charges receive workload credits or are formally acknowledged in performance reviews.**

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b) Implementation of Subject-Term Work Mapping within Projects

Aspect	Implementation Strategy
Mapping Subject Outcomes	**Faculty in-charges align their content beyond syllabus with the student's project by coordinating with the assigned project guide.**
Independent Evaluation	**Internal assessment panel evaluate students based on their application of subject-specific concepts within the project. This contributes to a** separate 25 marks allocated for termwork based on subject **application.**
Evidence Sources	**Evaluation is supported by project logbooks, subject-specific deliverables (e.g., tools, simulations, models), and review presentation inputs.**
Outcome Assurance	**Ensures practical demonstration of subject understanding and its integration into the interdisciplinary solution.**

Implementation Notes:

- Guide faculty assess their course's contribution using specific evidence such as:
  - Logbooks
  - Subject-specific outputs (e.g., simulations, designs)
  - Paper publications or review presentations

2) Guidelines for Assessment

Two-tier rubrics are applied independently to evaluate subject concept application and innovation within the project.

a) Assessment of IDEA Lab Projects (Individual Interdisciplinary Projects) (25 Marks)

Presentation-Based Assessment Structure (Total: 25 Marks)

Assessment Month	Weightage	Marks
Month 1 (Formative 1)	20%	5 marks
Month 2 (Formative 2)	40%	10 marks
Month 3 (Formative 3)	40%	10 marks

Rubric-Based Evaluation Criteria

Criteria	Month 1 (5)	Month 2 (10)	Month 3 (10)
Problem Understanding	Connects problem to subjects	Defines interdisciplinary scope	Demonstrates deep conceptual grasp
Subject Knowledge Application	Identifies relevant concepts	Applies principles in design	Integrates multiple subject areas correctly
Innovation & Design Thinking	Proposes creative idea	Develops and tests feasible solution	Final solution shows originality and utility
Documentation & Presentation	Logbook initiated, plan presented	Mid-design log and visuals	Final report and demo completed
Progress & Ownership	Meets deadlines, shows planning	Demonstrates self-motivation	Completes project independently with reflection

b) Term Work Assessment of Subject Concepts Applied in Projects (25 Marks)

Applicable to All Subjects Integrated with Interdisciplinary Projects

To reflect meaningful application of subject knowledge, each subject will be assessed through the following rubric:

Criteria	**Marks**	**Description**
Subject Knowledge Application	8	Depth and accuracy of concept integration into the project
Practical Design or Tool Usage	5	Use of subject-specific hardware/software/simulation/tools
Documentation	4	Quality and clarity of subject-related logs and reports
Viva/Presentation	4	Ability to explain subject's relevance and role in the project
Continuous Engagement	4	Evidence of consistent participation via logbooks and feedback

c) Total Assessment Structure

Component	Marks	Assessed By
Termwork – Project Execution	25 Marks	Project Guide
Termwork – Application of Subject Concepts	25 Marks	IDEA Lab Panel
Viva Voce (Final Evaluation)	50 Marks	External Examiner

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30
16212209	Basic Fluid Mechanics Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
16212209	Basic Fluid Mechanics Lab	--	--	--	--	25	25	50

Lab Objectives:

1 . Understand basic fluid properties and behaviors through experimental techniques.

2 . Apply theoretical principles such as Bernoulli's and Pascal's laws in laboratory conditions.

3 .Demonstrate fluid flow measurements using standard hydraulic devices and instruments.

4. Analyze energy losses in fluid systems under different flow and fitting conditions.

5 .Visualize fluid flow patterns and behavior in open channels and pipes.

6 .Introduce fundamental fluid machines (pumps, turbines) and flow-related structural behaviors.

Lab Outcomes:

After completion of the course, Students shall be able to

1 Measure and interpret viscosity, pressure, and flow using appropriate instruments.

2 Apply conservation laws to analyze pressure and velocity changes in fluid flow.

3 Quantify head loss and energy losses in pipelines and open-channel flows.

4 Visualize flow phenomena and interpret experimental results using theoretical principles.

5 Understand and analyze flow behavior through notches, orifices, and meters.

6 Describe and demonstrate performance characteristics of fluid machinery and floating structures.

List of Experiments.

Sr No	List of Experiments	Hrs

01	Determination of Viscosity of a Fluid Using Stokes' Law	2
02	Verification of Bernoulli's Theorem	2
03	Use of Manometers for Pressure Measurement	2
04	Flow Visualization using Dye Injection	2
05	Friction Loss Measurement in Pipe Flow	2
06	Minor Losses in Bends and Fittings	2
07	Demonstration of Flow through Open Channels	2
08	Observation of Hydraulic Jump in a Rectangular Channel	2
09	Flow Through Notches	2
10	Flow through Orifice	2
11	Flow through Venturi meter	2
12	Flow through Orifice meter	2
13	Stability of Floating Body (Metacentric height of ship Body)	2
14	Study of Wind tunnel	2
15	Demonstration of Centrifugal Pump and Hydraulic Turbine – Working Principle and Performance Observation	2

Sr No	**List of Assignments / Tutorials**
01	Questions Based on Module I and Crate PPT based on self-learning topics of module I
02	Questions Based on Module II and Crate PPT based on self-learning topics of module II

03	Questions Based on Module III and Crate PPT based on self-learning topics of module III
04	Questions Based on Module IV and Crate PPT based on self-learning topics of module IV
05	Questions Based on Module V and Crate PPT based on self-learning topics of module V
06	Questions Based on Module VI and Crate PPT based on self-learning topics of module VI

Text Books:

1. 1. Fluid Mechanics by Dr. A. K. Jain, Khanna Publishers.
2. 2. Fluid Mechanics and Fluid Machinery by R. K. Bansal, Laxmi Publications.
3. 3. A Textbook of Fluid Mechanics and Hydraulic Machines, Rajput, R. K, S. Chand Publishing

References:

4. Fluid Mechanics and Hydraulic Machines by McGraw Hill Education (India).
1. Fluid Mechanics by R. J. Garde, A.J Mirajgaonkar, SCITECH Publication.
2. Fluid Mechanics by K. Subramanya, McGraw Hill.
3. Fluid Mechanics by Frank White, McGraw Hill.

Online Resources:

Sr. No.	**Website Name**
1.	Virtual Lab

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

R-2025- F.E. Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30)
16412210	Engineering Workshop II	--	--	2	--	--	30	15	45	1.5

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT- 1	IAT-2	IAT-1 + IAT-2				
16412210	Engineering Workshop II	--	--	--	--	25	—-	25

Lab Objectives:

1. To understand and implement the fundamental safety rules, personal protective measures, and standard operating procedures essential for preventing accidents and ensuring a safe working environment in the engineering workshop.
2. To develop skills in using hand tools for fitting operations by performing basic metal cutting, filing, marking, and fitting exercises while following proper safety and operational procedures.
3. The objective is to enable students to understand different types of welding joints, select appropriate electrodes and equipment, and fabricate simple welded components while following standard safety procedures and workshop practices.
4. To introduce students to basic IOT and embedded systems by programming a NODE MCU ESP8266 micro controller to blink an LED..
5. To introduce students to fundamental robotics concepts through the assembly and programming of a basic line following robot.
6. To understand flight dynamics, sensor integration, remote control systems, and applications of drones in real-world.
7. Identify different types of 3D printers (FDM, SLA, SLS) and their components

Lab Outcomes: At the end of the course, the student will be able to

1. Able to Understand and follow standard safety rules and operating procedures for tools and machinery.
2. Able to identify and correctly use common fitting tools such as files, hacksaws, bench vices, punches, scribers, and hammers.
3. Able to Identify various types of welding processes such as gas welding, arc welding, and spot welding, along with their applications.
4. Able to collect data from sensors and control actuators using boards like Arduino, NodeMCU, or Raspberry Pi.
5. Able to Write and implement code to control robotic motion using microcontrollers like Arduino, Raspberry Pi, or other platforms.
6. Able to operate a drone using a remote controller and execute programmed missions using waypoint navigation
7. Able to Perform printer setup, filament loading, calibration, and execute the printing process successfully

Detailed Syllabus

Sr No	Name of Module	Detailed content	Hours	Lo
	Safety and precautions	Lab rules and lab safety, knowledge of proper use of safety kit.	**2**	**LO1**
1	**Fabrication**	Introduction to Fitting Section. ● Introduction to fitting tools, sheets ● Fitting job Introduction to welding section ● Introduction to types of welding machine , safety as well as types of welding etc. ● Lap Joint Job.	**6** **4**	**LO2** **LO3**
		Self learning https://youtu.be/deHaqv7WX5I?feature=shared(welding) https://youtu.be/NwWpuRfZDjI?feature=shared https://youtu.be/y-OKi8oSNQ4?feature=shared	**3**	
2	**Introduction to IOT and Embedded system**	Programming a NodeMCU ESP8266 microcontroller to blink an LED. ● Introduction to NODE MCU and IOT. ● Circuit setup and IDE configuration. ● Setting up Arduino IDE for ESP8266. Experimenting Variation and Discussion	**4**	**LO4**
		Self Learning Connect the DHT sensor to the NodeMCU. Write and upload a program using Arduino IDE to read temperature data. Write and upload a program using Arduino IDE to read temperature data. Send the data to Thing Speak (or any IoT dashboard). Visualize the readings on a real-time graph.	**3**	
3	**Introduction to Robotics**	Programming a basic line following robots ● Introduction to robotics and components	**4**	**LO5**

		• Assembling a line following robots • Programming the robot. Testing and evaluation		
		Self learning Build and Control a Basic Line-Following Robot (Modify the code to adjust speed based on curves.)	**3**	
4	**Introduction to drone technology**	Introduction to drone • Components familiarizations • Drone assembly • Calibration and coding upload • Flight testing and troubleshooting	**4**	**LO6**
		Self Learning Studying basic principle of drone Studying drone programming Basic drown fundamentals	**3**	
5	**Introduction to 3D Printing**	To design and print your first object • Introduction and basics. • 3d modelling • Slicing and preparing the print	**6**	**LO7**
		Self Learning Explore process parameter of 3d printer Explore 2d and 3d drafting and modelling	**3**	

Reference Books

1. Workshop Technology (Vol. 1)by S.K. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy
2. Welding Technology by O.P. Khanna
3. IoT: Building Arduino-Based Projects by Peter Waher.

4. Robotics: Modelling, Planning and Control by Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo.
5. 3D Printing: A Practical Guide for Librarians by Sara Russell Gonzalez, Denise Beaubien Bennett.
6. Make: DIY Drones for the Evil Genius by Ian Cinnamon.

Online Resources

Sr No	Reference
1	https://onlinecourses.nptel.ac.in/noc21_cs17 -Introduction to internet of things, by Prof. Sudip Misra , IIT Kharagpur
2	https://onlinecourses.nptel.ac.in/noc21_cs08 -Embedded Systems Design, By Prof. Anupam Basu, IIT Kharagpur
3	https://onlinecourses.nptel.ac.in/noc25_ae30/preview -Drone Systems and Control, By Prof. Suresh Sundaram, Dr. Rudrashis Majumder
4	https://onlinecourses.swayam2.ac.in/ntr25_ed66/preview - 3D Printing and Design for Educators, By Dr. Sharad K. Pradhan

Suggested list of Experiments:

Sr No	List of Experiments	Hrs.
01	Fitting Job	6
02	Lap joint Job.	4
03	Blinking LED with Node MCU.	4
04	Built and test basic Line following robot	4
05	Design and Print your first object.	6
06	To assemble and understand working of mini drone.	4

Assessment for Term Work (25 marks)

- **Term Work Marks:** 25 Marks (Total marks)
- **Job and Manual**:- 20 Marks
- **Regularity and active involvement:-** 5 Marks

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned					Total Credits (C)
		L	T	P	L	T	P	SL	Notional Learning Hour	(Notional Learning Hour/30
98441211	Indian Knowledge System	2	-	-	30		-	30	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
98441211	Indian Knowledge System	20	20	40	60	2.5	--	--	100

Rationale:

The Indian Knowledge System (IKS) is vital for preserving India's rich cultural heritage, fostering holistic and sustainable practices, and integrating ancient wisdom with modern science to address contemporary challenges and enrich global knowledge.

Course Objectives:

1. To explore and understand the evolution of Indian scientific thought
2. To evaluate the historical and modern educational systems in our country.
3. To analyse sustainable practices in in ancient India.
4. To know the richness of Indian Arts and Culture
5. To understand the contributions of Indian Scientists and Nobel Laureates
6. To understand the principles of good governance.

Course Outcomes:

1. Recognize the sources and concepts of the Indian knowledge system
2. Learn about our history of Indian ancient knowledge and its significance in the current scenario.
3. Demonstrate sustainable development in various fields like Science, Technology, agriculture, industry, architecture performing arts, etc.
4. Understand and appreciate the rich heritage that resides in literature
5. Learn about the ancient Bhartiya education system in comparison with the modern era
6. Showcase the multi-dimensional nature of IKS and its importance in modern

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	1.Students should have the foundational knowledge and skills necessary for a comprehensive understanding of IKS 2. Students should be familiar with the Indian Culture, Language, and History of Science and Technology in India.		

I	**Introduction to The Indian Knowledge System (I.K.S.)**	Basic knowledge and scope of IKS, IKS in ancient India and modern india,, Preservation of culture, tradition and Dharma through education. Sources of Education, Aim of Education, Curriculum, methods of learning, Reviving, Knowledge (Ancient Scientific Discoveries) **Self-Learning Topics: Macaulay's Education Policy and Max Mullar Ideology in destroying Indian Tradition**	5 5	CO2
II	**Development of Scientific Thoughts in Ancient India**	Development in Science, Technology, Astronomy, Mathematics, and Life Sciences – Life Science, Physiology, Ayurveda, etc. Discoveries during Ancient times **Self-Learning Topics: Technological Innovations in Ancient India, Architecture and Engineering**	5 5	CO1
III	**Development of Arts & Culture in India**	Development of Arts & Culture in India, Introduction to Ancient Architecture (Arts, Forts, Paintings, Sculpture, Temple architecture, etc.), Development in performing arts & culture: Music, Art of singing, Art of dancing, Natyakala, Cultural traditions and Folk arts **Self-Learning Topics: Origin and Evolution of Indian Classical Music and Dance, Natyashastra by Bharata Muni, Handicrafts and Decorative Arts**	5 5	CO4
IV	**Good Governance in Ancient India**	Introduction to Indian religions,Moral and Ethical Governance,Vishva Kalyan through Vasudhaiva Kutumbkam,Principles of Good Governance about Ramayana, Mahabharat, Artha Sastra and Kauṭilyan State,Scientific Explanation of Vedic or traditional system of	5	CO6

		society for Good Governance **Self-LearningTopics:Governance Models and Kingdoms, Court System and Judges, Crime, Punishment & Fairness**	5	
V	**Contribution of Indian Scientist & Nobel Laureates**	Baudhayan, Aryabhatta, Brahmgupta, Bhaskaracharya, Varahamihira, Nagarjuna, Susruta, Kanada & Charak Rabindranath Tagore, C.V. Raman, Har Gobind Khorana, Mother Teresa, Subrahmanyan Chandrasekhar, Amartya Sen, V.S. Naipaul, Venkatraman Ramakrishnan, Kailash Satyarthi and Abhijit Banerjee **Self-Learning Topics: Indian Contributions to Global Science**	5 5	CO5
VI	**Sustainable Practices in Ancient India**	Agriculture, waste management, water conservation, forest conservation, architecture, urban planning, biodiversity preservation, etc Yoga, Pranayama, and meditation for health and well-being. **Self-Learning Topics: Vaastu Shastra Principles, Minimalism and Non-materialism**	5 5	CO3
		Total	**60**	

Text Books:

1. A.K Bag, History of technology in India (Set 3 vol), Indian Nation Science Academy, 1997.
2. An Introduction to Indian Knowledge Systems: Concepts and Applications, B Mahadevan, V R Bhat, and Nagendra Pavana R N; 2022 (Prentice Hall of India).
3. Ancient Indian Knowledge: Implications To Education System, Boski Singh; 2019
4. India's Glorious Scientific Tradition by Suresh Soni; 2010 (Ocean Books Pvt. Ltd.)
5. Indian Art: Forms, Concerns, and Development in Historical Perspective (History of Science, Philosophy and Culture in Indian Civilization), General Editor: D.P. Chattopadhyaya, Ed. By. B.N. Goswamy; 1999 Munshiram Manoharlal Publishers Pvt. Ltd.
6. Indian Knowledge Systems: Vol I and II, Kapil Kapoor and A K Singh; 2005 (D.K. Print World Ltd).
7. Pandey, K.K. Kriya Sarira Comprehensive Human Physiology, Chaukhambha Sanskrit series, Varanasi, 2018
8. Shukla Vidyadhar & Tripathi Ravidatt, Aayurved ka Itihas evam Parichay, Chaukhambha Sanskrit Sansthaan, New Delhi, 2017
9. Textbook on The Knowledge System of Bharata by Bhag Chand Chauhan; 2023 (Garuda Prakashan) 6. Pride of India- A Glimpse of India's Scientific Heritage edited by Pradeep Kohle et al. Samskrit Bharati; 2006
10. Traditional Knowledge System in India, Amit Jha
11. J. K. Bajaj and M. D. Srinivas, Timeless India Resurgent India, Centre for Policy Studies, Chennai, 2001.

Online References:

Sr. No.	Website Name
1.	https://swayam.gov.in/explorer?searchText=iks
2.	https://iksindia.org/book-list.php
3.	https://iksindia.org/index.php

Assessment:

Internal Assessment:

Assessment consists of **one** class test of 20 marks, the first class test is to be conducted when approx. 50% syllabus is completed and **second** assessment will be of 20 marks based on field visit/case study report/PPT presentation. Duration of written test shall be one hour.

The End Semester Theory Examination shall consist of a total of 60 marks.

- **Question paper format**
- Question Paper will comprise of a total of six questions each carrying 15 marks Q.1 will be compulsory and should cover maximum contents of the syllabus
- Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of four questions need to be answered

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour / 30)
16461212	NSS & Civil Defence	-	-	4*	-	-	60	-	60	2

*: Students need to complete 60 hours throughout the semester as it is not possible to get 4 hours /week due to the dynamic schedule of the Government agencies.

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
16461212	NSS & Civil Defence	--	--	--	--	--	25	--	25

Rationale:

The National Service Scheme (NSS) is a central sector scheme of the Government of India aimed at developing the personality of students through community service. The NSS syllabus is designed with a strong rationale that aligns with the educational, social, and developmental goals of the nation. The NSS syllabus promotes the all-round development of students by instilling values such as discipline, leadership, empathy, and teamwork. It encourages experiential learning beyond the classroom, complementing academic education.

R-2025- Mechanical Engineering

Course Objectives:

1. To Introduce National Service Scheme to learners and explain how it is used in current social studies.
2. To make the students aware of the need of having a foundation in social science and NSS.
3. To develop the personality of NSS volunteers through community service. It can enhance the personal growth and social skills of students.
4. To introduce students to social concepts and issues in society, as well as to get involved in resolving social issues.
5. To equip NSS volunteers with basic skills in civil defence, first aid, fire safety, and crowd management, enabling them to act as first responders during emergencies.
6. To build awareness, preparedness, and responsiveness among NSS volunteers to effectively assist in disaster situations.

Course Outcomes:

1. **Describe** the fundamentals and history of the National Service Scheme (NSS), with specific reference to its role in social work and nation-building.
2. **Demonstrate** understanding of NSS-related procedures, including organizational structure, volunteer enrollment, and activity planning.
3. **Participate** in community-based social service activities such as voter awareness drives, campus cleanup, tree plantation, and cyber safety campaigns.
4. **Develop** leadership, team-building, and project management skills through planning and executing NSS activities.
5. **Explain** the basic concepts of civil defence and disaster response mechanisms.
6. **Apply** practical skills in fire safety, first aid, and emergency management during simulated and real-life situations.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Leadership & Personality development**	Meaning, definition, qualities, and characteristics of a Leader. Meaning of personality, Dimensions of personality. Personality and Leadership nexus. Universal Human Values and Ethics for youths, Sustainable Development Goals	06	CO1

II	**Activity Based Programmes**	(Colleges can plan various social activities for learners and make a detailed report) Activities can be conducted throughout the academic year .Evaluation will be based on record keeping of the attendance of the learner.	10	CO2
III	**Awareness based Programmes**	Awareness Programmes such as Rally, Seminar, Workshops, poster making, theme based rangoli making , essay writing, slogan writing, quizzes , Celebration of National and International days, Personality Development Programmes, Group Activities, etc.,	10	CO3
IV	**Area Based Projects**	Visit to Adopted villages, Swatchatha \Programme, Visit and Conserving Ancient monuments and heritage site, Socio Economic Survey of village/slum, Nature Camp, Environmental Education, Women Empowerment Programme, Health and hygiene programmes and Blood donation, Legal awareness Programme, Literacy Programme, Cyber theft awareness Water Conservation Programme and RWH, One Day Special Camp in a village (preferably in adopted village/Adopted areas/Slums/MR Schools etc.).	14	CO4
V	**Introduction to Civil Defence and Disaster Management**	Definition and objectives of civil defence, Structure and functions of the Civil Defence Organization, Types of disasters: natural and man-made, Phases of disaster management: prevention, preparedness, response, recovery, NDMA (National Disaster Management Authority) and its role, Role of youth in disaster management	10	CO5
VI	**Basics of Fire Safety and First Aid**	Types of fires and fire extinguishers, Basic fire-fighting techniques, First aid for common injuries: bleeding, fractures, burns, CPR, Emergency numbers and response protocol, Evacuation techniques	10	CO6
		Total	60	

Text Books:

1. National Service Scheme Manual 2006, Government of India
2. Salunkhe P.B. Ed, Chhatrapati Shahu the Pillar of Social Democracy
3. National Service Scheme Manual, Govt. of India
4. Training Programme on National Programme Scheme TISS
5. Orientation Courses for N.S.S. Programme Officers, TISS

Online References:

Sr. No.	Website Name
1.	https://nssmu.in
2.	https://nss.gymkhana.iitb.ac.in/home

Assessment:

Term work (TW) for 25 marks:

- Term Work (TW) will comprise a **report submitted by the students, detailing the 60 hours** of social service completed during the semester as per the assigned projects and activities.

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
16471213	**Audit Course (non-graded)**	3	-	-	3	-	-	-

Audit Course: Developing a Research Ecosystem @ SLRTCE

This audit course is specifically designed for students keen on exploring the multifaceted world of research within an engineering context. It offers a unique opportunity to gain a comprehensive understanding of the essential components that drive a vibrant research ecosystem, without the pressure of examinations or academic credit. Students auditing this course are expected to actively participate in class discussions and complete assigned work, thereby enriching their educational experience beyond the confines of their core curriculum.

Course Objectives:

The primary objective of this audit course is to equip students with foundational knowledge and practical insights into key areas crucial for cultivating a strong research culture in engineering colleges. By the end of this course, students will:

- Understand the significance of Intellectual Property Rights (IPR) in academic research.
- Differentiate between various forms of IPR, including Copyright and Patents, and their implications.
- Gain an introductory understanding of the patenting process.
- Learn the fundamental principles of effective research paper writing.
- Develop skills in structuring and writing compelling research proposals.
- Appreciate the ethical considerations and best practices in academic research.

Course Structure:

This course will be delivered in Semester 2 through three weekly lectures, each focusing on a specific aspect of the research ecosystem. The interactive nature of the lectures will encourage active participation, critical thinking, and collaborative learning.To ensure relevance and specialized learning, each department is empowered to customize the course content based on their unique discipline.

2. S.E Syllabus

SEM III MECHANICAL ENGINEERING

Theme: Sustainable Engineering Solutions for Climate Action and Industrial Innovation

Aligned with UNSDG 9: Industry, Innovation and Infrastructure, UNSDG 13: Climate Action, UNSDG 8: Decent Work and Economic Growth

Keywords: Accessible, digital literacy, disabilities

This theme allows students to apply their technical knowledge from subjects like thermodynamics, materials science, and strength of materials toward solving real-world sustainability challenges while developing entrepreneurial skills to implement these solutions commercially. The integration of environmental science ensures they understand the broader impact of their engineering decisions.

For Decent Work and Economic Growth (UNSDG 8):

- **Employment Opportunities:** Aims to reduce unemployment and underemployment, especially among youth and marginalized groups.
- **Inclusive Economic Growth**: Encourages GDP growth that benefits all segments of society, ensuring equity and poverty reduction.
- **Promotes Workers' Rights**: Advocates for safe work environments, fair wages, and labor rights across industries.
- **Boosts Productivity and Innovation:** Encourages entrepreneurship, skill development, and technology integration for sustainable growth.

For Industry, Innovation and Infrastructure (UNSDG 9):

- **Resilient Infrastructure:** Supports construction and maintenance of roads, bridges, and networks vital for economic and social development.
- **Encourages Technological Progress**: Drives innovation and research, which are key to sustainable development and competitiveness.
- **Industrial Development:** Strengthens domestic industries, supports SMEs, and creates job opportunities in manufacturing and technology sectors.
- **Reduces Inequalities**: Inclusive infrastructure and technology access help bridge urban-rural divides and support equitable development.

For Climate Action (UNSDG 13):

- **Mitigates Global Warming**: Focuses on reducing greenhouse gas emissions to limit global temperature rise.
- **Enhances Disaster Preparedness**: Promotes resilience to climate-related disasters like floods, droughts, and storms.
- **Protects Ecosystems**: Helps preserve biodiversity, forests, and natural resources threatened by climate change.
- **Encourages Global Cooperation**: Promotes climate justice, international agreements (like the Paris Agreement), and sustainable policies worldwide.

Problem Statement

Problem Statement 1. A Smart Solar-Powered Water Purification System

Solar-powered water purification system for rural communities that can process 1000 liters/day of contaminated water. The system must be cost-effective, environmentally sustainable, and manufacturable with precise tolerances.

Problem Statement 2: Autonomous Electric Vehicle Charging Station with Renewable Energy Integration

An autonomous electric vehicle charging station powered by hybrid renewable energy sources (solar + wind) with intelligent load management and structural durability for 20-year lifespan in harsh weather conditions.

Problem Statement 3: Intelligent Waste-to-Energy Conversion System for Industrial Applications

A modular waste-to-energy system that converts industrial organic waste into usable energy while meeting environmental regulations. The system must be scalable, efficient, and economically viable for small-to-medium enterprises.

Problem Statement 4: Smart Precision Agriculture Drone with Autonomous Operations

A fully autonomous agricultural drone system for precision farming that can monitor crop health, apply fertilizers/pesticides with precision, and operate continuously with minimal human intervention while being environmentally responsible.

Problem Statement 5: Hybrid Renewable Energy System for Remote Healthcare Facilities

A reliable hybrid renewable energy system (solar, wind, biogas) for remote healthcare facilities that ensures 24/7 power supply for critical medical equipment while maintaining cost-effectiveness and minimal environmental impact.

Problem Statement 6: Smart Manufacturing Cell for Sustainable Automotive Component Production

Industry 4.0 smart manufacturing cell for producing lightweight automotive components using sustainable materials and processes. The system must achieve zero waste, optimal energy efficiency, and real-time quality control while being economically competitive.

S.E SEM III

Course Code	Course Name	Teaching Scheme (Contact Hours Per week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
16211301	Integral Transform and Statistical Techniques	2	1	--	30	15	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-1+IAT-2					
16211301	Integral Transform and Statistical Techniques	20	20	40	60	2.5	25	--	125

Rationale:

In second-year Mechanical Engineering, mathematical tools like transforms, statistics, and numerical methods are essential for analyzing real-world systems. The Laplace Transform helps model dynamic behavior in systems like vibrations and control mechanisms, while the Inverse Laplace Transform allows engineers to interpret time-domain responses such as in spring-damper systems. Fourier Series are useful in analyzing periodic forces acting on rotating or reciprocating machinery. The Z-Transform supports the study of digital control systems used in automation and robotics. Statistical Techniques enable quality control and data analysis, such as evaluating product tolerance or reliability. Numerical Solutions of PDEs are crucial for simulating heat transfer, stress distribution, or fluid flow where analytical methods are insufficient. These topics build a strong foundation for modeling and solving mechanical engineering problems effectively.

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
16211301	Integral Transform and Statistical Techniques	2	1	--	30	15	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
16211301	Integral Transform and Statistical Techniques	20	20	40	60	2.5	25	--	125

Rationale:

In second-year Mechanical Engineering, mathematical tools like transforms, statistics, and numerical methods are essential for analyzing real-world systems. The Laplace Transform helps model dynamic behavior in systems like vibrations and control mechanisms, while the Inverse Laplace Transform allows engineers to interpret time-domain responses such as in spring-damper systems. Fourier Series are useful in analyzing periodic forces acting on rotating or reciprocating machinery. The Z-Transform supports the study of digital control systems used in automation and robotics. Statistical Techniques enable quality control and data analysis, such as evaluating product tolerance or reliability. Numerical Solutions of PDEs are crucial for simulating heat transfer, stress distribution, or fluid flow where analytical methods are insufficient. These topics build a strong foundation for modeling and solving mechanical engineering problems effectively.

R-2025- S.E Mechanical Engineering

Course Objectives:

1. To explain the Laplace transform and its use in solving linear differential equations in mechanical systems.
2. To demonstrate techniques for obtaining time-domain solutions using inverse Laplace transforms.
3. To illustrate how periodic functions are represented using Fourier series in mechanical vibrations and heat transfer.
4. To introduce Z-transforms for analyzing discrete-time systems relevant to digital control in mechanical systems.
5. To teach statistical methods for interpreting experimental data and quality control in mechanical processes.
6. To present numerical methods for solving partial differential equations (PDEs) related to heat and fluid flow.

Course Outcomes:

1. Students will be able to apply Laplace transforms to analyze mechanical systems such as mass-spring-damper models.
2. Students will solve mechanical system responses by computing inverse Laplace transforms of transfer functions.
3. Students will construct Fourier series to analyze periodic behavior in systems such as vibrating beams or rotating shafts.
4. Students will use Z-transform techniques to evaluate the behavior of sampled mechanical control systems.
5. Students will apply statistical tools to interpret data from experiments such as fatigue testing or tolerance analysis.
6. Students will solve PDEs using methods like finite difference to simulate temperature distribution in a heat exchanger or velocity fields in fluid flow.

Prerequisite:

1. Basics of integration and it's properties.
2. Partial differentiation.

R-2025- Mechanical Engineering

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Laplace Transform	Definition of Laplace transform, Condition of Existence of Laplace transform.	05	CO1
		Laplace Transform (L) of Standard Functions like e^{at}, $sin(at)$, $cos(at)$, $sinh(at)$, $cosh(at)$ and $t^n, n \geq 0$.		
		Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by *t*, Division by *t,* Laplace Transform of derivatives and integrals (Properties without proof).		
		Evaluation of integrals by using Laplace Transformation.		
		Self-learning Topics: 1. Heaviside's Unit Step function. 2. Laplace Transform. of Periodic functions. 3. Dirac Delta Function.	08	
II	Inverse Laplace Transform	Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives.	05	CO2
		Partial fractions method to find inverse Laplace transform		
		Inverse Laplace transform using Convolution theorem (without proof).		
		Self-learning Topics: 1. Applications of Laplace Transforms for solutions to ODE to electrical & electronics circuit problems. 2. Applications to solve initial and boundary value problems involving ordinary differential equations.	07	

R-2025- Mechanical Engineering

III	Fourier Series	Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof).	05	CO3
		Fourier series of periodic function with period 2π and $2l$.		
		Fourier series of even and odd functions.		
		Self-learning Topics: 1. Half range Sine and Cosine Series. 2. Complex form of Fourier Series. 3. Fourier Integral	08	
IV	Z-Transform	Definition and Region of Convergence,	05	CO4
		Transform of Standard Functions: $\{k^n a^k\}$, $\{a^k\}$, $\{c^k \sin(\alpha k+\beta)\}$, $\{c^k sinh\alpha k\}$, $\{c^k \cos(\alpha k+\beta)\}$, $\{c^k cosh\alpha k\}$		
		Properties of Z Transform: Change of Scale, Shifting Property, Multiplication, and Division by k.		
		Convolution theorem.		
		Inverse Z transform: Partial Fraction Method		
		Self-learning Topics: 1. Initial value theorem. 2. Final value theorem. 3. Inverse Using Convolution Theorem. 4. Inverse using Binominal expansion. 5. Inverse using long division.	07	
V	Statistical Techniques	Spearman's Rank correlation coefficient (R) (with repeated and non-repeated ranks)	05	CO5
		Lines of regression		
		Fitting of first- and second-degree curves.		

		Self-learning Topics: 1. Karl Pearson's Coefficient of correlation(r). 2. Fitting of exponential curve. 3. Fitting of logarithmic curve. 4. Covariance	07	
VI	Numerical methods for PDE	Introduction of Partial Differential equations, method of separation of variables. Vibrations of string.	05	CO6
		Analytical method for one dimensional heat and wave equations. (only problems)		
		Crank Nicholson method		
		Bender Schmidt method		
		Self-learning Topics: 1. Analytical methods of solving two- and three-dimensional problems. 2. Partial differential equations with constant coefficients 3. Classifications of second order linear partial differential equations.	08	

Text Books:

1. Grewal B. S.: "Higher Engineering Mathematics", Khanna Publishers, 44th Ed., 2021.

2. Kreyszig E.: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed., 2018.

3. Dass H. K.: "Higher Engineering Mathematics", S Chand & Company Ltd, 12th Ed., 2004.

4. Narayan S.: "Differential Calculus", S.Chand Publications, 30th Ed., 2005.

References:

1. Stewart J.: "Multivariable Calculus" Cengage Publications, 7th Ed., 2019.

2. Bali N.P and Goyal M.: "A Textbook of Engineering Mathematics" Laxmi Publications, 10th Ed., 2022.

3. Wylie C. R, Barrett L.C..: "Advanced Engineering Mathematics" McGraw Hill Book Co., New York, 6th Ed., 2017.

4. Ramana B.V.: "Higher Engineering Mathematics", Tata McGraw-Hill Publishing Company Limited, 1st Ed., 2006.

5. Pal S. & Bhunia S. C.: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016.

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/111/106/111106139/
2.	https://www.youtube.com/watch?v=LGxE_yZYigI
3.	https://www.youtube.com/watch?v=lkAvgVUvYvY
4.	https://www.youtube.com/watch?v=XfmbrUBrs5Q

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test.

Term work (TW) for 25 marks:

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per the university pattern for practical.
2. Students must be encouraged to write **at least 10** class tutorials on entire syllabus.

3. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1. Regularity and active involvement (Theory and Tutorial) 05 marks.
2. Class Tutorials on entire syllabus 10 marks.
3. Mini Project 10 marks.

R-2025-Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	**T**	**P**	**L**	**T**	**P**	**SL**	**Notional Learning Hour**	**Total Credits (C) (Notional Learning Hour/30**
1621 1302	**Mechanics of Solid**	3	-	--	45	--	--	45	90	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT 1+ IAT 2					
16211302	**Mechanics of Solid**	20	20	40	60	2.5	--	--	100

Rationale :

Most of the engineering branches are being off-spring of **Mechanical Engineering**, which forms the base for understanding material behavior and structural analysis. The *Mechanics of Solids* course helps

students learn how forces cause stress, strain, bending, deflection, and failure in components like beams, shafts, and columns.
It builds essential knowledge and skills for designing safe and efficient mechanical systems, and prepares students for advanced subjects like Machine Design and Structural Analysis. This subject is useful across many fields, including Civil, Aerospace, and Automobile Engineering.

Course Objectives:

1. **Explain** the basic concepts of different types of forces, loading conditions, and resulting stresses and strains in mechanical components.
2. **Construct** Shear Force Diagrams (SFD) and Bending Moment Diagrams (BMD) for various types of loading and support conditions.
3. **Analyze** shear and bending stresses developed in structural members under external loads.
4. **Evaluate** deflection in beams and stresses in circular shafts using standard methods.
5. **Estimate** deflection and strain energy stored in mechanical elements under different loading conditions.
6. **Examine** the critical buckling load for different types of columns under axial loading.

Course Outcomes: Six Course outcomes (Based on Bloom's Taxonomy)

1) Demonstrate fundamental knowledge about various types of loading and stresses induced.
2) Draw the SFD and BMD for different types of loads and support conditions.
3) Analyse the bending and shear stresses induced in the beam.
4) Analyze the deflection in beams and stresses in the shaft.
5) Analyse the stresses and deflection in beams and estimate the strain energy in mechanical elements.
6) Analyse buckling phenomenon in columns

Prerequisite: Knowledge of Engineering Mechanics.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Types of forces and free body diagrams, Conditions of equilibrium, Centroid and moment of inertia (basics), Basic concepts of friction, Newton's laws of motion (overview)		
I	**Introduction**	**Introduction**-Concept of Stress Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses, Stress Strain Diagram, elastic constants and their relations volumetric, linear and shear strains. Composite sections, Thermal stress and strain.	08	CO1
		Self-learning Topics: Principal stresses and Principal planes- Mohr's circle. Moment of inertia about an axis and polar moment of inertia	08	
II	**SFD & BMD**	Shear Force and Bending Moment in Beams: Introduction to types of beams, supports and loadings. Definition of bending moment and shear force, Sign conventions, relationship between load intensity, bending moment and shear force. Shear force and bending moment diagrams for statically determinate beams subjected to points load, uniformly distributed loads, uniformly	10	CO2

		varying loads, couple and their combinations		
		Self-learning Topics: Beams with multiple loads (point + UDL) Beams with inclined loads (resolve components) Beams with moments applied directly	10	
III	**Stresses in Beams:**	**Stresses in Beams**: Theory of bending of beams, bending stress distribution, shear stress distribution for point and distributed loads in simply supported and overhanging beams, cantilevers.	07	CO3
		Self-learning Topics: Bending + shear Bending + axial loading (e.g., eccentric load) Mohr's Circle for stress transformation	07	
IV	**Deflection of Beams:**	Deflection of a beam: Double integration method, Maxwell's reciprocal theorems for computation of slopes and deflection in beams for point and distributed loads. Torsion: Stresses in solid and hollow circular shafts.	08	CO4
		Self-learning Topics: Torsion: Stresses in solid and hollow circular shafts.	08	
V	**Thin Cylindrical and Spherical Shells and Strain energy**	**Self-learning Topics:** Strain energy stored in the member, Rankine formula	06	CO5
		Thin Cylindrical and Spherical Shells: Stresses and deformation in Thin Cylindrical and Spherical Shells subjected to internal pressure Strain Energy,Buckling load, Types of end	06	

		conditions for column, Euler's column theory and its limitations.		
VI	**Columns**	**Self-learning Topics: Stress and Strain** in eco-friendly and precision components	06	CO6
		Elastic Constants & Stress-Strain Diagrams for sustainable materials **Torsion in Shafts** – for energy systems and smart devices **Bending and Shear in Beams** – for drones, solar frames, and reactors **Principal Stresses and Combined Loading** – in modular and hybrid systems **Factor of Safety & Material Selection** – with focus on green design and durability	06	

Text Books:

1 R. K. Bansal – *A Textbook of Strength of Materials*, Laxmi Publications
2 S. S. Bhavikatti – *Strength of Materials*, Vikas Publishing House
3 R. K. Rajput – *Strength of Materials*, S. Chand
4 B. C. Punmia, Ashok Jain, Arun Jain – *Mechanics of Materials*, Laxmi Publications
5 Dr. Sadhu Singh – *Strength of Materials*, Khanna Publishers

References:

1 Mechanics of Materials by S.S.Ratan, Tata McGraw Hill Pvt. Ltd
2 Strength of Materials by S. Ramamrutham, Dhanpat Rai Pvt. Ltd
3 Strength of Materials by R. Subramanian, Oxford University Press, Third Edition 2016

Online References:

Sr. No.	Website Name
1.	http://www.nptelvideos.in/2012/11/strength-of-materials-prof.html 2.
2.	https://swayam.gov.in/nd1_noc20_ce34
3.	https://www.youtube.com/watch?v=7noPM9bGnFs&list=PL9H2IJVEgfm_wwJm0GIfeCWjHZtpG5VQI

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30
1621 1303	Engineering Thermodynamics	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT- 1	IAT-2	IAT-1 + IAT-2					
1621130 3	Engineering Thermodynamics	20	20	40	60	2.5	--	--	100

R-2025- Mechanical Engineering

Rationale:

Thermodynamics concepts are useful in understanding and designing systems involving energy transfer and energy transformation.

Course Objectives:

1.To familiarize the concepts of Energy in general and Heat and Work in particular

2. To study the fundamentals of quantification and grade of energy

3. To study the effect of energy transfer on properties of substances in the form of charts and diagrams
4. To familiarize with the application of the concepts of thermodynamics in vapour power and gas power cycles.
5. To study the concepts of compressible fluid flow
6. To study the concepts of reactive systems

Course Outcomes:

1. Demonstrate application of the laws of thermodynamics to a wide range of systems.

2. Compute heat and work interactions in thermodynamic systems

3. Demonstrate the interrelations between thermodynamic functions to solve practical problems.

4. Compute thermodynamic interactions using the steam table and Mollier chart

5. Compute efficiencies of heat engines, power cycles.

6. Apply the fundamentals of compressible fluid flow to the relevant systems

Prerequisite:

Thermodynamics system and types, Microscopic and Macroscopic approach, System, Boundary and Surrounding, Thermodynamic properties, Zeroth Law of Thermodynamics

R-2025- Mechanical Engineering

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Thermodynamics system and types, Microscopic and Macroscopic approach, System, Boundary and Surrounding, Thermodynamic properties, Zeroth Law of Thermodynamics, First law of thermodynamics, Internal Energy, Concept of Enthalpy and Entropy	0	
I	**Introduction**	**Introduction and Basic Concepts of Thermodynamics:** Thermodynamic state, path, process and cycle, Point and Path functions, Quasi-static process & Equilibrium, Characteristic gas equation, Heat and Work. Concept of PdV work. **First Law of Thermodynamics:** Statement & Equation, First law for Cyclic process (Joule's experiment), Perpetual Motion Machine of the First Kind, Application of first law to non-flow systems (Ideal gas processes with numerical)	6	CO1

		First law applied to flow system: Concept of flow process and flow energy, Concept of the steady flow process, Energy balance in a steady flow, Application of steady flow energy equation to nozzle, turbine, compressor, pump, boiler, condenser, heat exchanger, throttling device. Steady flow work, Significance of – VdP work, Relation between flow and non-flow work.		
		Self-learning Topics: Ideal gas properties	6	
II	**Second Law of Thermodynamics:**	**Second Law of Thermodynamics:** Limitation of the first law of thermodynamics, Thermal reservoir, Statement of the second law of thermodynamics, Reversible and irreversible Process, Causes of irreversibility, Perpetual Motion Machine of the second kind,Carnot cycle, Carnot theorem. **Entropy:** Clausius theorem, Entropy is property of a system, Temperature-Entropy diagram, Clausius inequality, Increase of entropy principle, T ds relations, Entropy change During a process.	8	CO2
		Self-learning Topics: Concept of heat engine, Heat pump and Refrigerator	8	

III	**Availability:**	**Availability:** High grade and low grade energy, Available and Unavailable energy, DeadState, Useful work, Irreversibility, Availability of closed system & steady flow process, Helmholtz & Gibbs function **Thermodynamic Relations:** Maxwell relations, Clausius-Clapeyron Equation, Mayer relation, Joule-Thomson coefficient	8	CO3
		Self-learning Topics: Concept of Thermal Reservoir.	8	
IV	**Properties of Pure Substance:**	**Properties of Pure Substance:** Advantages and applications of steam, Phase change process of water, Saturation pressure and temperature, Terminology associated with steam, Different types of steam. Property diagram: T-v diagram, p-v diagram, p-T diagram, Critical and triple point, T-s and an h-s diagram for water, Calculation of various properties of wet, dry and superheated steam using the steam table and Mollier chart. **Vapour Power cycle:** Carnot cycle and its limitations as a vapour cycle, Rankine cycle with different turbine inlet conditions, Mean	9	CO4

		temperature of heat addition, Reheat Rankine Cycle.		
		Self-learning Topics: Principal components of a simple steam power plant,	9	
V	**Gas Power cycles:**	**Gas Power cycles:** Nomenclature of a reciprocating engine, Mean effective pressure, Assumptions for Air Standard Cycle, Otto cycle, Diesel Cycle and Dual cycle, Comparison of Otto and Diesel cycle for same compression ratio, Brayton Cycle. Sterling Cycle, Ericsson Cycle, Lenoir cycle, and Atkinson cycle (Only theory).	6	CO5
		Self-learning Topics: Assumptions for Air Standard Cycle	6	
VI	**Waste-to-Energy Thermodynamics :**	Thermochemical conversion: combustion, pyrolysis, gasification Thermodynamic modeling of conversion processes Energy balance and mass balance in waste conversion systems	8	CO6
		Self-learning Topics: Biochemical conversion: anaerobic digestion	8	

Text Books:

Text / References Books:

1. Thermodynamics by P K Nag, 6thEdition,TMH
2. Thermodynamics by Onkar Singh, 4th Edition New Age International
3. Thermodynamics by C P Arora,1stEditionTMH
4. Thermodynamics: An Engineering Approach by Yunus A. Cengel and Michael A. Boles, 9thedition, TMH
5. Basic Engineering Thermodynamics by Rayner Joel, 5thedition, Longman Publishers
6. Engineering Thermodynamics by P Chattopadhyay, 2ndedition, Oxford University Press India
7. Engineering Thermodynamics Through Examples by Y V C Rao, Universities Press (India) Pvt Ltd
8. Fundamentals of Thermodynamics by Moran &Shapiro, Eighth Edition, Wiley
9. Thermodynamics by W.C. Reynolds, McGraw-Hill &Co
10. Thermodynamics by J P Holman, 4th Edition McGraw-Hill & Co

Online References:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/112/105/112105266
2	https://nptel.ac.in/courses/112/103/112103275
3	https://nptel.ac.in/courses/112/105/112105220
4	https://nptel.ac.in/courses/101/104/101104063

R-2025-Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30
1621 1304	**Material Science**	3	-	--	45	--	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT 1+IAT 2					
16211304	**Material Science**	20	20	40	60	2.5	--	--	100

Rationale :

Material Science is a foundation subject that helps engineers understand the relationship between the structure, properties, processing, and performance of materials. It plays a key role in selecting the right materials for various applications in mechanical, civil, electrical, and electronics engineering.

Understanding traditional and advanced materials along with failure mechanisms like fatigue and fracture is essential for efficient and safe engineering design.

Course Objectives: Six Course Objectives

1. To classify various types of engineering materials based on their structure and properties.
2. To understand failure mechanisms like fracture, fatigue, creep.
3. To interpret phase diagrams for understanding alloy formation and microstructures.
4. To analyze the impact of heat treatment processes on material properties.
5. To identify and compare advanced engineering materials and their applications.
6. To understand basic NDT methods.

Course Outcomes: Six Course outcomes (Based on Blooms Taxonomy)

1) To classify the different types of materials used in engineering applications and identify various crystal imperfections, deformation mechanisms and strengthening mechanisms.
2) To describe the various modes of failure mechanisms in engineering materials like fracture, fatigue and creep failure.
3) To interpret iron-iron carbide phase diagram, outline various phases present at different conditions and describe the theory of alloying.
4) To discuss various heat treatment processes, their effects and applications for different ferrous alloys reviewing iron-iron carbide phase diagram and TTT diagram and also explain the effect of alloying elements on properties of various steels and distinguish between tool steel and stainless steel.
5) To distinguish between composites, Nano-materials and smart materials.
6) To classify the different types of NDT used in Engineering Applications

Prerequisite: Knowledge of Physics and Chemistry.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Knowledge of physics :Miller indices, crystal structure and Chemistry: Engineering Materials.		CO1
I	**Introduction**	Concepts of crystals- Crystalline and Non-Crystalline Materials Unit cell, Crystal structures of metals, Crystal systems, Crystallographic planes and directions Crystal Defects: Crystal Imperfections- definition, classification and significance of imperfections -point defects, line defects, Surface defects and volume defects. Importance of dislocations in deformation and its mechanisms. Critical Resolved shear stress, Cold Working and Recrystallization annealing: Definition, effects and mechanism of cold work, Need for Recrystallization Annealing, the stages of recrystallization annealing and factors affecting it, Slip systems and deformability of FCC, BCC and HCP lattice systems	10	CO1
		Self-learning Topics: Definition of Materials, Engineering Materials and Applications, Classification of materials: Introduction to engineering materials – significance of structure	10	

		property correlations in all classes of engineering materials		
II	**Fracture, fatigue and creep**	Fracture of metals, Ductile to Brittle Transition Temperature (DBTT), Griffith's criteria Fatigue – Endurance limit of ferrous and non-ferrous metals -Fatigue test, S-N curves, factors affecting fatigue, structural changes accompanying fatigue; Creep – mechanism of creep – stages of creep and creep test, creep resistant materials	08	CO2
		Self-learning Topics: Strengthening mechanisms in materials, Principles of Fracture ,fatigue and Creep, Difference between Ductile Fracture and Brittle Fracture	08	
III	**Alloy and Phase diagrams**	Solidification of metals and - alloys– Cooling curves Classification of Alloys based on phases and phase Diagram-Binary alloy phase diagram – Isomorphous, Eutectics type I and II, Peritectic Iron-Iron carbide phase diagram – Invariant reactions – microstructural changes of hypo and hyper-eutectoid steel- TTT and CCT Diagram-Hardenability and its tests, Graphitization in cast irons.	06	CO3
		Self-learning Topics: Mechanism of Crystallization- Nucleation-	06	

		Homogeneous and Heterogeneous Nucleation and Growth		
IV	**Heat Treatment**	**Heat treatment:** Annealing and types, normalizing, hardening and tempering, austempering and martempering – microstructure changes Surface hardening processes: Carburizing –, nitriding – cyaniding and carbonitriding, induction and flame hardening, Laser and Electron beam hardening– principles and case depths Alloy steels- Tool steels, Maraging steels and Ausformed steels	08	CO4
		Self-learning Topics: Heat treatment: Overview – Objectives – Thorough treatments: Types of annealing, Microstructure changes during heat treatment, Surface hardening processes, Alloy steels-Stainless steels	08	
V	**Advanced materials**	**Self-learning Topics:** Engineering Materials and their properties, Basic concepts of composites, nano materials, Polymers, Engineering Polymers and Ceramics-types and their advantages over metallic materials	08	CO5
		Composites: Processing of composites, advantages over metallic materials, various types of composites and their applications **Nano Materials:** synthesis of nanomaterials, examples, applications and Nano composites	08	

		Processing of ceramics and composites through Injection Moulding, Introduction to Smart materials: Classification, Shape Memory Alloys and its applications		
VI	**NDT and its Role in Sustainability**	**Introduction to NDT and its Role in Sustainability** – Importance in zero-waste manufacturing, structural health monitoring, Nondestructive Testing of Materials-ultrasonic testing, radiographic methods, magnetic particle testing, Evaluation of Smart and Sustainable Materials using NDT – Testing of composites, polymers, recycled alloys **Case Studies & Selection of NDT Methods for Problem-Specific Needs** – Choosing appropriate NDT for drones, EV stations, modular energy units	05	CO6
		Self-learning Topics: Testing of Materials,Principle and types of **Ultrasonic Testing (UT),**Principle and safety in **Radiographic Testing (RT),** Difference between **X-rays and Gamma rays,** Basics of **Magnetic Particle Testing (MPT),**Equipment used in UT, RT, and MP, Applications and limitations of each method	05	

Text Books:

1 **Callister's** Materials Science and Engineering, 2nd edition by R.Balasubramanium Wiley India Pvt. Ltd
2 **V. Raghavan** – *Materials Science and Engineering*, Prentice Hall
3 **S. H. Avner** – *Introduction to Physical Metallurgy*, McGraw Hill
4 **Kodgire & Kodgire** – *Material Science and Metallurgy*, Everest Publishing House
5 **William D. Callister Jr.** – *Materials Science and Engineering: An Introduction*, Wiley
6 **R. S. Khurmi & R. S. Sedha** – *Material Science*, S. Chand

References:

1 **L. H. Van Vlack** – *Elements of Materials Science and Engineering*, Pearson
2 **Donald R. Askeland & Wendelin J. Wright** – *The Science and Engineering of Materials*, Cengage Learning
3 **S.K. Hajra Choudhury & A.K. Hajra Choudhury** – *Materials Science and Processes*, Indian Book Distributing Co.
4 **R.A. Higgins** – *Engineering Metallurgy: Part I – Applied Physical Metallurgy*, ELBS
5 **Balasubramanian** – *Materials Science*, Wiley India

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-mm09/
2.	https://nptel.ac.in/courses/113/102/113102080/
3.	https://nptel.ac.in/courses/112/104/112104229/
4.	https://nptel.ac.in/courses/118/104/118104008/

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➢ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 15 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30
16212305	Material Science Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT 1+IAT 2				
16212305	Material Science Lab	--	--	--	--	25	25	50

Lab Objectives:

1) To **understand** the working of metallurgical microscopes and characterization techniques.
2) To **prepare** metallographic samples and **apply** suitable etching techniques.
3) To **compare** microstructures and hardness of medium carbon steel before and after heat treatment.
4) **To perform** tensile tests to determine mechanical properties like yield strength and modulus of elasticity.
5) **To conduct** torsion and impact tests to assess material behavior under different loading conditions.
6) **To analyze** the influence of heat treatment and loading on mechanical properties.

Lab Outcomes:

1) **Demonstrate** the use of a metallurgical microscope and explain the principle behind it.
2) **Prepare** and **etch** metallographic samples for microstructural examination.
3) **Analyze** the effect of annealing, normalizing, and hardening on microstructure and hardness.
4) **Perform** tensile testing and **determine** yield strength, ultimate strength, and modulus of elasticity.
5) **Conduct** torsion and impact tests and **interpret** the material behavior under different loads.
6) **Evaluate** structure-property relationships based on experimental observations.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Study of Metallurgical Microscope	2
02	Study of Characterization techniques and Metallographic sample preparation and etching	2
03	Comparison of Microstructures and hardness before and after Annealing, Normalizing and Hardening in medium carbon steel	2
04	Tension test on mild steel bar (stress-strain behaviour, determination of yield strength and modulus of elasticity)	2
05	Torsion test on mild steel bar / cast iron bar	2
06	Impact test on metal specimen (Izod/Charpy Impact test)	2

Sr No	List of Assignments / Tutorials	Hrs
01	Simple stress strain	
02	SFD and BMD	
03	Stresses in beams	
04	Torsion and deflection.	
05	Thin cylinder and strain energy	
06	Buckling of Columns	

Text Books:

1. **R. K. Rajput** – *Strength of Materials*, S. Chand
2. **Kodgire & Kodgire** – *Material Science and Metallurgy*, Everest Publishing
3. **S. S. Bhavikatti** – *Strength of Materials*, Vikas Publishing House
4. **V. Raghavan** – *Materials Science and Engineering*, Prentice Hall
5. **T. K. Pal & H. S. Ray** – *Laboratory Manual in Materials Science*, New Age International

References:

1. **William D. Callister Jr.** – *Materials Science and Engineering: An Introduction*, Wiley
2. **S. H. Avner** – *Introduction to Physical Metallurgy*, McGraw Hill
3. **Donald R. Askeland & Wendelin Wright** – *The Science and Engineering of Materials*, Cengage
4. **E. P. Popov** – *Engineering Mechanics of Solids*, Pearson
5. **Gere & Timoshenko** – *Mechanics of Materials*, CBS Publishers

Online Resources:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/112104034
2.	https://nptel.ac.in/courses/113104070
3.	https://swayam.gov.in/nd1_noc23_me48/preview
4.	https://vlab.amrita.edu/index.php?sub=1&brch=282
5.	https://nptel.ac.in/courses/112105124

Assessment:

Term Work: Term Work shall consist part (a) + (b)

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30
16212306	Machine Drawing-GD & T	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT1 +IAT 2				
16212306	Machine Drawing-GD & T	--	--	--	--	25	25	50

R-2025- Mechanical Engineering

Lab Objectives:

1. To familiarize with different types of drawings and symbols used in working drawings
2. To impart fundamentals of - limits, tolerances and fits used in working drawings
3. To impart fundamentals of- surface roughness, machining symbols and working drawing reading
4. To impart fundamentals of GD & T
5. To familiarize with symbols, rules and datum's used in GD & T
6. To familiarize with form, orientation and position used in GD & T

Lab Outcomes:

After completion of this laboratory course, the students will be able to

1) Read and Interpret appropriate symbols used in working drawings
2) Read and Interpret tolerances used in working drawings
3) Represent the surface roughness components on the working drawing and read the working drawings
4) Show geometric characteristic symbols on a working drawing
5) Apply GD & T symbols in a working drawing
6) Show form and orientation on a part drawing

Prerequisite: ESC201: Engineering Graphics, ESL201: Engineering Graphics Lab

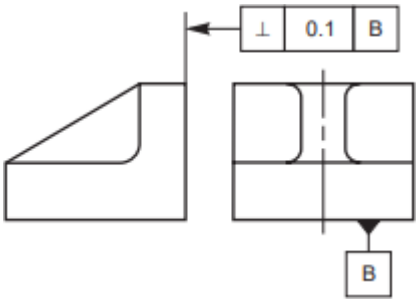
DETAILED SYLLABUS:

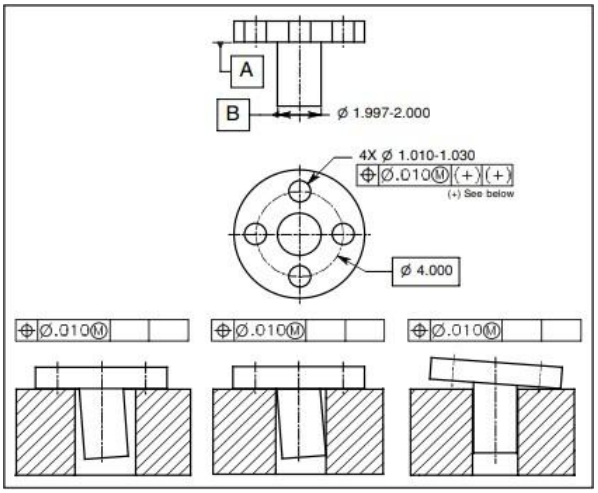
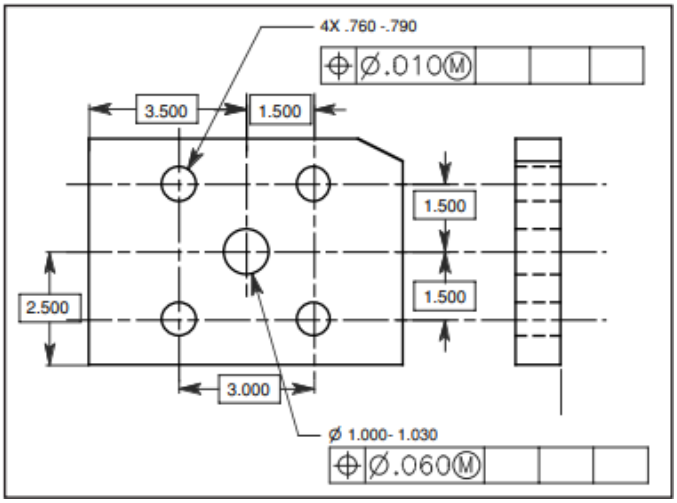
Sr. No.	Module	Detailed Content	Hours	LO (Lab Outcome) Mapping
0	Prerequisite	Engineering Graphics, Engineering Graphics Lab		
I	**Introduction**	Classification of drawings- machine drawing, production drawing, part drawing, assembly drawing and its types, patent drawing, Need of working drawing, difference between machine drawing and working drawing. Conventional representation (symbols) of materials, conventional representation of machine components – screw threads, welded joints, springs, gears, shafts bearings, knurling, Standard drafting and material abbreviations	**04**	**LO1**
II	**Limits, tolerances and fits**	Limit systems and terms used – tolerance, limits, deviation, actual deviation, upper deviation, lower deviation, allowance, basic size, design size, actual size. Tolerances- graphical illustration of tolerance zones, fundamental tolerances, fundamental deviation, calculation of fundamental shaft deviation, calculation of fundamental hole deviation Fits- types of fits with symbols and applications, hole basis and shaft basis systems	**04**	**LO2**

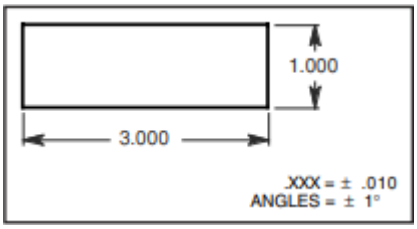
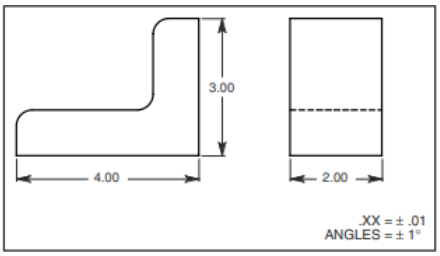
III	**Surface roughness, Machining symbols, working drawing**	Surface roughness representation, indication of surface roughness, symbols specifying direction of lay, indication of machining allowance and surface roughness allowance on drawings, Reading a working drawing	**06**	**LO3**
IV	**Introduction to GD & T**	What is GD & T, when to use GD & T, advantages of GD & T over Coordinate Dimensioning and Tolerance , Geometric characteristic symbols like- Form, Profile, Orientation, Run out , Location, etc.	**04**	**LO4**
V	**Symbols, Rules and Datums**	Geometric characteristic Symbols The feature control frame Rules Form- flatness, straightness, circularity, cylindricity Orientation- Parallelism, Perpendicularity, Angularity Position (general) - Specifying the Position Tolerance, Regardless of Feature Size, MMC, Shift Tolerance, LMC	**08**	**LO5**
VI	**Precision Assembly Design with GD&T**	Apply GD&T to ensure fit/function of filter casing, rotating valve, and manual pump, Use GD&T to ensure the alignment of rotating shafts, baffles, and drum housing, GD&T applied on hinges, modular joints, and locking systems	**04**	**LO5**

R-2025- Mechanical Engineering

List of Experiments.

Sr No	List of Exercises (Using AutoCAD)	Hrs
01	Draw a simple mechanical part (sample part is shown in figure below) and write an interpretation of the meaning of the geometrical tolerances for it by means of neat sketches and explanatory notes.  **Figure for sample exercise:** Sample mechanical part	
02	Students shall draw a simple mechanical part and indicate the following surface roughness components on it: a) Symmetrical surfaces requiring the same quality b) Cylindrical part c) Same surface quality all over	
03	Students shall draw a working drawing of any mechanical component and show following geometric characteristic symbol on it - a) Form (straightness/flatness/circularity/cylindricity) b) Profile (line/surface) c) Orientation (angularity/perpendicularity/parallelism) d) Runout (circular/total) e) Location (position/concentricity/symmetry)	

04	Students shall draw the given mechanical part and complete the feature control frames with datum and material condition symbols (few sample exercises are shown here) Sample exercise 1: Students shall draw the mechanical part and complete the feature control frames with datums and material condition symbols to reflect the drawing shown in figure below-  Figure for sample exercise 1: Datums at MMC and RFS Sample exercise 2: Students shall draw the mechanical part and provide the appropriate datum feature symbols on the drawing and datums in the feature control frames in the datum exercise shown in the figure below-  Figure for sample exercise 2: Specifying datums and datum feature symbols	

05	Draw a simple mechanical part and specify following on it – a) Form- flatness, straightness, circularity, cylindricity b) Orientation- Parallelism, Perpendicularity, Angularity Position (General) - Specifying the Position Tolerance, Regardless of Feature Size, MMC, Shift Tolerance, LMC **Sample exercise (form):** Students shall draw the mechanical part shown in figure below and specify a flatness control of .005 for the top surface of the part-  Sample exercise (orientation): Specify the 3cm surface of the part perpendicular to the bottom and back surfaces within a tolerance of 0.010 shown in figure below: 	

Sr No	List of Assignments	Hrs
01	To write an assignment showing – i. Conventional representation (symbols) of materials ii. conventional representation of machine components – screw threads, welded joints, springs, gears, shafts bearings, knurling, iii. Standard drafting and material abbreviations	

02	Copy of a working drawing of mechanical components (such as- rear tool post, pump housing, gear box cover, steam stop valve, milling fixture, etc.) to be provided to the students along with the questions based on the drawing reading and students shall write answers to the questions based on the drawing reading. Sample questions are provided here- What is the overall size? How many bolts are provided? How many screws are provided? What is the size of the tap? How is the cover fixed to the gear box? (**Note:** These are sample questions and to be customized based on the type of component)	
03	To write an assignment covering - the feature control frame, Material conditions - Regardless of feature size (RFS), Maximum material condition (MMC), Least material condition (LMC), Material condition symbols and abbreviations	

Text Books:

1) Narayana KL, Kannaiah P, Reddy VK, Machine Drawing, by New Age International Publishers
2) Bhatt ND, Machine Drawing, Charotar Publishing House Pvt. Ltd., 50th Edition, ISBN-13: 978 9385039232, 2014

References:

1) Cogorno GR, Geometric Dimensioning and Tolerancing for Mechanical Design: A Self-Teaching Guide to ANSI Y 14.5M1982 and ASME Y 14.5M1994 Standards / Edition 1 by The McGraw-Hill Companies, Inc.
2) Kampbell RG, Roth ES, Integrated Product Design and Manufacturing Using Geometric Dimensioning and Tolerancing, by Marcel Dekker, Inc.
3) Meadows JD, Geometric dimensioning and tolerancing, by B.S Publications.

Online Resources:

Sr. No.	Website Name
1	https://www.gdandtbasics.com/
2	https://www.asme.org/codes-standards/y14-standards
3	http://www.ttc-cogorno.com/Courses/BluePrint.pdf

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practical's based on the above list. Also, Term work Journal must include all the 05 exercises (prints) and 03 assignments.

Term Work Marks: 25 Marks (Total marks) = 20 Marks (Experiment/assignments) + 5 Marks

(Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
98431308	Entrepreneurship Development	2	-	-	30		-	30	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
98431308	Entrepreneurship Development	--	--	--	--	--	25	--	25

Rationale :

Entrepreneurship is a crucial skill in the 21st century, fostering innovation, self-employment, and economic development. This course is designed to equip students with practical entrepreneurial competencies such as ideation, business model development, financial planning, legal frameworks, and pitching.

Course Objectives:

1. Understand and explain the fundamentals of entrepreneurship and startup ecosystems.
2. Generate, validate, and refine business ideas using structured techniques.
3. Develop comprehensive business plans and financial strategies.
4. Explore legal and funding options for startups in India.

5. Apply marketing, digital tools, and CRM for business growth.
6. Design prototypes and present business pitches to stakeholders.

Course Outcomes:

On successful completion of the course learner will be able to:

1) Explain entrepreneurial concepts and analyze types and traits of entrepreneurs.
2) Apply ideation techniques and validate business ideas using customer discovery tools.
3) Create business plans with financial projections and risk analysis.
4) Evaluate funding sources and legal requirements for a startup.
5) Implement digital marketing and branding strategies effectively.
6) Prepare and deliver compelling business pitches with basic prototyping.

Prerequisite: Fundamentals of communication and leadership skills.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Fundamentals of communication and leadership skills.		
I	**Introduction to Entrepreneurship**	Definition, Characteristics, and Types of Entrepreneurs. Entrepreneurial Motivation and Traits. Start-up Ecosystem in India. Challenges in Entrepreneurship	4	CO1
		Self-learning Topics: Evolution of Indian startup ecosystem post-2010 **Case Study**: Nirma – A middle-class entrepreneur revolutionizing detergents.	4	
II	**Business Idea**	Ideation Techniques: Design Thinking, Brainstorming, Mind Mapping.	5	CO2

	Generation & Validation	Business Model Canvas (BMC). Market Research & Customer Validation. Minimum Viable Product (MVP) Concept.		
		Self-learning Topics: Lean Canvas, Persona Creation **Case Study:** Airbnb – Validating the concept with MVP	5	
III	**Business Planning & Strategy**	Writing a Business Plan. SWOT Analysis and Competitive Analysis. Financial Planning and Budgeting. Risk Assessment and Management.	5	CO3
		Self-learning Topics: Financial forecasting using Excel/Google Sheets. **Case Study:** Zomato – Expansion through mergers & strategic pivots	5	
IV	**Funding and Legal Framework**	Sources of Funding: Bootstrapping, Angel Investors, Venture Capital Government Schemes & Start-up India Initiatives. Business Registration & Legal Formalities. Intellectual Property Rights (IPR) & Patents	6	CO4
		Self-learning Topics: DPIIT recognition process and types of funding **Case Study:Paytm –** From Wallet to IPO: Funding journey	6	
V	**Marketing & Digital Presence**	Branding and Digital Marketing. Social Media Marketing & SEO. Customer Relationship	5	CO5

		Management (CRM). E-commerce & Online Business Models.		
		Self-learning Topics: Use of Canva, Google Analytics **Case Study:** Lenskart – Omnichannel e-commerce marketing	5	
VI	**Business Pitching & Prototype Development**	Pitch Deck Preparation & Presentation Techniques. Prototyping with Open-source Tools. Elevator Pitch & Investor Pitch.	5	CO6
		Self-learning Topics: Canva for pitch deck or Successful Start-ups **Case Study:** Dunzo – MVP to final app evolution	5	
Total			30	

Text Books:

1. "Entrepreneurship Development and Small Business Enterprises" – Poornima M. Charantimath, Pearson, 3rd Edition, 2021.
2. "Innovation and Entrepreneurship" – Peter F. Drucker, Harper Business, Reprint Edition, 2019.
3. "Startup and Entrepreneurship: A Practical Guide" – Rajeev Roy, Oxford University Press, 2022.
4. "Essentials of Entrepreneurship and Small Business Management" – Norman Scarborough, Pearson, 9th Edition, 2021.
5. "The Lean Startup" – Eric Ries, Crown Publishing, 2018.

References:

1. "Disciplined Entrepreneurship: 24 Steps to a Successful Startup" – Bill Aulet, MIT

Press, 2017.
2. "Zero to One: Notes on Startups, or How to Build the Future" – Peter Thiel, 2014.
3. "The $100 Startup" – Chris Guillebeau, Crown Business, 2019.
4. "Business Model Generation" – Alexander Osterwalder & Yves Pigneur, Wiley, 2020.
5. "Blue Ocean Strategy" – W. Chan Kim & Renée Mauborgne, Harvard Business Review Press, 2019.

Online References:

Sr. No.	Website Name
1.	Startup India Portal – https://www.startupindia.gov.in
2.	MIT OpenCourseWare – Entrepreneurship – https://ocw.mit.edu/courses/sloan- school-of-management/
3.	Coursera – Entrepreneurship Specialization – https://www.coursera.org/specializations/entrepreneurship

Assessment:

Term Work: Term Work shall consist of at least 4 to 5 **Case Study Analysis , Presentation** based on the above list. Also, Term work Journal must include at least 2 to 3 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Case Study report)+ 5 Marks (Assignments) + 5 Marks (Attendance)

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned					Total Credits (C)
		L	T	P	L	T	P	SL	Notional Learning Hour	(Notional Learning Hour/30
98451309	**Environmental Science**	**2**	**-**	**-**	**30**		**-**	**30**	60	**2**

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT 1	IAT 2	IAT1 +IAT 2					
98451309	**Environmental Science**	20	20	40	60	2.5	--	--	100

Rationale:

Environmental Science provides a multidisciplinary perspective to understand, analyze, and solve ecological challenges. With growing global concern over climate change, pollution, and sustainable development, it is essential to equip students with the knowledge, skills, and values needed to contribute to sustainable solutions.

Course Objectives:

1. To understand the interrelationship between human activities and the environment.
2. To explore natural ecosystems and biodiversity conservation techniques.

3. To identify causes, effects, and mitigation strategies for various types of environmental pollution.
4. To analyze key environmental policies, laws, and sustainability practices.
5. To develop awareness, ethics, and responsibility towards environmental protection.
6. To promote sustainable development through informed decision-making and community participation.

Course Outcomes:

On successful completion of the course learner will be able to:

1) Explain core concepts of environmental science and ecological balance.
2) Identify sources and impacts of pollution on ecosystems and human health
3) Evaluate biodiversity importance and conservation strategies.
4) Analyze climate change, global warming, and their mitigation approaches.
5) Interpret government policies and sustainable practices for environment management.
6) Propose solutions for environmental issues at local and global levels.

Prerequisite: Basic Science Knowledge, General Awareness – About environmental issues, public policies, and civic responsibilities.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic Science Knowledge, General Awareness – About environmental issues, public policies, and civic responsibilities.		
I	**The Multidisciplinary Nature of Environmental Studies**	Definition, scope and importance. Need for public awareness. Role of information technology in environment and human health. Human population and the Environment. Population growth, variation	5	CO1

		among nations. Population Explosion- family welfare program. Environment and human health Women and child welfare.		
		Self-learning Topics: Environmental ethics **Case Study**: Chipko Movement (India) – Grassroot conservation.	5	
II	**Natural Resources**	Renewable and non-renewable resources. Natural resources & associated problems: a. Forest resources: b. Water resources: Natural resources & associated problems c. Mineral resources: d. Food resources: e. Energy resources: Role of an c. Mineral resources: d. Food resources: e. Energy resources: Role of an individual in conservation of natural resources: f. Equitable use of resources for sustainable lifestyles.	5	CO2
		Self-learning Topics: Carbon footprint calculators **Case Study:** Rainwater Harvesting	5	
III	**Ecosystems**	Concepts of an ecosystem. Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem	5	CO3

		b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystem (ponds, streams, lakes, rivers, Oceans, estuaries). Case study on various ecosystems in India.		
		Self-learning Topics: Biodiversity in Indian context **Case Study:** various ecosystems in India.	5	
IV	**Biodiversity and its Conservation**	Introduction-Definition: genetic species and ecosystem diversity. Bio-geographical classification of India Value of biodiversity : Consumptive use, productive use, social, ethical, aesthetic and option values, Bio-diversity at global, national, local levels India as a mega diversity nation Case study on Bio diversity in India.	5	CO4
		Self-learning Topics: Indoor pollution sources	5	
V	**Environmental Pollution Definition**	Causes of Pollution , effects and control measures of: a. Air pollution b. Water pollution c. Soil pollution. Solid waste management: Causes, effect and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.	5	CO5
		Self-learning Topics: Greenhouse gases	5	

		Case study: Pollution Disaster management: floods, earthquake, cyclone and landslides. Carbon Credits for pollution prevention		
VI	**Social Issues and Environment**	From unsustainable to sustainable development Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Environmental ethics: issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Consumerism and waste products. Environment protection act. Public awareness.	5	CO6
		Self-learning Topics: Environmental audit methods. **Case Study:** Environmental Ethics.	5	
Total			30	

Text Books:

1. Environmental Science: Towards a Sustainable Future, G. Tyler Miller and Scott Spoolman, 13th Edition, Cengage Learning 2021
2. Environmental Management: Text and Cases, Bala Krishnamoorthy, 3rd Edition, PHI Learning, Publication Year: 2016
3. Green IT: Concepts, Technologies, and Best Practices, Markus Allemann 1. Springer 2008
4. Sustainable IT: Slimming Down and Greening Up Your IT Infrastructure, David F. Linthicum, IBM Press 2009

5. Environmental Modelling: Finding Solutions to Environmental Problems, David L. Murray, Cambridge University Press 2016
6. Remote Sensing and Image Interpretation, Thomas M. Lillesand, Ralph W. Kiefer, and Jonathan W. Chipman, 9th Edition, John Wiley & Sons 2020
7. Business Ethics: Concepts and Cases, Manuel Velasquez, Pearson 2012

References:

1. Environmental Law and Policy in India, Shyam Divan and Armin Rosencranz, 2nd Edition, Oxford University Press 2018.
2. The International Handbook of Environmental Laws, David Freestone and Jonathon L. Rubin, Edward Elgar Publishing 2000.
3. E-Waste Management: Challenges and Opportunities in Developing Countries, Ruediger Kuehr and Ram K. Jain, Springer 2008.
4. The E-Waste Handbook: Managing Electronic Waste, Klaus Hieronymi, Ruediger Kuehr, and Ram K. Jain, Earth 2009.
5. Environmental Ethics: An Introduction, J. Baird Callicott, University of Georgia Press, 1999.

Online References:

Sr. No.	Website Name
1.	Centre for Science and Environment (CSE), Website: cseindia.org
2.	Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India
3.	CSIR-National Environmental Engineering Research Institute (NEERI)

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30)
16612310	**IDEA LAB - (Innovation Design Engineering and Apply)**	1	--	2	15	--	30	15	60	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT1 + IAT 2				
16612310	**IDEA LAB - 1(Innovation Design Engineering and Apply)**	--	--	--	--	50	50	100

Rationale:

Aligned with the National Education Policy (NEP) 2020, the institution emphasizes experiential, interdisciplinary, and project-based learning through the IDEA Lab—a central hub for hands-on innovation.

To strengthen the undergraduate research ecosystem, the institution has adopted a theme-based academic model aligned with UN SGD. Each semester features six curated problem statements based on local need and aligned with core subjects in the same semester, enabling students to apply classroom knowledge to real-world challenges. Every student selects one problem and develops an individual, subject-integrated solution—enhancing both academic understanding and research skills.

The IDEA Lab supports this initiative with facilities for design thinking, prototyping, and product development. Students maintain a project logbook throughout the semester to track their progress and reflections.

To ensure academic accountability, a two-tier assessment framework is implemented:

- Project Assessment based on standardized IDEA Lab rubrics.
- Subject-Based Term Work Assessment focused on the application of same-semester subject knowledge in the project.

Lab Objectives:

1. To promote experiential and project-based learning that bridges theoretical knowledge with real-world problem-solving.
2. To encourage interdisciplinary integration by enabling students to apply concepts from multiple subjects within a single cohesive project.
3. To develop innovation and design thinking skills through hands-on activities and iterative solution development.
4. To foster critical thinking and creativity by engaging students in open-ended problems with multiple solution pathways.
5. To enhance communication, collaboration, and documentation skills essential for professional engineering practice.
6. To build an entrepreneurial and research mindset by guiding students to develop scalable, socially-relevant, and technically viable prototype

Lab Outcomes: Student will be able to

1. Recall and articulate key concepts from core and allied subjects relevant to the assigned project.
2. Explain the interdisciplinary nature of the problem and the role of each subject in addressing it.
3. Apply appropriate tools, techniques, and theoretical knowledge to develop project components.
4. Analyze problem constraints and user requirements to structure a feasible and efficient solution.
5. Evaluate multiple design options and justify the chosen solution based on technical and practical considerations.
6. Create a functional prototype or solution that demonstrates innovation, utility, and integration of interdisciplinary knowledge

1) Guidelines for IDEA Project

a) Project Guidelines (Interdisciplinary Project Execution in IDEA Lab)

- Each student works on an individual interdisciplinary project aligned with the semester theme.
- Faculty in-charges for the IDEA Lab are assigned according to the complexity of the project and the capacity of the respective departments.
- Faculty in-charges mentor both the academic and technical aspects, and track weekly progress.
- Project assessment will be rubric-based, ensuring depth, innovation, documentation, and ownership.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- Faculty in-charges must attend relevant FDPs to ensure uniformity in mentoring and

evaluation.

b) Guidelines for same semester Subject Concepts Applied within the Project

- Termwork for each subject will partially reflect how well a student applies subject-specific concepts in their interdisciplinary project.
- Internal assessment panel will collaborate to align project components with subject learning outcomes.

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c) Role of Faculty In-Charges in IDEA Lab Projects

Faculty in-charges play a pivotal role in the success of interdisciplinary, theme-based projects under the IDEA Lab. Their responsibilities extend beyond technical supervision to include academic alignment, innovation facilitation, and active student engagement. Their key roles include:

1. **Motivating and Inspiring Students**
   - Encourage students to take ownership of their learning and projects.
   - Cultivate a mindset of curiosity, exploration, and social relevance.
   - Foster an environment where students feel empowered to take creative risks.
2. **Conducting Brainstorming and Ideation Sessions**
   - Organize structured brainstorming sessions at the start of the semester to help students define their problem statements and solution pathways.
   - Promote collaborative thinking, design exploration, and interdisciplinary integration.
3. **Arranging Guest Lectures and Expert Talks**
   - Identify and invite industry experts, researchers, and innovators for guest lectures aligned with the semester's theme or subject areas.
   - Facilitate exposure to real-world challenges, current trends, and future opportunities.
4. **Ensuring Uniqueness and Originality of Projects**
   - Actively review proposed ideas to ensure **no duplication of solutions** across students.
   - Encourage students to explore novel approaches, technologies, and perspectives.
5. **Promoting Discussion and Collaborative Learning**
   - Create platforms for students to present, discuss, and receive peer and mentor feedback.
   - Facilitate idea refinement through regular discussions and group engagement.

6. **Aligning Subject Content Beyond Syllabus**
    - Faculty in-charges must **align subject content beyond the syllabus of the same semester** with the **IDEA Lab theme and assigned problem statements**.
    - This ensures relevance, depth, and meaningful interdisciplinary integration.
7. **Same Semester Faculty Requirement**
    - Faculty in-charges must be teaching subjects in the **same semester** as the students' project to ensure seamless academic integration and contextual understanding.
8. **Monitoring and Documentation**
    - Oversee project logbook maintenance, milestone tracking, and submission of progress reports.
    - Provide ongoing feedback and ensure project alignment with learning outcomes.
9. **Coordination with Subject Faculty**
    - Work in collaboration with other subject faculty to help students embed theoretical and practical aspects of their coursework into the project.
    - Facilitate subject-term mapping and contribute to termwork assessment based on evidence.

2) Implementation Strategy

a) Project Implementation in IDEA Lab

Aspect	Implementation Strategy
Faculty in-charges	**Faculty in-charges assigned based on project nature and department capacity.**
Mentoring Role	**Faculty in-charges oversee academic/technical development, interdisciplinary integration, and timely documentation.**
Capacity Building	**Faculty in-charges undergo workshops on design thinking, innovation, assessment rubrics, and outcome-based mentoring.**
Assessment Contribution	**Faculty in-charges contribute to 25 marks allocated for the IDEA Lab project termwork. The remaining assessments are conducted by the external examiner.**
Recognition & Incentives	**Faculty in-charges receive workload credits or are formally acknowledged in performance reviews.**

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b) Implementation of Subject-Term Work Mapping within Projects

Aspect	Implementation Strategy
Mapping Subject Outcomes	**Faculty in-charges align their content beyond syllabus with the student's project by coordinating with the assigned project guide.**
Independent Evaluation	**Internal assessment panel evaluate students based on their application of subject-specific concepts within the project. This contributes to a** separate 25 marks allocated for termwork based on subject **application.**
Evidence Sources	**Evaluation is supported by project logbooks, subject-specific deliverables (e.g., tools, simulations, models), and review presentation inputs.**
Outcome Assurance	**Ensures practical demonstration of subject understanding and its integration into the interdisciplinary solution.**

Implementation Notes:

- Guide faculty assess their course's contribution using specific evidence such as:
  - Logbooks
  - Subject-specific outputs (e.g., simulations, designs)
  - Paper publications or review presentations

2) Guidelines for Assessment

Two-tier rubrics are applied independently to evaluate subject concept application and innovation within the project.

a) Assessment of IDEA Lab Projects (Individual Interdisciplinary Projects) (25 Marks)

Presentation-Based Assessment Structure (Total: 25 Marks)

Assessment Month	Weightage	Marks
Month 1 (Formative 1)	20%	5 marks
Month 2 (Formative 2)	40%	10 marks
Month 3 (Formative 3)	40%	10 marks

Rubric-Based Evaluation Criteria

Criteria	**Month 1 (5)**	**Month 2 (10)**	**Month 3 (10)**
Problem Understanding	Connects problem to subjects	Defines interdisciplinary scope	Demonstrates deep conceptual grasp
Subject Knowledge Application	Identifies relevant concepts	Applies principles in design	Integrates multiple subject areas correctly
Innovation & Design Thinking	Proposes creative idea	Develops and tests feasible solution	Final solution shows originality and utility
Documentation & Presentation	Logbook initiated, plan presented	Mid-design log and visuals	Final report and demo completed
Progress & Ownership	Meets deadlines, shows planning	Demonstrates self-motivation	Completes project independently with reflection

b) Term Work Assessment of Subject Concepts Applied in Projects (25 Marks)

Applicable to All Subjects Integrated with Interdisciplinary Projects

To reflect meaningful application of subject knowledge, each subject will be assessed through the following rubric:

Criteria	**Marks**	**Description**
Subject Knowledge Application	8	Depth and accuracy of concept integration into the project
Practical Design or Tool Usage	5	Use of subject-specific hardware/software/simulation/tools
Documentation	4	Quality and clarity of subject-related logs and reports
Viva/Presentation	4	Ability to explain subject's relevance and role in the project
Continuous Engagement	4	Evidence of consistent participation via logbooks and feedback

c) Total Assessment Structure

Component	Marks	Assessed By
Termwork – Project Execution	25 Marks	Project Guide
Termwork – Application of Subject Concepts	25 Marks	IDEA Lab Panel
Viva Voce (Final Evaluation)	50 Marks	External Examiner

S.E SEM IV

Sem IV

Theme: Digital Manufacturing Innovation for Sustainable Industrial Transformation

Aligned with **UNSDG 9: Industry, Innovation and Infrastructure, UNSDG 8: Decent Work and Economic Growth, UNSDG 12: Responsible Consumption and Production, UNSDG 13: Climate Action**

Keywords: Digital Manufacturing, Sustainable Industrial Transformation, Green Manufacturing
This theme enables students to leverage digital tools (CAD, FEA) and modern manufacturing knowledge to create innovative, sustainable solutions while developing business acumen through design thinking and business model development. The integration ensures they can design, analyze, manufacture, and commercialize products that contribute to sustainable industrial development and climate action.

For Industry, Innovation and Infrastructure (UNSDG 9):

- **Strengthens economic growth** through the development of reliable infrastructure that supports industries and services.
- **Encourages innovation** and technological advancements that increase productivity and global competitiveness.
- **Sustainable industrialization**, which creates jobs and promotes environmentally responsible manufacturing.
- **Reduces regional inequalities** by improving connectivity and infrastructure in underdeveloped and rural areas.

For Decent Work and Economic Growth (UNSDG 8):

- **Promotes economic development** that lifts people out of poverty and ensures equal opportunities for all.
- **Creates productive employment** and decent work conditions, contributing to social stability and individual well-being.
- **Encourages entrepreneurship and innovation**, which are critical drivers of long-term economic resilience.
- **Ensures equal opportunities** fair wages, labor rights, and safe working environments, reducing exploitation and inequalities in the workforce.

For Responsible Consumption and Production (UNSDG 12):

- **Reduces environmental degradation** by encouraging efficient use of resources and minimizing waste generation.
- **Promotes sustainable business** practices that balance economic growth with environmental stewardship.
- **Encourages consumers to adopt eco-friendly lifestyles**, reducing the ecological footprint and promoting sustainability.
- **Enhances supply chain** responsibility, ensuring ethical sourcing, production, and disposal processes.

For Climate Action (UNSDG 13):

- **Reduces greenhouse gas emissions** to mitigate the adverse effects of climate change on ecosystems and communities.
- **Promotes national and global policies** aimed at climate resilience and low-carbon development.
- **Strengthens disaster risk management** and preparedness to reduce the impact of climate-related hazards.
- **Encourages public awareness** and education on climate issues, fostering global participation in climate solutions.

Problem Statement

Problem Statement 1: Smart Modular Wind Turbine System for Urban Applications

A modular, small-scale wind turbine system for urban environments that can be mass-produced, easily assembled, and optimized for varying wind conditions. The system must be cost-effective, noise-minimized, and suitable for rooftop installations.

Problem Statement 2: Autonomous Precision Manufacturing Cell for Medical Device Production

An autonomous manufacturing cell capable of producing high-precision medical implants with real-time quality control, traceability, and regulatory compliance. The system must ensure 100% quality while being economically viable for small batch production.

Problem Statement 3: Sustainable Packaging Machine for Food Industry with Zero Waste Goal

An intelligent packaging machine that uses biodegradable materials, minimizes waste, adapts to different product sizes, and integrates with existing food production lines while maintaining food safety standards and economic competitiveness.

Problem Statement 4: Intelligent Prosthetic Limb with Adaptive Control and Affordable Manufacturing

An intelligent prosthetic limb with adaptive control that learns user behavior, provides natural movement, and can be manufactured affordably using advanced manufacturing techniques while ensuring comfort and durability.

Problem Statement 5: Smart Agricultural Harvesting Robot for Small-Scale Farmers

An affordable, autonomous harvesting robot for small-scale farmers that can identify ripe crops, harvest with minimal damage, operate on uneven terrain, and provide data analytics for farm management while being maintainable in rural environments.

Problem Statement 6: Modular Electric Vehicle Charging Infrastructure with Smart Grid Integration

A modular, scalable electric vehicle charging infrastructure that integrates with smart grids, provides fast charging capabilities, adapts to different vehicle types, and can be manufactured efficiently while supporting grid stability and renewable energy integration.

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
16111401	Sampling Theory and Optimization	2	1	--	30	15	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1 +IAT-2					
16111401	Sampling Theory and Optimization	20	20	40	60	2.5	25	--	125

Rationale:

In second-year Mechanical Engineering, understanding statistical and optimization methods is crucial for improving design accuracy, manufacturing quality, and operational efficiency. Probability and normal distributions help model variations in material strength, dimensions, and system performance. Large and small sample tests support quality checks—for example, testing if manufactured parts meet tolerance standards. Chi-square and F-tests are useful in comparing variability across different machines or analyzing failure data. Linear programming and the Simplex method are applied in optimizing production schedules, material use, and cost efficiency, while Duality provides insight into resource constraints. For nonlinear problems, such as minimizing energy loss in thermal systems or optimizing stress distribution, Kuhn-Tucker conditions offer solutions under complex constraints. Transportation and Assignment Models are used in plant logistics—for instance, assigning jobs to machines or distributing raw materials efficiently. These tools prepare students to analyze and optimize mechanical systems and industrial processes with precision.

R-2025- Mechanical Engineering

Course Objectives:

1. To explain probability distributions, especially the normal distribution, to model variations in mechanical systems.
2. To describe hypothesis testing methods to evaluate sample data reliability in mechanical engineering experiments.
3. To understand the application of Chi-square and F-tests for variance and independence analysis in mechanical systems.
4. To understand linear programming methods for optimizing resource allocation in mechanical engineering projects.
5. To explain nonlinear constrained optimization techniques relevant to mechanical design problems.
6. To describe transportation and assignment models to optimize material handling and workforce scheduling.

Course Outcomes:

1. Students will be able to apply normal distribution to analyze variability in material properties like tensile strength.
2. Students will be able to whether the mean fatigue life of a component meets specifications using Z-test and t-test.
3. Students will be able to analyze the consistency of manufacturing process variables using Chi-square and F-tests.
4. Students will be able to linear optimization problems for minimizing cost or maximizing output using simplex method and duality.
5. Students will be able to apply Kuhn-Tucker conditions to solve nonlinear constrained optimization problems in mechanical design.
6. Students will be able to optimize transportation and assignment of machines or labor to minimize cost and time.

Prerequisite:

1. Definition of probability, Exhaustive events, Pair wise independent events, Multiplicative law of probability, Conditional probability, Baye's theorem.

R-2025- Mechanical Engineering

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Probability Distribution	Discrete and Continuous random variables, Probability mass and density function, Probability distribution for random variables	05	CO1
		Normal distribution.		
		Expectation, Variance, Moment generating function, Raw and central moments up to 4th order.		
		Central limit theorem.		
		Self-learning Topics: 1. Skewness and Kurtosis of distribution (data). 2. Discrete distribution: Bernoulli, Binomial, Poisson.	07	
I	Sampling theory-I	Sampling distribution, Test of Hypothesis, Level of Significance, Critical region, One-tailed, and two tailed test, Degree of freedom.	05	CO2
		Test significance for large samples. Test the significance of mean.		
		Students' t-distribution (Small sample). Test the significance of single sample mean and two independent sample means and paired t- test)		
		Self-learning Topics: 1. Estimate parameters of a population. 2. Test of significance of large samples, Proportion test. 3. Difference between the means of two large samples.	08	
III	Sampling theory-II	Chi-square test: Test of goodness of fit and independence of attributes (Contingency table) including Yate's Correction.	05	CO3

		Analysis of variance: F-test (significant difference between variances of two samples).		
		Self-learning Topics: 1. ANOVA**:** One way classification, 2 . ANOVA**:** Two-way classification (short-cut method).	07	
IV	Linear Programming Problems	Types of solutions, Standard and Canonical of LPP, Basic and Feasiblesolutions, slack variables, surplus variables.	05	CO4
		Simplex method.		
		Duality, Dual of LPP.		
		Dual Simplex Method.		
		Self-learning Topics: 1. Artificial variable method, Big M method. 2. Sensitivity Analysis, Two-Phase Simplex Method, Revised Simplex Method.	08	
V	Nonlinear Programming Problems	NLPP with one equality constraint (two or three variables) using the method of Lagrange's multipliers	05	CO5
		NLPP with one inequality constraint (two variables): Kuhn-Tucker conditions		
		Self-learning Topics: 1. NLPP with one equality constraint (three variables) using the method of Lagrange's multipliers 2. NLPP with one inequality constraint (three variables): Kuhn-Tucker conditions	07	
VI	Transportation and	Transportation Problem Basics & Formulation	05	CO6
		North-West Corner Rule		

	Assignment Models	Least Cost Method		
		Vogel's Approximation Method (VAM), Optimality Check (MODI Method)		
		Assignment Problem Basics, Hungarian Method		
		Self-learning Topics: 1. Introduction & Concepts of PERT and CPM 2. Earliest Start (ES) and Earliest Finish (EF). 3. CPM Backward Pass & Critical Path 4. PERT Expected Time & Variance. 5. PERT Network Forward and Backward Pass. 6. Probability Calculations.	08	

Text Books:

1. Operations Research, Hira and Gupta, S. Chand Publication.

2. Fundamentals of Statistics, S. C. Gupta.

3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa.

4. Murray Spiegel, "Schaum's Outline of Probability and Statistics", 4th Edition, Tata McGraw-Hill.

References:

1. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons.

2. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill education.

3. Operations Research: An Introduction, Hamdy A Taha, Pearson.

4. Engineering Optimization: Theory and Practice, S.S Rao, Wiley-Blackwell.

5. S. D. Sharma, "Operations Research", Kedarnath Ramnath Publishing, Meerut, 8th Edition, 2015.

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/117103017
2.	https://ocw.mit.edu/courses/res-6-012-introduction-to-probability-spring-2018/
3.	https://archive.nptel.ac.in/courses/117/103/117103017/
4.	https://archive.nptel.ac.in/courses/111/102/111102111/
5.	https://www.youtube.com/playlist?list=PLyqSpQzTE6M_JcleDbrVyPnE0PixKs2JE

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30
16211402	Heat Transfer	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
16211402	Heat Transfer	20	20	40	60	2.5	--	--	100

R-2025 Mechanical Engineering

Rationale :

Heat transfer is a fundamental subject in engineering that deals with the movement of thermal energy in different modes—conduction, convection, and radiation. Understanding these mechanisms is essential for designing and optimizing systems such as engines, HVAC systems, electronics cooling, and power plants. This course equips learners with analytical and computational tools to model and solve practical heat transfer problems, including transient phenomena and phase change processes like boiling and condensation. Students also gain insights into the performance analysis of heat exchangers, enabling them to contribute effectively to energy efficiency and thermal system innovation in various industries.

Course Objectives:

1. **Understand** the fundamental principles of conduction, convection, and radiation.
2. **Explain** the physical significance and mechanisms of various heat transfer modes.
3. **Formulate** mathematical models for steady-state and unsteady-state heat conduction.
4. **Develop** analytical and numerical solutions for transient heat transfer problems.
5. **Describe** the processes of phase change heat transfer, including boiling and condensation.
6. **Evaluate** the design and performance characteristics of different types of heat exchangers.

Course Outcomes:

1. **Identify** the three modes of heat transfer (conduction, convection, and radiation). ***(Remembering)***
2. **Illustrate** basic modes of heat transfer. ***(Understanding)***
3. **Develop** mathematical models for each mode of heat transfer. ***(Applying)***
4. **Develop** mathematical models for transient heat transfer. ***(Applying)***
5. **Demonstrate and explain** the mechanism of boiling and condensation. ***(Understanding and Applying)***
6. **Analyse** different heat exchangers and **quantify** their performance. ***(Analysing and Evaluating)***

Prerequisite: A basic understanding of thermodynamics, fluid mechanics, and engineering mathematics is essential. Learners should be familiar with energy concepts, fluid flow, and differential equations to model and analyze heat transfer processes effectively.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	**Engineering Thermodynamics:** Understanding of the laws of thermodynamics Concepts of energy, entropy, and thermodynamic cycles **Fluid Mechanics:** Basic fluid properties, flow regimes, and conservation equations Concepts of boundary layers and convective flows **Engineering Mathematics:** Differential equations (ordinary and partial) Multivariable calculus and linear algebra	00	
I	**Basic concepts of heat transfer**	Define heat transfer and its importance in engineering applications, Difference between heat transfer and Thermodynamics, Physical Mechanism of modes of heat transfer, Governing laws of heat transfer, Conduction mode: Thermal conductivity, Thermal diffusivity, Convection mode: Free and Forced convection, Heat transfer Coefficient, Radiation mode: Emissivity, transmissivity, reflectivity, absorptivity, Black body, Grey body, Opaque body Steady and unsteady heat transfer, One dimensional, two dimensional and three dimensional heat transfer, Thermal resistance concept in heat transfer, Thermal contact resistance	04	CO1
		Self-learning Topics: Identify instances where all three modes of heat transfer used	04	

II	**Conduction**	Assumptions in heat conduction, Generalized heat conduction equation in rectangular, cylindrical coordinates, Initial and boundary conditions, Steady state heat conduction through plane wall, Composite wall, cylinder, composite cylinder wall, sphere, Internal Heat generation concept, Heat conduction with heat generation in plane wall, solid cylinder and solid sphere, Critical radius of insulation in cylinder and sphere	09	CO2
		Self-learning Topics: Derive differential equation of conduction in cylindrical and spherical coordinates	09	
III	**Unsteady State Heat Transfer & Extended Surface**	**Heat transfer from Extended Surface:** Types of extended surface and its significance, Governing differential equation for fin and its solution, Fin performance: Fin effectiveness and Fin efficiency, Thermo Well **Unsteady state heat transfer:** Applications of unsteady state heat transfer, lumped system analysis, Criteria for lumped system analysis: characteristic length, Biot Number, Thermal time constant and Response of a thermocouple, Heisler Charts	08	CO3
		Self-learning Topics: Analyze conical fin	08	
IV	**Convection**	Determination of heat transfer coefficient, Dimensional Analysis, Dimensionless numbers in free and forced convection and their significance **External Flow:** Velocity Boundary layer and Thermal Boundary layer, Laminar and turbulent flow over a flat plate, Flow across cylinder and sphere, Flow across bank of tubes	08	CO4

		Self-learning Topics: Analyze heat transfer coefficients for different arrangements	08	
V	**Radiation**	Basic laws of radiation, Black body radiation, Planck's law, Kirchhoff's law, Wein displacement law, Lambert cosine law, Radiation intensity, Radiation heat exchange between black bodies, Shape factor algebra, Radiation heat exchange between nonblack bodies, Electrical network approach for radiation heat exchange: Radiosity and irradiation, Radiation shield	08	CO5
		Self-learning Topics: Analyses temperature of sun and other surfaces	08	
VI	**Boiling and Condensation Heat Exchangers**	Boiling heat transfer, Pool boiling: different regimes and pool boiling curve, Flow boiling: Different Regimes and Boiling curve, Condensation heat transfer, Film condensation, Dropwise Condensation Types of heat exchangers, Overall heat transfer coefficient, Fouling factor, Analysis of heat exchangers, LMTD, Effectiveness –NTU method, Correction factor, Effectiveness of heat exchangers Construction and Application of Heat Pipe	08	CO6
		Self-learning Topics: Design heat exchanger for industrial application	08	

Text Books / References:

1. Introduction to thermodynamics and Heat transfer by Yunus A Cengel 2ndEdition, McGraw Hill International
2. Fundamentals of Heat and Mass Transfer by FPIncropera and D P deWitt, Wiley India
3. Heat Transfer by P S Ghoshdastidar, 2nd Edition, Oxford University Press
4. Heat and Mass Transfer, by R Rudramoorthy and L Malaysamy,2ndEdition, PEARSON
5. Heat Transfer by J P Holman, Mcgraw Hill
6. Heat Transfer by S P Sukhatme, University Press
7. Heat and Mass Transfer by PK Nag, TMH
8. Heat and Mass Transfer by Mahesh Rathod, Laxmi Publications
9. Heat and Mass Transfer byR K Rajput, S Chand and company

Online References:

Sr. No.	Website Name
1	https://onlinecourses.nptel.ac.in/noc22_me63
2	https://onlinecourses.nptel.ac.in/noc23_ch65
3	https://www.youtube.com/watch?v=qa-PQOjS3zA&list=PL5F4F46C1983C6785

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30
1621 1403	Theory of Machines	3	--	--	45	--	--	45	90	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT 1	IAT 2	IAT1 +IAT 2					
16211403	Theory of Machines	20	20	40	60	2.5	--	--	100

Rationale:

Theory of Machines is an important subject in mechanical engineering that helps us understand

how different parts of a machine move and work together. It teaches us how to study motion, design mechanisms, and analyze forces in machines.

Course Objectives:

1. **To acquaint myself with the basic concept of kinematics of machine elements.**
2. **To familiarize with basic and special mechanisms.**
3. **To study the functioning of motion transmission machine elements.**
4. **To study the functioning of power transmission machine elements**
5. **To acquaint with working principles and applications of Governors**
6. **To acquaint with working principles and applications of Gyroscope**

Course Outcomes:

1. Identify various components of mechanisms and develop mechanisms to provide specific motion
2. Draw and analyse velocity and acceleration diagrams for various mechanisms
3. Development of cam profile for the specific follower motion.
4. Predict conditions for maximum power transmission in the case of a belt drive
5. Demonstrate working Principles of different types of governors and Gyroscopic effects on the mechanical systems.
6. Illustrate requirements for an interference-free gear pair

Prerequisite:

R-2025- Mechanical Engineering

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Engineering Mechanics – Statics and Dynamics, Differential and Integral Calculus, Linear Algebra and Matrices, Ordinary Differential Equations Basic Mechanical Engineering Concepts, Simple Machines (levers, pulleys, gears), Machine Elements (gears, cams, shafts, flywheels), Engineering Drawing / CAD, Kinematic Diagrams and 3D Visualization, Strength of Materials (stress, strain, deformation), Material Properties Newton's Laws of Motion, Free Body Diagram Analysis, Work and Energy Principles, Basics of Rotational Motion		
I	**Introduction**	Basic Kinematics Kinematic link & its types, Kinematic pairs, Types of Kinematic pairs, Kinematic chains, Types of constrained motions, Mechanism, Machine, Structure, Types of joints, Degree of freedom (mobility), Kutzbach mobility criterion, Grűbler's criterion & its limitations. Four bar chain and its inversions, Slider crank chain and its inversions, Double slider crank chain and its inversions	06 08	CO1
		Self-learning Topics: Hooks Joint (Single and double)	08	
II		Velocity Analysis of Mechanisms (mechanisms up to 6 links)	09	CO2

	Velocity and Acceleration Analysis	2.1 Velocity analysis by relative velocity method (Graphical approach) 2.2 Acceleration Analysis of Mechanisms (mechanisms up to 6 links) Acceleration analysis by relative method (Graphical approach).		
		Self-learning Topics: Coriolis acceleration (Graphical approach)	09	
III	**Cam and Follower Mechanism**	3.1 Cam and follower; Classification Cam and follower terminology; 3.2 Motions of the follower: Uniform Velocity, SHM, Constant acceleration and deceleration (parabolic),	06	CO3
		Self-learning Topics: Cycloidal (Displacement, Velocity and acceleration Plots)	06	
IV	**Power Transmission**	Power Transmission Belts, Chains and Gear 4.1 Belts: Introduction, Types, Dynamic analysis –belt tensions, condition of maximum power transmission 4.2 Chains: Introduction to Chain Drives, Classification of chains, length of chain. Types of brakes Introduction and Classification.(No Numerical) 4.3 Gears: Law of gearing, Forms of tooth, Details of gear terminology, Path of contact, Arc of contact,	10	CO4

		Contact ratio, Interference in involutes gears,		
		Self-learning Topics: Minimum number of teeth for interference free motion	10	
V	**Governors and Gyroscopes**	5.1 Governors: Introduction to Centrifugal and Inertia governors, Study and Force analysis of Porter and Hartnell governors. 5.2 Gyroscope: Introduction, Gyroscopic couple and its effect on spinning bodies,	06	CO5
		Self-learning Topics: naval ship during steering, pitching, rolling and their stabilization.	06	
VI	**Gear and Gear Train**	Design of compound gear trains for synchronized multi-station operations, Application of planetary gear systems in rotary packing heads	06	CO6
		Self-learning Topics: Timing belt drives vs gear drives in low-vibration operations	06	

Text Books:

Text / References Books:

1. **S.S. Ratan, —Theory of Machines‖, Tata McGraw Hill**
2. **Ghosh and A.K. Mallik, —Theory of Mechanisms and Machines‖, East-West Press**
3. **Theory of Machines by Jagdish Lal Metropolitan Book New Delhi, Company, Daryaganj, Delhi**
4. **1.J.J. Uicker, G.R. Pennock, and J.E. Shigley, —Theory of Machines and Mechanism‖, Oxford Higher Education**
5. **P.L. Ballaney, —Theory of Machines‖, Khanna Publishers**
6. **M.A. Mostafa, —Mechanics of Machinery‖, CRC Press**

7. **R.L. Norton, —Kinematics and Dynamics of Machinery‖, McGraw Hill**
8. **A.G. Erdman, G.N. Sander, and S. Kota, —Mechanism Design: Analysis and Synthesis Vol I‖, Pearson**
9. **Theory of Machines Thomas Bevan CSB Publishers & Distributor**

Online References:

Sr. No.	Website Name
1	**https://nptel.ac.in/courses/112/105/112105268/**
2	**https://www.youtube.com/playlist?list=PLYRGB44zNZWVibVLmWANp-7obQzOhJLRt**
3	**http://www.nptelvideos.in/2012/12/kinematics-of-machines.html**

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30
16212404	Theory of Machines	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT1 +IAT 2				
16212404	Theory of Machines	--	--	--	--	25	25	50

Lab Objectives:

1. To familiarize with various mechanisms and inversions

2. To acquaint with basics of power transmission systems

3. To acquaint velocity and acceleration of mechanisms

4. To acquaint motion and power transmission

5. To acquaint with working principles and applications of governors

6. To acquaint with working principles and applications of gyroscope

Lab Outcomes:

1) Develop and build mechanisms to provide specific motion
2) Find velocity of a mechanism by using Relative method
3) Analyze velocity and acceleration of a specific link of a slider crank mechanism using graphical approach by Relative method.
4) Plot displacement-time, velocity-time, and acceleration-time diagrams of follower motion and Draw cam profile for the specific follower motion
5) Plot and analyze governor characteristics
6) Analyze principle of gyroscopic on laboratory model

List of Experiments.

Sr No	List of Experiments	Hrs
01	Using Virtual lab any one experiment on mechanism	
02	Analysis of velocity of mechanisms by Relative Velocity method – 3 to 5 problems	
03	Analysis of acceleration of mechanism by Relative method including pairs involving Coriolis acceleration – 3 to 5 problems	
04	Motion analysis and plotting of displacement–time, velocity-time and acceleration-time, jerk-time, and layout of cam profiles - 2 to 3 problems	
05	Experiments on Governors- Porter Governor, Hartnell Governor	
06	To verify the Gyroscopic couple experimentally	

Sr No	List of Assignments / Tutorials	Hrs
01	Basics of Kinetics and Kinematics	
02	Belts and Chains	

03	Gears	
04	Governors & Gyroscope	

Part C

Course project on design and fabrication of any one mechanism for a group of maximum 4 students

Text Books:

1. **S.S. Ratan, —Theory of Machines‖, Tata McGraw Hill**
2. **Ghosh and A.K. Mallik, —Theory of Mechanisms and Machines‖, East-West Press**
3. **Theory of Machines by Jagdish Lal Metropolitan Book New Delhi, Company, Daryaganj, Delhi**

References:

1. **1.J.J. Uicker, G.R. Pennock, and J.E. Shigley, —Theory of Machines and Mechanism‖, Oxford Higher Education**
2. **P.L. Ballaney, —Theory of Machines‖, Khanna Publishers**
3. **M.A. Mostafa, —Mechanics of Machinery‖, CRC Press**
4. **R.L. Norton, —Kinematics and Dynamics of Machinery‖, McGraw Hill**
5. **A.G. Erdman, G.N. Sander, and S. Kota, —Mechanism Design: Analysis and Synthesis Vol I‖, Pearson**
6. **Theory of Machines Thomas Bevan CSB Publishers & Distributor**

Online Resources:

Sr. No.	Website Name
1	**https://nptel.ac.in/courses/112/105/112105268/**
2	**https://www.youtube.com/playlist?list=PLYRGB44zNZWVibVLmWANp-7obQzOhJLRt**
3	**http://www.nptelvideos.in/2012/12/kinematics-of-machines.html**

Assessment:

Term Work: Term Work shall consist part (a) + (b) +(c).

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 5 Marks (Assignments)

+ 5 Marks (Course Project) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30
16612405	IDEA LAB- 2 (CAD Modeling)	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT1 +IAT 2				
16612405	CAD Modeling	--	--	--	--	50	50	100

Lab Objectives:

1. To familiarize geometric modeling techniques
2. To impart 2D sketching skills using CAD software

3. To impart the 3D Solid Modeling skills for the development of 3D models of engineering components

4. To impart the 3D surface modeling skills for development of 3D models of basic engineering components

5. To impart the 3D modeling skills for assembling different parts made in 3D modeling software

6. To introduce Product data exchange among CAD systems.

Lab Outcomes:

1) Use appropriate techniques for geometric modeling.

2) Apply 2D sketching tools to prepare sketches of a given object using 3D CAD software.

3) Create a solid model of the object using 3D CAD software.

4) Develop the surface model of a given object using 3D CAD software.

5) Generate assembly of given objects using assembly tools of a 3D CAD software

6) Use product data exchange formats to perform product data exchange among CAD systems.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	1. ESL201: Engineering Graphics laboratory 2. PLC 303: Working Drawing – GD & T laboratory	02	
I	**Introduction to CAD**	Different modelling techniques (solid modeling, surface modeling, parametric modeling, feature based modeling) for creation of CAD models, creation of CAD models from different perspectives.	02	CO1
II	**Sketching using 2D sketch tools**	Setting the sketch environment, creating sketch from a geometry using the sketching commands like- line, circle, arc, etc., modification in sketches using commands like- move, trim, rotate, etc.), use of viewing commands	08	CO2

		like- pan, zoom, rotate, etc., use of sketch constraints.		
III	**Solid Modelling**	Settings environment for part modeling, creating machine/engineering parts/components using features like – extrude, revolve, mirror, threading, fillet, hole, bend, rib, patterns (rectangular, circular, etc.), etc.	12	CO3
IV	**Surface Modelling**	Generation of surfaces from open profiles using create tools like extrude, sweep, loft, trim, etc., path & guide surface option commands like – extend, trim, shell, patch, etc., mesh of curves, free form surfaces	10	CO4
V	**Assembly and Data Exchange**	Constraints, exploded views, interference check, drafting (layouts, standard & sectional views, detailing & plotting), use of transformations and manipulation commands (translate, rotate, scale, etc.) to modify and assemble the created CAD models. CAD data exchange formats Like IGES, PDES, PARASOLID, DXF and STL along with their comparison and applicability	16	CO5
VI	**3D Design and Development of Eco- Innovative Systems**	Design and 3D Modeling of a Manual Greywater Filter and Pump System, 3D Mo3D Design and Animation of a Rotating Drum Composting Machine Modeling of a Smart Vertical Farming Rack with Rotary Tray System,	02	CO6

List of Exercises.

Sr No	List of Experiments	Hrs
01	3D modeling of basic Engineering components like - Nuts, Bolts, Keys, cotter, Screws, Springs etc. (Note: Any two out of above)	
02	3D modeling of basic machine components like - Clapper block, Single tool post, Lathe and Milling tail stock, Shaper tool head slide, jigs and fixtures Cotter, Knuckle joint, Couplings: simple, muff, flanged Protected flange coupling, Oldham's coupling, Universal coupling, element of engine system and Miscellaneous parts. (Note: Any two out of above)	
03	Generation of surface model of any two objects like - hull of a ship, aero plane wing, etc. using various surface creation tools in CAD software.	
04	1) Generation of an assembly model (minimum five child parts) along with working (production) drawing of the system, creation of 3D models with assembly constraints, interference check, exploded view, GD&T, tolerance table and fit table, bill of material. 2) Reverse Engineering of a physical model: disassembling of physical model having not less than five parts, measuring the required dimensions of each component, sketch the minimum views required for each component, convert these sketches into 3-D model and create an assembly drawing with actual dimensions (Note: Any one out of above)	

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practical's based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 50 Marks (Experiment/Assignments)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

R-2025 Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
16212406	**Heat Transfer Laboratory**	**-**	**2**	**-**	**-**	**1**	**-**	**1**

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
16212406	**Heat Transfer Laboratory**	--	--	--	--	25	25	50

Lab Objectives:

1. **Determine** the thermal conductivity of metals, non-metals, and liquids using standard experimental techniques.
2. **Evaluate** heat transfer coefficients under natural and forced convection using theoretical and experimental approaches.
3. **Measure and interpret** the emissivity of a grey body through experimental setup and data analysis.
4. **Calculate** fin effectiveness and efficiency by analyzing temperature distribution and heat transfer from extended surfaces.
5. **Assess** the performance of different types of heat exchangers using effectiveness-NTU and LMTD methods.
6. **Apply** the principle of energy balance to real-world heat exchanger systems by quantifying heat lost and gained.

Lab Outcomes:

1. **Estimate** the thermal conductivity of metals, non-metals, and liquids using appropriate experimental methods.
2. **Compute** the heat transfer coefficient in both natural and forced convection through theoretical and practical approaches.
3. **Measure** the emissivity of a grey body using experimental techniques and interpret the results.
4. **Quantify** the effectiveness and efficiency of fins by analyzing temperature profiles and heat dissipation.
5. **Analyze** the performance of heat exchangers using NTU, effectiveness, and LMTD methods.
6. **Demonstrate** the energy balance in a heat exchanger by evaluating inlet and outlet energy flows.

a. Experiments: Students should use the commercial software or open source application programs, to verify the results obtained by manual calculations. The input data and output results of the problem solved using the computer programs (Minimum 6) should be included in the Journal.

The proposed list is given below:

Sr No	List of Experiments	Hrs
01	**Conduction: (Any One)** 1. Measurement of thermal conductivity of metal rod 2. Measurement of thermal conductivity of insulating material	4
02	**Convection: (Any Two)** 1. Measurement of heat transfer coefficient in natural convection 2. Measurement of heat transfer coefficient in forced convection 3. Comparison of heat transfer coefficient of free and forced convection	4
03	**Radiation: (Any One)** 1. Verification of Stefan Boltzmann Law 2. Measurement of Emissivity of Grey surface	4
04	**Transient Conduction:** 1. Unsteady state heat transfer in cylinder/rod/wall	4
05	**Fins: (Any One)** 1. Determination of fin efficiency and fin effectiveness 2. Comparison of fin performance of Various type of fins	4
06	**Boiling and Condensation: (Any One)** 1. Measurement of heat transfer coefficient in boiling process of water. 2. Measurement of heat transfer coefficient in condensation of saturated steam.	4
07	**Heat Exchangers: (Any One)** 1. Estimation of overall heat transfer coefficient and effectiveness of double pipe heat exchanger (parallel flow and Counter flow arrangement) 2. Estimation of overall heat transfer coefficient and effectiveness of shell and tube heat exchanger (parallel flow and Counter flow arrangement) 3. Estimation of overall heat transfer coefficient and effectiveness of plate type heat exchanger	6

b. Course Project: (Any one task out of the following proposed list)

A group of not more than four students, shall do

1) Develop the program to verify the results obtained by manual calculations for any above mentioned experiment using Python, MATLAB programming platform etc.
2) Develop experimental setup which will be useful for understanding concepts of heat transfer

End Semester Practical/Oral examination

1. Pair of Internal and External Examiner should conduct practical/viva based on contents
2. Duration of practical examination is 2 hour
3. Distribution of marks for practical/viva examination shall be as follows:
    a. Practical performance ……**15** marks
    b. Oral……..... **10** marks

Evaluation of practical examination to be done based on the experiment performed and the output of the experiments during practical examination.
Students work along with evaluation report to be preserved till the next examination.

Text Books / References:

1. Introduction to thermodynamics and Heat transfer by Yunus A Cengel 2ndEdition, McGraw Hill International
2. Fundamentals of Heat and Mass Transfer by FPIncropera and D P deWitt, Wiley India
3. Heat Transfer by P S Ghoshdastidar, 2nd Edition, Oxford University Press
4. Heat and Mass Transfer, by R Rudramoorthy and L Malaysamy,2ndEdition, PEARSON
5. Heat Transfer by J P Holman, Mcgraw Hill
6. Heat Transfer by S P Sukhatme, University Press
7. Heat and Mass Transfer by PK Nag, TMH
8. Heat and Mass Transfer by Mahesh Rathod, Laxmi Publications
9. Heat and Mass Transfer byR K Rajput, S Chand and company

Online Resources:

Sr. No.	Website Name
1.	https://aero04-iitb.vlabs.ac.in/exp3/index.html
2.	https://vlab.amrita.edu/index.php?sub=1&brch=194
3.	https://htv-au.vlabs.ac.in

Assessment:

Term Work: Term Work shall consist of at least 6 practicals based on the above list. Also, Term work Journal must include project based on industrial application

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 10 Marks (Project) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

R-2025 Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30
993117WW	Smart Manufacturing in Assembly Line	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT 1+ IAT 2					
993117WW	Smart Manufacturing in Assembly Line	20	20	40	60	2.5	--	--	100

Rationale :

Smart Manufacturing in Assembly Lines enhances productivity and quality by integrating automation, data analytics, and real-time monitoring. It enables faster decision-making, reduces downtime, and supports mass customization in modern industrial systems.

R-2025 Mechanical Engineering

Course Objectives:

1. Understand smart manufacturing concepts and technologies.
2. Learn automation and robotics in assembly lines.
3. Introduce IIoT architecture and industrial use.
4. Understand data analytics and AI in manufacturing.
5. Learn metal forming and shaping processes.
6. Understand fundamentals of machining processes.

Course Outcomes:

1. Explain key smart manufacturing principles.
2. Design automation and robotic solutions for assembly.
3. Describe IIoT connectivity and data exchange.
4. Apply data analytics and AI for process improvement.
5. Explain machining operations and tool selection.
6. Identify and compare forming and shaping methods.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Engineering materials, basic mechanical properties, simple engineering drawing interpretation, basic shop floor safety and practices.	0	
I	**Introduction to Smart Manufacturing**	• **Overview of Manufacturing Evolution** o Industry 1.0 to Industry 5.0 o Traditional vs Smart Manufacturing o Key Technologies Enabling Smart Manufacturing	8	CO1
		Self-learning: Concepts of Smart Manufacturing and Smart Factories	8	
II	**Automation and Robotics in Assembly Lines**	• Basics of Industrial Automation • Types of Assembly Line Robots • PLCs and SCADA Systems • Robotic Arms, AGVs, and Cobots • IoT, Big Data, AI/ML, Robotics, Cloud	7	CO2

		Computing • Interoperability, Data Security, Skills Gap		
		Self-learning: Key components of a robotic system: actuators, sensors, controllers	7	
III	**Industrial Internet of Things (IIoT)**	• Introduction to Industrial Robots • Kinematics & Robot Programming • Human-Robot Collaboration (Cobots) • Vision Systems and Object Recognition • IoT and Edge Computing for CPS • Architecture and Deployment Strategies	7	CO3
		Self-learning: CPS architecture and real-time systems	7	
IV	**Data Analytics and AI in Smart Manufacturing**	• Data Collection & Cleaning in Production • Predictive Maintenance and Quality Control • Machine Learning in Assembly Optimization • Real-time Monitoring & Dashboards (e.g., Power BI)	7	CO4
		Self-learning: study of multi point cutting tool	7	
V	**Fundamentals of Machining**	• Introduction to Metal Cutting • Types of Machining: Turning, Milling, Drilling, Grinding • Tool Geometry and Materials • Chip Formation and Cutting Fluids	8	CO5
		Self-learning: Surface finishing processes – lapping, honing, superfinishing	8	
VI	**Forming and Shaping Processes**	• Fundamentals of forming – Hot and Cold working • Forging, Rolling, Extrusion, Drawing – principles and applications • Sheet metal working – shearing, bending, deep drawing	8	CO6

		Self-learning: Powder metallurgy – basic steps and applications	8	

Text / References Books:

- Smart Manufacturing: Concepts and Methods – Masoud Soroush
- Industrial Internet of Things – Sabina Jeschke et al.
- Introduction to Robotics: Mechanics and Control – John J. Craig
- Artificial Intelligence for Manufacturing – Jay Lee & Hung-An Kao
- Manufacturing Engineering and Technology – Kalpakjian & Schmid
- Fundamentals of Modern Manufacturing – Mikell P. Groover

Online Resources:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/112/107/112107145/
2	https://nptel.ac.in/courses/112/105/112105127/

R-2025 Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30
993128WW	Smart Manufacturing in Assembly Line	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT 1+ IAT2				
993128WW	Smart Manufacturing in Assembly Line	--	--	--	--	25	25	50

Lab Objectives:

1. Understand and apply principles of smart manufacturing through design and layout of intelligent assembly lines.
2. Analyze real-world smart manufacturing implementations using automotive industry case studies.
3. Design and simulate cyber-physical systems (CPS) integrating sensors, computation, and control.
4. Study and evaluate the design and functionality of multi-point cutting tools used in advanced machining.
5. Implement IoT-based monitoring systems for die casting processes and assess their effectiveness.
6. Explore and understand powder metallurgy processes through virtual or simulated environments.

Lab Outcomes:

1. Understand and apply principles of smart manufacturing through design and layout of intelligent assembly lines.
2. Analyze real-world smart manufacturing implementations using automotive industry case studies.
3. Design and simulate cyber-physical systems (CPS) integrating sensors, computation, and control.
4. Study and evaluate the design and functionality of multi-point cutting tools used in advanced machining.
5. Implement IoT-based monitoring systems for die casting processes and assess their effectiveness.
6. Explore and understand powder metallurgy processes through virtual or simulated environments.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Design a Smart Assembly Line Layout	2
02	Case Study Analysis: Automotive Smart Line,	2
03	Design and Simulate a CPS Architecture	2
04	Single/Multi-Point Cutting Tool Analysis	2
05	Build a simple IoT-based die casting monitoring system	2
06	Study powder metallurgy steps via a virtual lab or recorded experiment	2

Sr No	List of Assignments / Tutorials	Hrs
01	Design a SCADA screen for a process of your choice.	2
02	Compare cloud vs edge computing in smart factory use cases.	2
03	Virtual lab observation reports (e.g., Amrita VLABs).	2

Part C

Course project on design and fabrication of any one mechanism for a group of maximum 4 students

References:

- Groover, M. P., *Automation, Production Systems, and CIM*, Pearson, 2015.
- Kagermann, H. et al., *Industrie 4.0: Final Report*, 2013.
- Lee, J. et al., *CPS Architecture for Industry 4.0*, *Manufacturing Letters*, 2015.
- Zuehlke, D., *SmartFactory – Factory-of-Things*, *Annual Reviews in Control*, 2010.
- Rajput, R. K., *Manufacturing Technology*, Laxmi Publications, 2016.
- Krar, S. et al., *Technology of Machine Tools*, McGraw-Hill, 2020.
- Mourtzis, D. et al., *IoT and Big Data in Manufacturing*, *Procedia CIRP*, 2016.
- ASTM E407 – *Standard for Powder Metallurgy and Casting Processes*, 2015.

Online Resources:

Sr. No.	Website Name
1	https://archive.nptel.ac.in/courses/106/105/106105195/
2	NPTEL: Industry 4.0 & IIoT (IIT Kharagpur)

Assessment:

Term Work: Term Work shall consist part (a) + (b) +(c).

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 5 Marks (Assignments)

+ 5 Marks (Course Project) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned					Total Credits (C)
		L	T	P	L	T	P	SL	Notional Learning Hour	(Notional Learning Hour/30
98451410	Design Thinking	2	-	-	30		-	30	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
98451410	Design Thinking	20	20	40	60	2.5	--	--	100

Rationale:

Design Thinking is a human-centered approach that fosters creativity, empathy, and problem-solving. This course equips students with tools to understand user needs, generate innovative ideas, and develop practical solutions for real-world challenges.

Course Objectives:

1. Introduce the core principles and stages of the Design Thinking process.
2. Develop an empathetic mindset to understand user needs.
3. Frame clear problem statements using user-centered tools.
4. Apply ideation techniques to generate creative solutions.
5. Understand various types of prototypes and their role in product development.
6. Learn the process of testing and refining ideas based on feedback.

Course Outcomes:

On successful completion of the course learner will be able to:

1. Compare traditional and design thinking-based approaches to problem solving.
2. Define user personas using empathy and mapping techniques.
3. Frame actionable problem statements using POV and problem definition tools.
4. Apply ideation techniques to develop diverse solution sets.
5. Differentiate between low and high-fidelity prototypes and understand their usage.
6. Explain how to test prototypes based on desirability, feasibility, and usability..

Prerequisite: Fundamentals of communication and leadership skills.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Fundamentals of communication and leadership skills		
I	**Introduction to Design Thinking**	**Introduction to Design Thinking:** Definition, Comparison of Design Thinking and traditional problem-solving approach, Need for Design Thinking approach, Key tenets of Design Thinking, 5 stages of Design Thinking (Empathize, Define, Ideate, Prototype, Test)	4	CO1
		Self-learning Topics: Design thinking case studies from various domains. **Link:** https://www.design-thinking-association.org/explore-design-thinking-topics/external-links/design-thinking-case-study-index	4	

II	**Empathy**	Foundation of empathy, Purpose of empathy, Observation for empathy, User observation technique, Creation of empathy map.	5	CO2
		Self-learning Topics: Creation of empathy maps **Link:** https://www.interaction-design.org/literature/topics/empathy-mapping **Case Study:** Designing MRI for Children – GE Healthcare	5	
III	**Define**	**S**ignificance of defining a problem, Rules of prioritizing problem solving, Conditions for robust problem framing, Problem statement and POV	5	CO3
		Self-learning Topics: Creating a Persona – A step-by-step guide with tips and examples **Link:** https://uxpressia.com/blog/how-to-create- persona-guide-examples	5	
IV	**IIdeate**	What is ideation? Need for ideation, Ideation techniques, Guidelines for ideation: Multi- disciplinary approach, Imitating with grace, Breaking patterns, Challenging assumptions, Looking across value chain, Looking beyond recommendation, Techniques for ideation: Brainstorming, Mind mapping	6	CO4
		Self-learning Topics: How To Run an Effective Ideation Workshop: A Step-By-Step Guide **Link:** https://uxplanet.org/how-to-	6	

		run-an-effective- ideation-workshop-a-step-by-step-guide-d520e41b1b96		
V	**Prototype**	Low and high-fidelity prototypes, Paper prototype, Story board prototype, Scenario Prototype.	4	CO5
		Self-learning Topics: IDEO Prototyping Toolkit	4	
VI	**Test**	5 guidelines of conducting test, The end goals of test: Desirability, Feasibility and Viability, Usability testing	6	CO6
		Self-learning Topics: Real-world Testing Examples from Stanford d.school or IDEO **Case Study:** IDEO's Shopping Cart Redesign – A classic innovation sprint (All stages)	6	
Total			30	

Textbooks:

1. Design Your Thinking: The Mindsets, Toolsets, and Skill Sets for Creative Problem-solving, Pavan Soni, Penguin, Random House India Private Limited
2. Design Thinking: Methodology Book, Emrah Yayichi, 2016
3. Handbook of Design Thinking: Christian Mueller-Roterberg, 2018

Reference books:

1. Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School, Idris Mootee, Wiley, 2013
2. Change by Design, Tim Brown, Harper Business, 2009

Online References:

Sr. No.	Website Name
1.	Design Thinking and Innovation by Ravi Poovaiah https://onlinecourses.swayam2.ac.in/aic23_ge17/preview
2.	Introduction to Design Thinking by Dr. Rajeshwari Patil, Dr. Manisha Shukla, Dr Deepali Raheja, Dr. Mansi Kapoor https://onlinecourses.swayam2.ac.in/imb24_mg37/preview
3.	Usability Testing https://www.interaction-design.org/literature/topics/usability-testing

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
98431411	**Business Model Development**	2	-	-	30		-	30	60	**2**

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
98431411	**Business Model Development**	--	--	--	--	--	25	--	25

Rationale:

Entrepreneurship is the backbone of innovation and economic growth. In the 21st-century knowledge economy, students must be equipped not just with employment-ready skills but with a problem-solving and innovation mindset to become job creators. This course blends core entrepreneurship principles with business model design, startup financing, and digital business strategies.

Course Objectives:

1. To introduce students to entrepreneurship and its socio-economic relevance.
2. To enable understanding of different business structures and MSME significance.
3. To familiarize learners with funding mechanisms for startups.
4. To introduce the basics of IPR and ethical innovation practices.
5. To equip students with tools for building business models and MVPs.
6. To explore digital marketing and disruption in online business ecosystems.

Course Outcomes:

On successful completion of the course learner will be able to:

1. Define and explain entrepreneurship and its key types.
2. Analyze the legal and operational structure of business ownership.
3. Identify and compare startup funding models and sources.
4. Apply the fundamentals of IPR to protect entrepreneurial innovations.
5. Create comprehensive business models using BMC tools.
6. Evaluate and apply digital marketing techniques for online business models.

Prerequisite: Basic Design Thinking principles.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Basic Design Thinking principles		
I	**Introduction to Entrepreneurship**	Definition, the role of entrepreneurship in the economic development, The entrepreneurial process, Women entrepreneurs, Corporate entrepreneurship, Entrepreneurial mindset.	5	CO1
		Self-learning Topics: Case studies: Henry Ford	5	

		https://www.thehenryford.org/docs/default- source/default-document-library/default-document-library/henryfordandinnovation.pdf?sfvrsn=0 The Tatas: How a Family Built a Business and a Nation by Girish Kuber, April 2019, Harper Business		
II	**Entrepreneurship Development**	Types of business ownerships: Proprietorship, Public and Private Companies, Co-operative businesses, Micro, Small and Medium Enterprises (MSME): Definition and role of MSMEs in economic development.	4	CO2
		Self-learning Topics:MSME Act and Udyam Registration portal **Case Study:** Amul – Co-operative innovation in dairy sector	4	
III	**Start-up financing**	**Start-up financing:** Cost and revenue models, Sources of start-up fundings: Angel investors, Venture capitalists, Crowd funding, Government schemes funding(e.g., SIDBI, Startup India).	5	CO3
		Self-learning Topics: Successful business pitching. **Case Study:** Shark Tank pitch breakdown.	5	
IV	**Intellectual Property Rights (IPR)**	Types of IPR: Patents, trademarks and copyrights, Patent search and analysis, Strategies for IPR protection, Ethics in technology and innovation.	5	CO4

		Self-learning Topics: Case Study: WIPO Patent Search Exercise	5	
V	**Business Model Development**	Types of business models, Value proposition, Customer segments, Customer relationships, Channels, Key partners, Key activities, Key resources, Prototyping and MVP.	6	CO5
		Self-learning Topics: The Art of the Start 2.0: The Time-Tested, Battle- Hardened Guide for Anyone Starting Anything by Guy Kawasaki **Case Study:** The Rise of Zomato – A Disruptive Food Delivery Platform	6	
VI	**Digital Business Management**	Digital Business models (Subscription, Freemium *etc*), Digital marketing: Search Engine Optimization (SEO), Search Engine Marketing (SEM), Social media and influencer marketing, Disruption and innovation in digital business.	5	CO6
		Self-learning Topics: Case study: Airbnb https://www.prismetric.com/airbnb-business-m	5	
Total			30	

Sr No	List of Assignments	Hrs
01	Presentation on case study of a failed business model	2
02	Presentation on case study of a woman entrepreneur	2

Textbooks:

1. Entrepreneurship: David A. Kirby, McGraw Hill, 2002
2. Harvard Business Review: Entrepreneurs Handbook, HBR Press, 2018
3. Business Model Generation; Alexander Ostlewalder and Yves Pigneur, Strategyzer, 2010
4. E- Business & E– Commerce Management: Strategy, Implementation, Practice – Dave Chaffey, Pearson Education

Reference books:

1. Entrepreneurship: New venture creation by David Holt, Prentice Hall of India Pvt. Ltd.
2. E- Business & E– Commerce Management: Strategy, Implementation, Practice – Dave Chaffey, Pearson Education

Online References:

Sr. No.	Website Name
1.	Startup India Portal – https://www.startupindia.gov.in
2.	Entrepreneurship by Prof. C Bhaktavatsala Rao https://onlinecourses.nptel.ac.in/noc20_mg35/preview
3.	Innovation, Business Models and Entrepreneurship by Prof. Rajat Agrawal, Prof. Vinay Sharma https://onlinecourses.nptel.ac.in/noc21_mg63/preview
4.	Sarasvathy's principles for effectuation https://innovationenglish.sites.ku.dk/model/sarasvathy-effectuation/
5.	WIPO Patent Search https://www.wipo.int/portal/en/index.html
6.	Airbnb Business Model Case https://www.prismetric.com/airbnb-business-model/
7.	BMC Tool https://www.strategyzer.com/canvas/business-model-canvas

Assessment:

Term Work: Term Work shall consist of at least 4 to 5 **Case Study Analysis , Presentation** based on the above list. Also, Term work Journal must include at least 2 to 3 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Case Study report)+ 5 Marks (Assignments) + 5 Marks (Attendance).

3.T.E Syllabus

T.E SEM V

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC501	Mechanical Measurements and Controls	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT-2	IAT-1 + IAT-2					
MEC501	**Mechanical Measurements and Controls**	20	20	40	60	2.5	--	--	100

R-2025- Mechanical Engineering

Course Objectives:

1. To study the principles of precision measuring instruments & their significance.
2. To familiarize with the handling & use of precision measuring instruments/ equipment's.
3. To impart knowledge of architecture of the measurement system.
4. To deliver working principle of mechanical measurement system.
5. To study concept of mathematical modelling of the control system.
6. To acquaint with control system under different time domain.

Course Outcomes: Learner will be able to...

1. Handle, operate and apply the precision measuring instruments / equipment's.
2. Analyze simple machined components for dimensional stability & functionality.
3. Classify various types of static characteristics and types of errors occurring in the system.
4. Classify and select proper measuring instrument for displacement, pressure, flow and temperature measurements.
5. Design mathematical model of system/process for standard input responses and analyse error and differentiate various types of control systems and time domain specifications
6. Analyse the problems associated with stability.

Prerequisite: – Basic Phyics, Units & Measurements

R-2025- Mechanical Engineering

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	**Basic Phyics, Units & Measurements**		
I	**Introduction to Metrology and Limit Gauges Design**	1.1 Introduction to Metrology, Need for inspection, Fundamental principles and definition, Standards of measurement, Errors in measurements, International standardization. 1.2 Limits, fits and tolerances of interchangeable manufacture, Elements of interchangeable system, Hole based and shaft based systems, Tolerance grades, Types of fits, General requirements of Go & No-Go gauging, Taylor's principle, Design of Go & No go gauges.	**06**	**CO1**
II	**Surface, Screw thread and Gear Measurement**	2.1 Principles of interference, Concept of flatness, Flatness testing, Optical flats, Optical Interferometer and Laser interferometer. 2.2 Surface texture measurement: importance of surface conditions,	**08**	**CO2**

		roughness and waviness, surface roughness standards specifying surface roughness parameters - Ra, Ry, Rz, RMS value etc., Surface roughness measuring instruments. 2.3 Screw Thread measurement: Two wire and three wire methods, Floating carriage micrometer. 2.4 Gear measurement: Gear tooth comparator, Master gears, Measurement using rollers and Parkinson's Tester.		
III	**Significance of Mechanical Measurement**	3.1 Significance of Mechanical Measurements, Classification of measuring instruments, generalized measurement system, types of inputs: Desired, interfering and modifying inputs. 3.2 Static characteristics: Static calibration, Linearity, Static Sensitivity, Accuracy, Static error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span & Range etc.	**07**	**CO3**
IV	**Displacement, Strain, Pressure, Flow, Temperature Measurement**	4.1 Displacement Measurement: Transducers for displacement, displacement measurement, potentiometer, LVDT, Capacitance	**09**	**CO4**

		Types, Digital Transducers (optical encoder), Nozzle Flapper Transducer 4.2 Strain Measurement: Theory of Strain Gauges, gauge factor, temperature Compensation, Bridge circuit, orientation of strain gauges for force and torque, Strain gauge based load cells and torque sensors 4.3 Pressure Measurement: Elastic pressure transducers viz. Bourdon tubes, diaphragm, bellows and piezoelectric pressure sensors, High Pressure Measurements, Bridge man gauge. Vacuum measurement: Vacuum gauges viz. McLeod gauge, Ionization and Thermal Conductivity gauges 4.4 Flow Measurement: Bernoulli flowmeters, Ultrasonic Flowmeter, Magnetic flow meter, rotameter 4.5 Temperature Measurement: Electrical methods of temperature measurement Resistance thermometers, Thermistors and thermocouples, Pyrometers		
V	**Introduction to Control System**	5.1 Introduction to control systems, Classification of control system. Open loop and closed loop systems.	**09**	**CO5**

		5.2 Mathematical modelling of control systems, concept of transfer function, Block diagram algebra 5.3 Transient and steady state analysis of first and second order system. Time Domain specifications. Step response of second order system. Steady-state error, error coefficients, steady state analysis of different type of systems using step, ramp and parabolic inputs		
VI	**Stability Analysis of Control System**	6.1 Stability analysis: Introduction to concepts of stability, The Routh criteria for stability 6.2 Experimental determination of frequency response, Stability analysis using Root locus, Bode plot	**06**	**CO6**

Text Books/ Reference:

1. Engineering. Metrology, I.C. GUPTA, Dhanpat Rai Publications.

2. Engineering. Metrology, R. K. Jain, Khanna Publisher.

3. Measurement Systems: Applications and Design, by EO Doebelin,5th Edition, McGraw Hill

4. Mechanical Engineering Measurements, A. K. Sawhney, Dhanpat Rai & Sons, New Delhi

5. Instrumentation & Mechanical Measurements, A. K. Thayal

6. Control System Engineering by Nagrath I.J. and Gopal M, Wiley EasternLtd.

7. Modem Control engineering: by K. Ogata, Prentice Hall

8. Control systems by Dhanesh Manik, Cengage Learning

9. Engineering Metrology and Measurements by N V Raghavendra and L Krishnamurthy,

OxfordUniversity Press.

10. Instrumentation and Control System, W. Bolton, Elsevier

11. Experimental Methods for Engineers by J P Holman, McGraw Hills Int. Edition

12. Engineering Experimentation by EO Doebelin, McGraw Hills Int. Edition

13. Mechanical Measurements by S P Venkateshan, John Wiley & Sons

Online References:

Sr. No.	Website Name
1	**https://nptel.ac.in/courses/112/103/112103261/** - Principles of Mechanical Measurement, IIT Guwahati
2	**https://nptel.ac.in/courses/112/107/112107242/** - Mechanical Measurement System, IIT Roorkee
3	**https://nptel.ac.in/courses/112/106/112106138/** - Mechanical Measurements and Metrology, IIT Madras

Assessment:

R-2025 Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC502	Thermal engineering	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT 1+ IAT 2					
MEC502	Thermal engineering	20	20	20	80	3	--	--	100

Prerequisite: Basic Thermodynamics, Engineering Mathematics, Fluid Mechanics

Course Objectives:

1. To study the heat transfer concepts applicable for steady state and transient conditions.
2. To study mathematical modeling and design concepts of heat exchangers.
3. To familiarize with the working of S.I. and C.I. engines and their performance.

Course Outcomes:

1. Understand and apply heat transfer modes and steady-state conduction in various geometries.
2. Analyze heat transfer from fins and unsteady heat transfer using lumped system analysis.
3. Evaluate convection in external/internal flows and understand boiling, condensation, and radiation.
4. Apply mass transfer principles and analyze heat exchangers using LMTD and NTU methods.
5. Explain working, cycles, and combustion in SI and CI engines.
6. Assess engine performance, emissions, and control methods.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Fundamentals of Heat Transfer**	**1.1. Modes of Heat Transfer**: Mechanism of conduction, Convection and radiation heat transfer and it's Governing laws. **1.2.** Generalized heat conduction equation in rectangular, cylindrical and spherical coordinates (only equations for cylindrical and spherical coordinates, no derivation). Steady state heat conduction through plane wall, composite wall, cylinder, composite cylinder, sphere and composite sphere. Thermal contact resistance. Critical radius of insulation in cylinder and sphere.	**06**	**CO1**
II	**Extended Surfaces and Unsteady Heat Transfer**	**2.1 Heat transfer from Extended Surfaces**: Types of extended surfaces and its significance. Governing differential equation for fin (Finite, Infinite, and Insulated tips) and its solution. Fin efficiency and effectiveness. Analysis of Thermometric well. **2.2 Unsteady state heat transfer:** Lumped heat capacity Analysis. Applications of unsteady state heat transfer, Thermal time constant.	**08**	**CO2**
III	**Convection, Boiling,**	**3.1 Convection:** Free and Forced convection. **External Flow**: Velocity Boundary layer and Thermal Boundary layer, Laminar and turbulent flow over a flat plate.	**08**	**CO3**

	Condensation, and Radiation	**Internal Flow:** Velocity Boundary layer and Thermal Boundary layer, Laminar and Turbulent flow in tubes. General thermal analysis: Constant heat flux and constant surface temperature. **3.2 Boiling and Condensation**: Introduction to Different boiling regimes, Film condensation, Drop wise Condensation. **3.3 Radiation:** Basics laws of radiation and heat exchange between two bodies.		
IV	**Heat Exchangers**	**4.1 Heat Exchangers:** Types of heat exchangers, Overall heat transfer coefficient, LMTD, Effectiveness, Effectiveness – Number of Transfer Unit (ε- NTU) method, Correction factor for multi pass (up to 2 passes on shell and tube side) and cross flow heat exchanger.	**08**	**CO4**
V	**Internal Combustion Engines – Basics and Combustion**	5.1 Introduction to I.C. Engines and its Classification. Working of Four stroke and Two-stroke engines, Valve Timing Diagram. Fuel air cycles, Actual cycle. 5.2 Introduction to Fuel Supply, Ignition, combustion and knocking in SI Engines. MPFI in SI Engine. 5.3 Introduction to Fuel Injection system, Combustion and detonation in CI Engines.	**08**	**CO5**
VI	**Engine Performance and Emissions**	**6.1 Engine Testing and Performance**: Measurement of various performance parameters, Performance characteristic of SI and CI Engine, Effect of load and speed on performance parameters, Heat balance sheet. **6.2 Engine Emission and Control:**	**08**	**CO6**

		Sources of Engine Emissions**,** Constituents of S.I. and C.I. Engine exhaust and their effects on environment and health. Study of emission (Euro & Bharat stage) norms, Control methods for S.I and C I engine emissions.		

Text Books/ Reference:

1. Fundamentals of Heat and Mass Transfer by F.P. Incropera and D P deWitt, Wiley India 3rd Edition.
2. Introduction to thermodynamics and Heat transfer by YunusACengel 2ndEdition, McGraw Hill.
3. Fundamentals of Heat and Mass Transfer, M. Thirumaleshwar, Pearson Education India, 2009.
4. Introduction to Heat Transfer, Som S. K ,PHI Publication.
5. Heat Transfer by P S Ghoshdastidar, 2nd Edition, Oxford University Press.
6. Heat and Mass Transfer, by R Rudramoorthy and L Malaysamy, 2nd Edition, PEARSON.
7. Heat Transfer by J P Holman, Mcgraw Hill**.**
8. Heat Transfer by S P Sukhatme, University Press.
9. Heat and Mass Transfer by PK Nag, TMH.
10. Internal Combustion Engines, Willard W.Pulkrabek, Pearson Education.
11. Internal Combustion Engines, Shyam Agrawal, New Age International
12. Internal Combustion Engine, Mathur and Sharma
13. Internal Combustion Engines, Mohanty, Standard Book House
14. Internal Combustion Engine, Gills and Smith
15. Internal Combustion Engines Fundamentals, John B. Heywood , TMH
16. Internal Combustion Engines, Gupta H N, 2nd ed, PHI
17. Internal Combustion Engine, V Ganesan, TMH
18. Introduction to Internal Combustion Engines, Richard Stone, Palgrave Publication, 4th Edition
19. Internal Combustion Engine, S.L. Beohar
20. Internal Combustion Engine, P.M Heldt.
21. Internal Combustion Engine, E.F. Oberi.
22. Internal Combustion Engine by Domkundwar

Online References:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/112/101/112101097/ - Heat and Mass Transfer, IIT Bombay https://nptel.ac.in/courses/112/105/112105248/ - Heat Exchangers: Fundamentals and Design Analysis, IIT Kharagpur
2	https://nptel.ac.in/courses/112/104/112104033/ - Engine Combustion, IIT Kanpur https://nptel.ac.in/courses/112/103/112103262/ - IC Engines and Gas Turbines, IIT Guwahati
3	https://nptel.ac.in/courses/112/101/112101097/ - Heat and Mass Transfer, IIT Bombay https://nptel.ac.in/courses/112/105/112105248/ - Heat Exchangers: Fundamentals and Design Analysis, IIT Kharagpur

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC503	Dynamics of Machinery	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
MEC503	Dynamics of Machinery	20	20	40	60	2.5	--	--	100

Rationale :

This subject equips students with essential knowledge of dynamic mechanical systems. It builds foundational understanding of governor mechanisms, gyroscopic effects, vibration analysis, and balancing of rotating and reciprocating masses. These concepts are critical for designing stable and efficient machines in automotive, aerospace, and industrial applications, ensuring reliability, safety, and performance in real-world engineering systems.

Course Objectives:

1. To acquaint with working principles and applications of Governors / Gyroscope.
2. To study static and dynamic force analysis in the mechanisms.

3. To familiarize with basics of mechanical vibrations.
4. To study the balancing of mechanical systems.

Course Outcomes:

1. Demonstrate working Principles of different types of governors and Gyroscopic effects on the mechanical systems
2. Illustrate basic of static and dynamic forces
3. Determine natural frequency of element/system
4. Determine vibration response of mechanical elements / systems
5. Design vibration isolation system for a specific application
6. Demonstrate basic concepts of balancing of forces and couples

Prerequisite: Engineering mechanics, Theory of machines- Basic, Mathematics, Physics.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Governors and Gyroscopes**	**Governors and Gyroscopes:** **1.1 Governors:** Introduction to Centrifugal and Inertia governors, Study and Force analysis of Porter and Hartnell governors including Performance characteristics, Governors effort and power. **1.2 Gyroscope:** Introduction, Gyroscopic couple and its effect on spinning bodies,	08	CO1

		naval ships during steering, pitching, rolling and their stabilization.		
II	**Mechanism Dynamics and Equivalent System Representation**	**2.1 Static and Dynamic force analysis** of Slider crank mechanism (neglecting mass of connecting rod and crank), Turning moment on crank shaft. **2.2 Dynamically equivalent systems** to convert rigid body into two mass with and without correction couple(Case study- Connecting rod)	06	CO2
III	**Fundamentals of Mechanical Vibrations**	**3.1 Basic Concepts of Vibration:** Vibration and oscillation, causes and effects of vibrations, Importance of study of vibrations, Vibration parameters - springs, mass, damper, Motion- periodic, non-periodic, degree of freedom, static equilibrium position, vibration classification, steps involved in vibration analysis **3.2 Free Undamped Single Degree of Freedom Vibration System:** Longitudinal, transverse, torsional vibration system, Methods for formulation of differential equations by Newton, Energy, Lagrangian and Rayleigh's method	07	CO3
IV		**4.1 Free Damped Single Degree of Freedom Vibration System:** Introduction to different methods of damping, Study and analysis of		

	Damped Vibrations and System Simplification	**1) Viscous damped system** (under damped, critically damped, over damped; Logarithmic decrement.) **2) Coulomb's damping** (Combined Viscous and Coulomb damping excluded) **4.2 Equivalent Single Degree of Freedom Vibration System:** Conversion of multi springs, multi masses, multi-dampers into a single spring and damper with linear or rotational co-ordinate system.	07	CO4
V	**Forced Vibrations, Isolation, and Measurement Techniques**	**5.1 Forced Single Degree of Freedom Vibratory System:** Analysis of linear and torsional systems subjected to harmonic force excitation and harmonic motion excitation (excluding elastic damper) 08 **5.2 Vibration Isolation and Transmissibility:** Force Transmissibility, motion transmissibility, typical isolators & mounts. **5.3 Vibration Measuring instruments:** Principle of seismic instruments, vibrometer, accelerometer - undamped and damped, Introduction to conditioning monitoring and fault diagnosis	09	CO5

VI	**Rotor Dynamics and Balancing of Mechanical Systems**	**6.1 Rotor Dynamics:** Critical speed of single rotor, undamped and damped **6.2 Balancing:** Static and Dynamic balancing of multi rotor system (up to four rotors), balancing of reciprocating masses in In-line engines (up to four cylinders) , Introduction to V-engines (excluding other radial engines)	08	CO6

Text / References Books:

1. Theory of Machines Thomas Bevan CSB Publishers & Distributors
2. Theory of Machines by Jagdishlal Metropolitan Book New Delhi, Company, Daryaganj, Delhi
3. Theory of Machines by S. S. Ratan Tata McGraw Hill, New Delhi
4. Theory of Machines by P. L. Bellaney Khanna publication, New Delhi
5. Theory of Machines and Mechanisms by John J Uicker, Gordon R Pennock and Joseph E Shigley, Oxford University Press
6. Theory of Vibration with Applications, by W. Thomson, 2nd edition, Pearson Education
7. Mechanical Vibrations by S. S. Rao, fourth edition, Pearson Education
8. Mechanical Vibrations by G. K. Grover
9. Fundamentals of Mechanical Vibration by S. Graham Kelly, Tata McGraw Hill
10. Principles of Vibration by Benson H Tongue, 2nd Edition, Oxford University Press
11. Vibration Analysis by P. Srineevasan, TMH
12. Mechanical Vibrations- Schaum's outline series, William W. Seto, McGraw- Hill
13. Theory and Practice of Mechanical Vibrations by J S Rao and K Gupta, New Age International
14. Elements of Vibration Analysis by Leonard Meirovitch, McGrav- Hill, New York

Online References:

Sr. No.	Links for online NPTEL/SWAYAM courses
1	**https://nptel.ac.in/courses/112/101/112101096/ -** Dynamics of Machines, IIT Bombay
2	**https://nptel.ac.in/courses/112/107/112107212/ -** Introduction to Mechanical Vibration, IIT Roorkee

R-2025 Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Credit Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
MEC504	Finite Element Analysis	3	--	--	3	--	--	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
MEC504	Finite Element Analysis	20	20	40	60	2.5	--	--	100

R-2025 Mechanical Engineering

Rationale :

Finite Element Analysis (FEA) is a vital computational technique rooted in the principles of Mechanical Engineering, serving as a bridge between theoretical mechanics and real-world applications. The FEA course enables students to understand how complex structures and components respond to various loads, constraints, and environmental conditions by breaking them down into simpler elements.

It equips students with the skills to analyse stress, strain, deformation, and failure in components using simulation tools. This course lays a strong foundation for subjects like Advanced Structural Analysis, Machine Design, and Thermal Systems. FEA is widely applicable across multiple engineering disciplines, including Civil, Aerospace, Automotive, and Biomedical Engineering, making it essential for designing safe, reliable, and optimized engineering solutions.

Course Objectives:

1. **Understand** the fundamentals of weighted residual methods for solving differential equations relevant to engineering applications. *(Understand)*
2. **Explain** the process of deriving finite element equations from governing second-order differential equations. *(Understand)*
3. **Apply** one-dimensional finite element formulation techniques to analyze simple engineering structures and **develop** basic Python code to solve them. *(Apply/Create)*
4. **Apply** two-dimensional finite element methods to analyze mechanical components under plane stress, strain, and axisymmetric conditions. *(Apply)*
5. **Analyze** and **interpret** results related to natural frequency estimation of single-degree-of-freedom vibration systems using FEA. *(Analyze)*
6. **Demonstrate** the ability to use commercial FEA software tools to model, simulate, and solve real-life mechanical engineering problems. *(Apply/Evaluate)*

Course Outcomes:

1. **Solve** differential equations using weighted residual methods. *(Apply/Analyze)*
2. **Develop** the finite element equations to model engineering problems governed by second-order differential equations. *(Create)*
3. **Apply** the basic finite element formulation techniques to solve engineering problems using one-dimensional elements and **write** corresponding Python code. *(Apply/Create)*
4. **Apply** the finite element formulation techniques to analyze engineering problems using two-dimensional elements. *(Apply/Analyze)*
5. **Apply** finite element methods to determine the natural frequency of single-degree-of-freedom vibration systems. *(Apply/Analyze)*
6. Apply commercial FEA software, to solve problems related to mechanical engineering. *(Apply)*

Prerequisite: Knowledge of Engineering Mechanics, Mechanics of Solids, Heat Transfer

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Differential equations (Formulation and solution, Types-Ordinary, Partial, Order and degree of the DE and the boundary conditions) Matrix algebra (Matrix operations, gauss elimination method to get inverse the inverse of matrix) Basics of the core field (Governing laws, relationship between the various variables and constants –like in structural field stress-strain, Thermal field-temp, heat transfer rate etc	00	
I	**Introduction to Weighted Residual Methods**	1.1 Introductory Concepts: Introduction to FEM, Historical Background, General FEM procedure, Applications of FEM in various fields Advantages and disadvantages of FEM 1.2 Mathematical Modelling of field problems in engineering, Governing Differential equations, primary/secondary variables, boundary conditions types-essential/natural etc. 1.3 Approximate solution of differential equations, Weighted residual methods (Galerkin , Subdomain method)	08	CO1

II	**FEA Procedure:(Pre-processing, Processing, Post-processing)**	2.1 Discrete and Continuous Models, Weighted Residual Methods – Ritz Technique- Basic Concepts of the Finite Element Method. 2.2 Definitions of various terms used in FEM like element, order of the element, internal and external node/s, degree of freedom. 2.3 Minimization of a functional, Principle of minimum total potential, Piecewise Rayleigh-Ritz method, Formulation of 'stiffness matrix', assembly concepts to develop system equation.	08	CO2
III	**One Dimensional Problems**	3.1 One dimensional second order equations - discretization-element types - linear and higher order elements - derivation of shape functions and stiffness matrices and force vectors. 3.2 Assembly of Matrices- solution of problems in one dimensional structural analysis, heat transfer and fluid flow (stepped and taper bars, fluid network, Spring-Cart Systems) 3.3 Analysis of Plane trusses, Analysis of Beams	08	CO3
IV	**Two Dimensional Finite Element Formulations**	4.1 Introduction, three nodes triangular element, four nodes rectangular element 4.2 Natural coordinates and coordinates transformations: serendipity and Lagrange's methods for deriving shape functions for triangular element. 4.3 Convergence criterion, sources of errors	08	CO4

V	**Two Dimensional Vector Variable Problems**	5.1 Equations of elasticity - Plane stress, plane strain and axi-symmetric problems 5.2 Jacobian matrix, stress analysis of CST.	08	CO5
VI	**Finite Element Formulation of Dynamics and Numerical Techniques:**	6.1 Applications to free vibration problems of rod and beam, Lumped and consistent mass matrices. 6.2 Solutions techniques to Dynamic problems, longitudinal vibration frequencies and mode shapes, Fourth order beam equation, transverse deflections and natural frequencies of beams.	05	CO6

Text Books:

1 Textbook of Finite Element Analysis by Seshu P, Prentice Hall of India
2 Finite Element Method by J N Reddy, TMH
3 Introduction to Finite Elements in Engineering, Chandrupatla and Belegundu, Pearson Education

References:

1 'Concepts and Applications of Finite Element Analysis by Cook R D, Malkus D S, Plesha ME, John- Wiley Sons
2 The Finite Element Method in Engineering by S. S. Rao, Butter Worth Heinemann
3 Fundamental Finite Element Analysis and Application with Mathematica and MATLAB Computations by M. Asghar Bhatti, Wiley India Pvt. Ltd

Online References:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/112/104/112104193/
2	https://nptel.ac.in/courses/105/106/105106051/
3	https://nptel.ac.in/courses/112/104/112104115/
4	https://nptel.ac.in/courses/112/103/112103295/
5	https://nptel.ac.in/courses/112/106/112106135/
6	https://nptel.ac.in/courses/112/106/112106130/

7	https://nptel.ac.in/courses/105/105/105105041/
8	https://nptel.ac.in/courses/112/104/112104116/

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC551	Optimization Techniques	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
MEC551	**Optimization Techniques**	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To understand the need and origin of the optimization methods

2. To understand various linear, nonlinear and other optimization techniques

3. To understand various multi criterion and multi-objective decision making methods

4. To understand recent tools in optimization

Course Outcomes:

1) Identify the types of optimization problems and apply the calculus method to single variable Problems
2) Formulate the problem as Linear Programming problem and analyze the sensitivity of a decision variable
3) Apply various linear and non-linear techniques for problem solving in various domain
4) Apply multi-objective decision making methods for problem in manufacturing environment and other domain
5) Apply multi criterion decision making methods for problem in manufacturing environment and other domain
6) Apply Design of Experiments method for Optimization

Prerequisite:

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite			
I	**Basic Concepts**	Statement of the Optimization Problem, Basic Definitions, Optimality Criteria for Unconstrained Optimization, Optimality Criteria for Constrained Optimization, Engineering Application of Optimization,	**07**	**CO1**

		Classification of Optimization Problems. Classical Optimization Techniques: Single variable optimization		
II	**Linear Programming Problem**	Linear Programming Problem: Formulation, Simplex method, Big M Method, Two Phase, Primal to Dual, Dual Simplex method, Sensitivity Analysis and applications of LP Transportation and Assignment Models	**09**	**CO2**
III	**Integer Programming Model**	Gomory's cutting plane method, Branch & Bound Technique. Non L.P. Model: Lagrangian method & Kuhn tucker Method, Newton's method. Discrete Event Simulation: Generation of Random Variable, Simulation Processes, Monte-Carlo Technique	**09**	**CO3**
IV	**Multi Objective Decision making (MODM) Methods**	Introduction to Multi objective optimization, Traditional Techniques such as, quadratic programming, geometric programming, Numerical on goal programming and dynamic programming. Introduction to Non-traditional optimization Techniques such as Genetic Algorithm, particle swarm, genetic algorithms, simulated annealing and Techniques	**09**	**CO4**

		based on Neural network & Fuzziness (Only concepts)		
V	**Multi Criterion Decision-making (MCDM) Methods**	Introduction to multi criterion optimization Simple Additive Weighting (SAW) Method Weighted Product Method (WPM) Analytic Network Process (ANP) Analytic Hierarchy Process (AHP) Method TOPSIS Method PROMETHEE	**07**	**CO5**
VI	**Robust Design Methods**	Robust Design Methods: DOE and Taguchi techniques Full Factorial Design: The basics of "full factorials", ANOVA, Factorial effects and plots, and Model evaluation Fractional Factorial Design: The one-half fraction and one-quarter of the 2k design, The general 2k-p fractional factorial design Application of related software (Minitab, Design Expert or MATLAB)	**09**	**CO6**

Text Books/ Reference:

1. S.S. Rao, "Engineering Optimization - Theory and Practice", John Wiley and Sons Inc.

2. Ranjan Ganguli, "Engineering Optimization - A Modern Approach" Universities Press

3. Pablo Pedregal, "Introduction to Optimization", Springer

4. L.C. Jhamb, "Quantitative Techniques Vol. 1 and 2", Everest Pub. House

5. Pierre D.A., "Optimization, Theory with Application", John Wiley & sons.

6. R V Rao, "Decision Making in the Manufacturing Environment Using Graph Theory and Fuzzy Multiple Attribute Decision Making" (Springer Publication).

7. Ritter, H., Martinetz, T., &Schulten, K., Addison,"Neural Computation and Self-Organizing Maps"-Wesley Publishing Company

8. Douglas C.Montgomery,"Design and analysis of experiments"(John Wiley & Sons Inc.)

9. Saravanan R,"Manufacturing Optimization through Intelligent Techniques", Taylor & Francis (CRC Press)-2006.

Online References:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/112/101/112101298/

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC552	Statistical Techniques	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
MEC552	**Statistical Techniques**	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To acquaint the learners with the basic concepts of Statistical Techniques

2. To develop understanding of sampling theory

3. To study methods for curve fitting and regression

4. To learn statistical decision theory

Course Outcomes:

1) Apply the concepts of statistical distributions in engineering applications
2) Use sampling theory for a given data set
3) Fit curve for a given data set
4) Demonstrate the understanding of correlation and regression analysis
5) Perform analysis of variance from the available experimental data
6) Demonstrate the understanding of Statistical Decision making and Hypothesis testing

Prerequisite:

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite			
I	**Statistical Distributions**	Random Variable and Probability Distribution. Binomial, Poisson, Normal, Exponential, Hypergeometric, Uniform distributions	**06**	**CO1**
II	**Sampling Theory**	Meaning and Objectives of Sampling. Types of Sampling, Methods of drawing random samples. Sampling Distributions, Standard Error and Probable Error	**09**	**CO2**

III	**Curve Fitting and Methods of Least Squares**	Relationship between Variables, Curve Fitting, Equations of Approximating Curves, The Method of Least Squares, The Least Squares Line, Non-linear Relationships, The Least Squares Parabola	**09**	**CO3**
IV	**Correlation and Regression**	Types of Correlation. Linear Correlation, Measures of Correlation, Standard Error of Estimate, Karl Pearson's and Rank Correlation coefficient. Simple linear regression: Least Squares Method	**09**	**CO4**
V	**Analysis of Variance (ANOVA)**	The Purpose of Analysis of Variance, One-Way Classification, Total Variation, Variation Within Treatments and Variation Between Treatments. The F Test for the Null Hypothesis of Equal Means, Two-Way Classification, Analysis of Variance for Two-Factor Experiments	**06**	**CO5**
VI	**Statistical Decision Theory**	Statistical Decisions, Statistical Hypotheses, Tests of Hypotheses and Significance, or Decision Rules, Type I and Type II Errors, Level of Significance, Tests Involving Normal Distributions, Two-tailed and One-tailed Tests, Special Tests.	**06**	**CO6**

		Confidence Interval, Z test and Chi Square Test for Goodness of fit.		

Text Books/ Reference:

1. Douglas C. Montgomery, "Design and Analysis of Experiments", John Wiley and Sons Inc.

2. Murray R. Spiegel, "Probability and Statistics", Schaum's Outline Series, McGraw-Hill Book Company

3. Kothari, C.R., 1985, "Research Methodology-Methods and Techniques", Wiley Publications

4. N. G. Das, "Statistical Methods", Vol – I & II, Tata McGraw Hill.

Online References:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/112104211
2	https://onlinecourses.nptel.ac.in/noc21_ma74/preview
3	https://onlinecourses.nptel.ac.in/noc20_ma19/preview

R-2025 Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEL506	Thermal engineering	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT 1+ IAT 2				
MEL506	Thermal engineering	--	--	--	--	25	25	50

Lab Objectives:

1. To acquaint with working principles and applications of gyroscope and governors.
2. To acquaint with the principles of vibration measuring instruments.
3. To study balancing of mechanical systems.

Lab Outcomes:

1. Plot and analyze governor characteristics.
2. Analyze gyroscopic effect on laboratory model.
3. Estimate natural frequency of mechanical systems.
4. Analyze vibration response of mechanical systems.
5. Determine damping coefficient of a system.
6. Balance rotating mass.

Prerequisite: Basic Thermodynamics, Engineering Mathematics, Fluid Mechanics

Term Work: (Comprises part 'a' and 'b')

a) List of Experiments: (Minimum Eight)
b) Assignment:

a) List of Experiments:

Sr. No	List of Experiments	Hrs.
01	Measurement of thermal conductivity of metal rod/liquids/insulating powder	**02**
02	Measurement of thermal conductivity of composite wall	**02**
03	Performance analysis of extended surfaces under free and forced convection	**02**
04	Measurement of thermal conductivity of metal rod/liquids/insulating powder	**02**
05	Measurement of thermal conductivity of composite wall	**02**
06	Performance analysis of extended surfaces under free and forced convection	**02**
07	Measurement of heat transfer coefficient for flow over flat surface in free/forced convection	**02**
08	Measurement of heat transfer coefficient for flow through tubes in free/forced convection	**02**
09	Verification of Stefan–Boltzmann Law	**02**
10	Measurement of emissivity of grey surface	**02**
11	Thermodynamic evaluation and emission analysis of multi-cylinder petrol engines with preparation of heat balance sheets.	**02**
12	Principles and application of the Morse test for determining frictional power and mechanical efficiency of multi-cylinder petrol engines.	**02**

b) Assignment:

Minimum two problems on each of the following topics:

1. Types and modes of heat transfer with examples
2. Derivation and application of one-dimensional heat conduction equation
3. Heat transfer in extended surfaces (fins) – types, efficiency, and effectiveness
4. Lumped heat capacity method – assumptions and applications
5. Boiling and condensation heat transfer – types and differences
6. Radiation laws – Stefan-Boltzmann law, emissivity, and heat exchange between surfaces
7. Classification and working of 2-stroke and 4-stroke engines
8. Valve timing diagram and fuel-air cycle for SI and CI engines
9. Combustion and knocking in SI vs. CI engines
10. Heat balance sheet – purpose and calculation
11. Engine performance parameters – BHP, IHP, efficiency, SFC
12. Emission norms (EURO/Bharat stage) and control methods

Project Based Learning may be incorporated by judiciously reducing number of assignments.
Text Books:

- **R.K. Rajput** – *Heat and Mass Transfer*
- **J.P. Holman** – *Heat Transfer*
- **P.K. Nag** – *Heat and Mass Transfer*
- **V. Ganesan** – *Internal Combustion Engines*
- **Mathur & Sharma** – *Internal Combustion Engines*

Online References:

Sr. No.	Website Name
1	**https://nptel.ac.in**
2	**https://ocw.mit.edu**
3	**https://www.engineeringtoolbox.com**

Term Work The distribution of marks for term work shall be as follows:

- Laboratory work: 15 marks.
- Assignments: 05 marks.
- Attendance: 05 Marks.

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEL507	Dynamics of Machinery	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
MEL507	Dynamics of Machinery	--	--	--	--	25	25	50

Lab Objectives:

1. To acquaint with working principles and applications of gyroscope and governors.

2. To acquaint with the principles of vibration measuring instruments.

3. To study balancing of mechanical systems.

Lab Outcomes:

1. Plot and analyze governor characteristics.
2. Analyze gyroscopic effect on laboratory model.
3. Estimate natural frequency of mechanical systems.
4. Analyze vibration response of mechanical systems.

5. Determine damping coefficient of a system.
6. Balance rotating mass.

Prerequisite: Basic knowledge of engineering mechanics, Understanding of mechanical vibrations.

Term Work: (Comprises part 'a' and 'b')

a) List of Experiments: (Minimum Eight)

b) Assignment:

a) List of Experiments:

Sr. No	List of Experiments	Hrs.
01	Experiments on Governors- Porter Governor, Hartnell Governor	**02**
02	Experiments on Gyroscope	**02**
03	Determine natural frequency of compound pendulum, equivalent simple pendulum system.	**02**
04	Determine natural frequency for longitudinal vibrations of helical springs, and springs in series and parallel	**02**
05	Determine natural frequency and nodal points for single rotor and two-rotor vibratory system	**02**
06	Experiment on whirling of shaft	**02**
07	Determination of damping coefficient of any system/media	**02**
08	Experimental balancing of single and multi-rotor system	**02**
09	Measurement of vibration response of a system	**02**
10	Vibration analysis of mechanical system using MATLAB/SCILAB/GNU Octave	**02**

b) List of Assignment (Minimum two):

Sr. No.	List of Assignments	Hrs.
1	Minimum two problems Governors and Gyroscope	-
2	Minimum two problems Static and dynamic force analysis	-
3	Minimum two problems Vibration, isolation and control	-
4	Minimum two problems Vibration measuring instruments	-
5	Minimum two problems Rotor dynamics	-

Project Based Learning may be incorporated by judiciously reducing number of assignments.

Text Books:

Online References:

1. **https://dom-nitk.vlabs.ac.in/List%20of%20experiments.html** – Dynamics of Machine Lab, NITK, Surathkal
2. **http://mdmv-nitk.vlabs.ac.in/#** - Machine Dynamics and Mechanical Vibrations Lab, NITK, Surathkal
3. **https://mv-iitg.vlabs.ac.in/** - Virtual Labs for Mechanical Vibrations, IIT Guwahati

Assessment:

Term Work The distribution of marks for term work shall be as follows:

- Laboratory work: 15 marks.
- Assignments: 05 marks.
- Attendance: 05 Marks.

Practical / Oral Exam: An Oral / Practical exam will be held based on the above syllabus.

R-2025 Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEL508	**Finite Element Analysis Laboratory**	**-**	**2**	**-**	**-**	**1**	**-**	**1**

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
MEL508	**Finite Element Analysis Laboratory**	--	--	--	--	25	25	50

Lab Objectives:

1. To introduce students to various finite elements and enable them to choose appropriate elements for different types of engineering problems.
2. To develop students' understanding of meshing techniques and teach them to apply mesh refinement and convergence analysis effectively.
3. To familiarize students with different types of solvers and guide them in selecting suitable solvers based on problem requirements.
4. To train students in post-processing tools and techniques to accurately interpret simulation results.
5. To build foundational knowledge of FEA principles and demonstrate their application in solving real-world engineering problems.
6. To instill the ability to critically analyze and validate simulation results by comparing with theoretical, empirical, or experimental data.

Lab Outcomes:

1. Select appropriate element for given problem
2. Select suitable meshing and perform convergence test
3. Select appropriate solver for given problem
4. Interpret the result
5. Apply basic aspects of FEA to solve engineering problems
6. Validate FEA solution

a. Experiments: Students should use the commercial software or open source application programs, to verify the results obtained by manual calculations. The input data and output results of the problem solved using the computer programs (Minimum 6) should be included in the Journal.
The proposed list is given below:

Sr No	List of Experiments	Hrs
01	Any two problems using bar element	4
02	Any two problems using truss element	4
03	Any two problems using CST element	4
04	Any two problem using axisymmetric element	4
05	Any one problem of free vibration analysis using bar element	4
06	Any one problem on steady state heat conduction	4
07	Any one problem for analysis of Beams.	6

While performing the analysis the students should understand the concepts of selection of element type, meshing and convergence of solution. (using approach of refining mesh and or order of the element)

b. Course Project: (Any one task out of the following proposed list)
A group of not more than four students, shall do
1) Finite Element Analysis of any mechanical engineering element /system, which involves element selection, assigning properties, meshing, assigning loads, and boundary conditions, analysis and result interpretation.
2) Develop the program to verify the results obtained by manual calculations for simple 1D/2D problems using Python, MATLAB programming platform etc.
3) Simulate a problem and validate the results with experimental results (the test rigs from Strength of material /Heat transfer/Dynamics of machine/fluid lab etc may be used for obtaining the experimental results)

End Semester Practical/Oral examination

1. Pair of Internal and External Examiner should conduct practical/viva based on contents
2. Duration of practical examination is 2 hour
3. Distribution of marks for practical/viva examination shall be as follows:

a. Practical performance ……**15** marks
b. Oral…….. …….**10** marks

Evaluation of practical examination to be done based on the experiment performed and the output of the experiments during practical examination.
Students work along with evaluation report to be preserved till the next examination.

Text/Reference Books:

1. Programming the Finite Element Method, I M Smith,D V Griffiths and Margetts WILEY Publications.
2. The Finite Element Method: Theory, Implementation, and Applications, Larson, Mats G., Bengzon, Fredrik,Springer
3. Introduction to Finite Element Analysis and Design by N. H. Kim, B. V. Sankar, and A. V. Kumar by Wiley publication
4. Finite Element analysis using ANSYS by PaletiSrinivas,Krishna Chaitanya, Rajesh Kumar Detti, PHI Publication.
5. Finite Element Analysis Theory and Application With ANSYS by Saeed Moaveni, Pearson Publication.
6. Introduction to Finite Element Analysis Using MATLAB and Abaqus By Amar Khennane, CRC Press publication

Online Resources:

Sr. No.	Website Name
1.	https://innovationspace.ansys.com/product/fea-analysis-of-the-finite-element-method/
2.	https://www.youtube.com/watch?v=_5bXWeSGzX4&list=PLJuuzyTpkpy_ZmqqdYf_UyqBBz_X0nz1t

Assessment:

Term Work: Term Work shall consist of at least 6 practicals based on the above list. Also, Term work Journal must include project based on industrial application

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 10 Marks (Project) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEL509	Professional communication and ethics		2+2*	-	-	2	-	2

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT- 1	IAT-2	IAT-1 + IAT-2					
MEL509	Professional communication and ethics	–	–	–	–	–	25	25	50

Learners should be able to:

1. Discern and develop an effective style of writing important technical/business documents.
2. Investigate possible resources and plan a successful job campaign.
3. Understand the dynamics of professional communication in the form of group discussions, meetings, etc. required for career enhancement.
4. Develop creative and impactful presentation skills.

5. Analyse personal traits, interests, values, aptitudes and skills.

6. Understand the importance of integrity and develop a personal code of ethics**.**

Lab Outcomes:

Learners will be able to…

1. Plan and prepare effective business/ technical documents which will in turn provide solid foundation for their future managerial roles.
2. Strategize their personal and professional skills to build a professional image and meet the
3. demands of the industry.
4. Emerge successful in group discussions, meetings and result-oriented agreeable solutions in group communication situations.
5. Deliver persuasive and professional presentations.
6. Develop creative thinking and interpersonal skills required for effective professional communication.
7. Apply codes of ethical conduct, personal integrity and norms of organizational behaviour.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours
I	**ADVANCED TECHNICAL WRITING PROJECT/PROBLEM BASED LEARNING (PBL)**	**1.1. Purpose and Classification of Reports** Classification on the basis of: Subject Matter (Technology, Accounting, Finance, Marketing, etc.) Time Interval (Periodic, One-time, Special) Function (Informational, Analytical, etc.) Physical Factors (Memorandum, Letter, Short &; Long)	06

		1.2. Parts of a Long Formal Report Prefatory Parts (Front Matter) Report Proper (Main Body) Appended Parts (Back Matter) **1.3. Language and Style of Reports** Tense, Person &; Voice of Reports,Numbering Style of Chapters, Sections, Figures, Tables and Equations Referencing Styles in APA &; MLA Format Proofreading through Plagiarism Checkers **1.4. Definition, Purpose &; Types of Proposals** Solicited (in conformance with RFP) &; Unsolicited Proposals Types (Short and Long proposals) **1.5. Parts of a Proposal** Elements Scope and Limitations Conclusion **1.6. Technical Paper Writing** Parts of a Technical Paper (Abstract, Introduction, Research Methods, Findings and Analysis, Discussion, Limitations, Future Scope and References) Language and Formatting Referencing in IEEE Format	
II	**EMPLOYMENT SKILLS**	**2.1. Cover Letter &Resume** Parts and Content of a Cover Letter Difference between Bio-data, Resume &; CV Essential Parts of a Resume	05

		Types of Resume (Chronological, Functional & Combination) **2.2 Statement of Purpose** Importance of SOP Tips for Writing an Effective SOP **2.3 Verbal Aptitude Test** **Modelled on CAT, GRE, GMAT exams** **2.4. Group Discussions** Purpose of a GD Parameters of Evaluating a GD Types of GDs (Normal, Case-based &; Role Plays) GD Etiquettes **2.5. Personal Interviews** Planning and Preparation Types of Questions Types of Interviews (Structured, Stress, Behavioural, Problem Solving &; Case-based) Modes of Interviews: Face-to-face (One-to one and Panel) Telephonic, Virtual	
III	**BUSINESS MEETINGS**	**3.1. Conducting Business Meetings** Types of Meetings Roles and Responsibilities of Chairperson, Secretary and Members Meeting Etiquette **3.2. Documentation** Notice Agenda Minutes	06

IV	**TECHNICAL/ BUSINESS PRESENTATIONS**	**4.1. Effective Presentation Strategies** Defining Purpose Analysing Audience, Location and Event Gathering, Selecting &;Arranging Material Structuring a Presentation Making Effective Slides Types of Presentations Aids Closing a Presentation Platform Skills	06
V	**INTERPERSONAL SKILLS**	Emotional Intelligence Leadership & Motivation Conflict Management &; Negotiation Time Management Assertiveness Decision Making **5.2 Start-up Skills** Financial Literacy Risk Assessment Data Analysis (e.g. Consumer Behaviour, Market Trends, etc.)	08

VI	**CORPORATE ETHICS**	**6.1. Intellectual Property Rights** Copyrights Trademarks Patents Industrial Designs Geographical Indications Integrated Circuits Trade Secrets (Undisclosed Information)	07

List of Assignments for Termwork

1. Cover Letter and Resume
2. Short Proposal
3. Meeting Documentation
4. Writing a Technical Paper/ Analysing a Published Technical Paper
5. Writing a SOP
7. IPR
8. Interpersonal Skills
9. Aptitude test (Verbal Ability)

Note:

1. **The Main Body of the project/book report should contain minimum 25 pages (excluding Front and Back matter).**
2. **The group size for the final report presentation should not be less than 5 students or exceed 7 students.**

Guidelines for Internal Assessment

Term Work 25 Marks

Assignments 10 Marks

Attendance 05 Marks

Presentation slides 05 Marks

Book Report (hard copy) 05 Marks

Internal Oral - 25 Marks

Oral Examination will be based on a GD & the Project/Book Report presentation.

Group Discussion 10 Marks

Project presentation (Individual Presentation) 10 Marks

Group Dynamics 05 Marks

Suggested Reading

1. Arms, V. M. (2005). Humanities for the engineering curriculum: With selected chapters from Olsen/Huckin: Technical writing and professional communication, second edition. Boston, MA: McGraw-Hill.

2. Bovée, C. L., &;Thill, J. V. (2021). Business communication today. Upper Saddle River, NJ: Pearson.

3. Butterfield, J. (2017). Verbal communication: Soft skills for a digital workplace. Boston, MA: Cengage Learning.

4. Masters, L. A., Wallace, H. R., &; Harwood, L. (2011).Personal development for life and work. Mason: South-Western Cengage Learning.

5. Robbins, S. P., Judge, T. A., &; Campbell, T. T. (2017). Organizational Behaviour. Harlow, England: Pearson.

6. Meenakshi Raman, Sangeeta Sharma (2004) Technical Communication, Principles and Practice. Oxford University Press

7. Archana Ram (2018) Place Mentor, Tests of Aptitude For Placement Readiness. Oxford University Press

Online References:

Sr. No.	Links for online NPTEL/SWAYAM courses
1	https://ve-iitg.vlabs.ac.in Virtual English and Communication Virtual Lab, IIT Guwahati
2	http://vlabs.iitb.ac.in/vlabs-dev/labs/communication Professional Communication Virtual Lab, IIT Bombay

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEL510	Mini Project – 2A	-	4	-	-	2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
MEL510	Mini Project – 2A	--	--	--	--	25	25	50

Lab Objectives:

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Lab Outcomes:

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.

3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to lifelong learning.
9. Demonstrate project management principles during project work.

Prerequisite: Basic knowledge of Mechanical Engineering

Guidelines for Mini Project:

1. Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
2. Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
3. Students hall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
4. A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
5. Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
6. Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
7. Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
8. The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
9. With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters V and VI.
10. However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with

suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below:
    - **Marks awarded by guide/supervisor based on log book : 10 Marks**
    - **Marks awarded by review committee : 10 Marks**
    - **Quality of Project report : 05 Marks**

<u>Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.</u>

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
    - First shall be for finalization of problem
    - Second shall be on finalization of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
    - First review is based on readiness of building working prototype to be conducted.
    - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
  - Identification of need/problem
  - Proposed final solution
  - Procurement of components/systems
  - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
  - First shall be for finalization of problem and proposed solution
  - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project:

Mini Project shall be assessed based on following criteria:

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

- In one year, project, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In case of half year project all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

1. Report should be prepared as per the guidelines issued by the University of Mumbai.
2. Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.
3. Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points:

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication.

T.E SEM VI

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC601	Machine Design	4	-	-	4	-	-	4

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
MEC601	Machine Design	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To study basic principles of machine design

2. To familiarize with use of design data books & various codes of practice

3. To acquaint with functional and strength design principles of important machine elements

4. To familiarize selection of standard elements such as rolling element bearings, belts etc.

5. To make conversant with preparation of working drawings based on designs

Course Outcomes:

1) Use design data book/standard codes to standardize the designed dimensions
2) Design Knuckle Joint, cotter joint and Screw Jack
3) Design shaft under various conditions and couplings
4) Select bearings for a given applications from the manufacturers catalogue
5) Select and/or design belts and flywheel for given applications
6) Design springs, clutches and brakes

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction**	Mechanical Engineering Design, Design methods, Aesthetic and Ergonomics consideration in design, Material properties and their uses in design, Manufacturing consideration in design, Design consideration of casting and forging, Basic principle of Machine Design, Modes of failures, Factor of safety, Design stresses, Theories of failures 08(Selection in the process of designing), Standards, I.S. Codes, Preferred Series and Numbers Thick Cylinders: Design of thick cylinders subjected to an internal pressure using Lame's equation	09	CO1

II	**Design against static loads**	Design against static loads: Socket and Spigot Cotter joint, Knuckle joint, Bolted and welded joints under eccentric loading; Power Screw-Screw Jack.	09	CO2
III	**Design against fluctuating loads**	**3.1 Design against fluctuating loads:** variables stresses, reversed, repeated, fluctuating stresses. Fatigue failure: static and fatigue stress concentration factors, Endurance limit- estimation of endurance limit, Design for finite and infinite life, Soderberg and Goodman design criteria, **3.2 Design of Shaft:** power transmitting, power distribution shafts, Module (excluding crank shaft) under static and fatigue criteria. **Keys:** Types of Keys and their selection based on shafting condition. **Couplings:** Classification of coupling, Design of Flange couplings, Bush pin type flexible couplings	13	CO3
IV	**Design of Bearings**	4.1 Rolling Contact Bearings: Types of bearing and designation, selection of rolling contact bearings based on constant / variable load & speed conditions (includes deep groove ball bearing, cylindrical roller,	09	CO4

		spherical roller, taper roller, self-aligning bearing and thrust bearing) 4.2 Sliding Contact Bearings: Design of hydro dynamically lubricated bearings (self-contained), Introduction to hydro static bearings,		
V	**Design of Belt, Chain and Flywheel**	5.1 Design and selection of Belts: Flat and V-belts with pulley construction. 5.2 Design and selection of standard roller chains. 5.3 Design of Flywheel – Introduction, Fluctuation of energy and speed, turning moment diagram, estimating inertia of flywheel for reciprocating prime movers and machines, Weight of the flywheel, flywheel for punches, rim constructions, stresses in rims and arms, Construction of flywheel.	09	CO5
VI	**Design of Springs, clutch and Brakes**	6.1 Design of Springs: Helical compression, Tension Springs under Static and Variable loads, Leaf springs. 6.2 Design of Clutches: Introduction, types, Basic theory of plate and cone type clutches, Design of single plate, multi-plate and with spring, lever design and thermal, wear considerations.	09	CO6

		6.3 Design of Brakes: Design of single shoe brake.		

Text / Reference Books:

1) **Design of Machine Elements - V.B. Banadari, Tata McGraw Hill Publication**
2) **Design of Machine Elements - Sharma, Purohil. Prentice Hall India Publication**
3) **Machine Design -An Integrated Approach - Robert L. Norton, Pearson Education**
4) **Machine Design by Pandya & Shah, Charotar Publishing**
5) **Mechanical Engineering Design by J.E.Shigley, McGraw Hill**
6) **Machine Design by Reshetov, Mir Publication**
7) **Machine Design by Black Adams, McGraw Hill.**
8) **Fundamentals of Machine Elements by Hawrock, Jacobson McGraw Hill.**
9) **Machine Design by R.C.Patel, Pandya, Sikh, Vol-I & II C. Jamnadas& Co.**
10) **Design of Machine Elements by V.M.Faires.**
11) **Design of Machine Elements by Spotts.**
12) **Recommended Data Books – Design Data: Data Book of Engineers by PSG College, KalaikathirAchchagam**

Online References:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/112/105/112105124/
2	https://nptel.ac.in/courses/112/106/112106137/

R-2025-Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC602	Turbo Machinery	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
MEC602	Turbo Machinery	20	20	40	60	2.5	--	--	100

Rationale :

This subject provides foundational knowledge of steam generators, pumps, compressors, turbines, and gas-based energy systems. It helps students understand the construction, classification, and working principles of thermal and fluid machines. Emphasis is placed on performance analysis through efficiency, work estimation, and characteristic curves.

The course introduces turbo machines using Euler's theory and covers real-world systems like thermal power plants, jet engines, and gas turbines. Students also learn about advanced topics such as multistage compression, cavitation, and vibration in compressors. This knowledge is essential for careers in power, process, and manufacturing industries. It bridges theory with practical design and operation of energy-conversion systems.

R-2025-Mechanical Engineering

Course Objectives:

1. To apply principles of thermodynamics and fluid mechanics to turbomachines.
2. To learn the design and significance of various components of the turbomachine.
3. To estimate various parameters related to turbo machines using the governing equations.
4. To evaluate the performance of turbo machines.

Course Outcomes:

1. Understand boiler types and basics of turbomachines using thermodynamic principles.
2. Apply the principles of impulse and reaction turbines to analyze performance parameters and determine work output and efficiency.
3. Understand the classification, construction, and performance characteristics of centrifugal and reciprocating pumps.
4. Explain the working, classification, and performance aspects of reciprocating and centrifugal compressors, including concepts of multistaging, surging, and choking.
5. Apply the principles of impulse and reaction turbines to interpret velocity diagrams and calculate performance parameters for steam turbines.
6. Explain the working principles, classification, and performance parameters of gas turbines and jet propulsion systems.

Prerequisite: Thermodynamics (Basic & Applied), Engineering Mechanics, Fluid Mechanics

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Fundamentals of Steam Generators and Turbo Machinery**	**Steam Generators-** Layout of Thermal Power Plant, Classification of boiler, Difference between Fire tube and Water tube boiler with examples, Low pressure and high pressure boilers, once through boiler, important features of HP boilers, Mountings and accessories, Equivalent evaporation of boilers, Boiler performance, Boiler efficiency. **Introduction to turbo machines:** **Review of Thermodynamic principles,** compressible gas flow relations, estimation of non-dimensional performance parameters for incompressible flow, specific speed. **Basic Euler's theory** of turbo machines and it application to pumps, turbines and compressors.	09	CO1
II	**Hydraulic Turbines**	**Hydraulic Turbines:** Basic theory, classification of turbines, theory of impulse and reaction turbines, estimation of work done, efficiency, characteristics of turbines, concept of draft tube and its types	07	CO2

III	**Pumps**	**Pumps:** Classification of pumps, definition of pumping systems and system characteristics. **Centrifugal pumps:** Construction, estimation of work done, efficiency, characteristics, determination of operating point, cavitation and NPSH, specific speed of pumps **Positive Displacement pumps:** Types and applications, general feature of reciprocating pumps, definition of head, discharge, work done and efficiency, types of reciprocating pumps, indicator diagram (no numerical on reciprocating pump). Use of air vessel (only application no numerical).	10	CO3
IV	**Air compressor**	**Air compressor-** Introduction and general classification of reciprocating compressor positive displacement, Multi Staging of reciprocating compressor (no derivation, numerical on single stage and two stage compressor). Centrifugal compressor, surging and choking of compressor (No numerical on centrifugal compressor).	06	CO4

V	**Steam Turbine**	**Steam Turbine:** Basic of steam turbine, Classification, compounding of turbine, Impulse turbine – velocity diagram, Condition for max efficiency Reaction turbine, Numerical on Simple Impulse turbine (De-Laval turbine) of single stage only. Degree of reaction, Parson's turbine, Condition for maximum efficiency, Numerical on Parson's turbine only.	07	CO5
VI	**Gas Turbines & Jet Propulsion Engines**	**Gas Turbines**: Applications of gas turbine, Actual Brayton cycle, open and closed cycle gas turbine, methods to improve efficiency and specific output, open cycle with intercooling, reheat, and regeneration, Effect of operating variable on thermal efficiency and work ratio. **Jet Propulsion Engines:** Classification of jet propulsion engines, Thrust, Thrust power, Propulsive efficiency and thermal efficiency.	06	CO6

Text Books:

1. Thermal Engineering, Ajoy Kumar, G. N. Sah, Narosa Publishing House, New Delhi
2. Fluid Mechanics and Machinery; CSP Ojha, R. Berndtsson, Oxford University.
3. Fluid Mechanics and Fluid Machines by Gautam Biswas, S. K. Som, Suman Chakraborty - Tata McGraw-Hill Education Pvt. Ltd.

4. Turbines, Compressors and Fans by S. M. Yahya, McGraw-Hill Education Pvt. Ltd.
5. Turbomachinery Design and Theory by Aijaz and Gorla
6. Fluid Mechanics, thermodynamics of turbomachinery- S. L. Dixon,
7. Amsterdam; Boston: Elsevier-Butterworth-Heinemann

References Books:

1. R. K. Rajput; Engineering Fluid Mechanics; S. Chand publications.
2. Dr. Mody & Seth; Hydraulics and Fluid Mechanics; Standard book house
3. S. Ramamrutham, Hydraulic, Fluid Mechanics & Fluid Machines, Dhanpat Rai publishing company.
4. Strecter, Fluid Mechanics, Tata McGraw Hill.
5. Thermal Engineering, R K. Rajput, Laxmi Publication
6. Fluid Mechanics: Fundamentals and application; Yunus A Cengel and John M Cimbala Publisher: Special India

Online References:

Sr. No.	Links for online NPTEL/SWAYAM courses
1	https://nptel.ac.in/courses/112/106/112106303/ - Introduction to Turbomachines, IIT Madras
2	https://nptel.ac.in/courses/112/106/112106200/ - Fluid Dynamics and Turbomachines, IIT Madras

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC603	Heating, Ventilation, Air conditioning and Refrigeration	**3**	–	-	**3**	–	-	**3**

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT-2	IAT-1 + IAT-2					
MEC603	Heating, Ventilation, Air conditioning and Refrigeration	20	20	40	60	2.5	--	--	100

Rationale :

Thermodynamics concepts are useful in understanding and designing systems involving energy transfer and energy transformation.

Prerequisite: Basic Thermodynamics

Course Objectives:

1. Learning the fundamental principles and different methods of refrigeration and air conditioning
2. Study of various refrigeration cycles and evaluate performance of each cycle.
3. Study of components of refrigeration and air-conditioning systems along with the applications

Course Outcomes:

1. Illustrate the fundamental principles and applications of refrigeration and air conditioning systems.
2. Identify various HVAC&R components
3. .Evaluate performance of various refrigeration system
4. E stimate cooling and heating loads for an airconditioning system.
5. Select air handling unit & design air distribution system
6. Apply the knowledge of HVAC for the sustainable development of refrigeration and air conditioning systems.

Prerequisite: calculus and integrals

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Carnot refrigerator Carnot heat pump, Carnot,coefficient of performance, Reversed Carnot cycle, and its limitaion Effect of temperature and pressure on COP of the cycle	0	
I	**Basic Concepts**	**Refrigerants:** Classification,Designation,Selection of refrigerant,Physical and chemical properties of refrigerants, Secondary Refrigerants **Air Refrigeration System:** Bell Coleman cycle, Necessity of air cooling, Factors considered for the selection of air refrigeration system, Types of air refrigeration system with schematic and T-Sdiagram, Numerical based on simple and bootstrap air refrigeration system.	7	CO1

II	**Refrigeration System & Heat Pump**	**VapourCompression Refrigeration System:** Simple system on P-h and T-s diagrams, analysis of the simple cycle, factors affecting the performance of the cycle, actual cycle, Numerical based on standard vapour compression system byusing P-h chart .and refrigerant table **Vapour Absorption Refrigeration System.** Simple and practical,vapour absorption systemRefrigerant-adsorbent properties, COP of ideal vapour absorption system, DomesticElectroluxrefrigerator, Lithiumbromideabsorption system. **Heat Pump:** performance,Primary energy ratio,Energy efficiency Introduction,Coefficient of ratio, Heating season performance factor, Seasonal energy efficiency, ratio,Classification of heat pump,Vapour compression heat	9	CO2

		pump systems Heat pump application in an industry.		
III	**Thermal Comfort Conditions:**	**Thermal ComfortConditions:** Selection of inside design conditions, thermal comfort, heat balance equation for a human being, factors affecting thermal comfort, Effective temperature, comfort chart and factors governing effective temperature, selection of outside design conditions **Psychrometry:**of Air Conditioning Processes Psychrometry properties,relations and processes , Adiabatic air mixing , process Psychrometric chart, RSHF, GSHF, ERSHF, Bypass factor , Apparatus dew point Numerical based on psychrometric chart and . Classification of air conditioning system,relations **Cooling Load Estimation** **,**Introduction, Components of cooling load Different heat sources ,Various load	11	CO3

		Estimation, Design of air conditioning system Building survey and economic aspect used in design.		
IV	**Air Distribution System:**	**Duct** Classification of ducts,duct material, pressure in duct, Flow through duct, pressure losses in ductA,ir flow through simple duct system Equivalent diameter, Methods of duct system design: **Air Handling Unit** Coduction Intr Fan coil unit, Types of fans used air conditioning applications, Fan lawsF,ilters,supply and return grills,Sensors.	7	CO4
V	**HVACR & Components**	Working of reciprocating, screw and scroll compressors, working of air cooled, and water cooled and evaporative condensers, Working of DX, Flooded, and Forced feed evaporators, Expansion devices Capillary tube, TXV, EXV, Type of insulation materials.	7	CO5
VI	**Application of HVAC&R**	Ice plant, Food storage plants, dairy and food processing plants, freeze drying, A/c in textile, Printing pharmaceutical industry and Hospitals ,Cold chain Technology, Transport air	4	CO6

		conditioning,Solar refrigeration.		

Text / References Books:

1. Refrigeration and Air Conditioning by C.P.Arora, McGraw Hill education (India) (P) limited, New Delhi

2. Principles of Refrigeration by Roy J. Dossat, Pearson education, New Delhi

3. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P) limited, New Delhi

4. Refrigeration and Air Conditioning by S.C.Arora and S.Domkundwar, Dhanpatrai and sons, Delhi

5. Khurmi R.S. and Gupta J.K., Refrigeration and Air conditioning, Eurasia Publishing House Pvt. Ltd, New Delhi

6. ISHRAE Air Conditioning Handbook

7. ISHRAE Refrigeration Handbook

8. ASHRAE Handbook of Fundamentals

9. ASHRAE Handbook of Equipment

10. ASHARE Handbook of System

11. Open Source Software/learning website

Online References:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/112/107/112107208 Refrigeration and Air Conditioning, IIT Roorkee
2	https://nptel.ac.in/courses/112/105/112105128 Refrigeration and Air Conditioning, IIT Kharagpur

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC604	Automation and Artificial Intelligence	3	-	-	3	-	-	**3**

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT 1	IAT 2	IAT1 +IAT 2					
MEC604	Automation and Artificial Intelligence	20	20	40	60	2.5	--	--	100

Course Objectives:

1. **To understand the need and justification of automation**
2. To study design of pneumatic and hydraulic circuits.
3. To study and understand electro pneumatic circuits and PLC Design.
4. To familiarize with robotic systems in automated manufacturing processes.
5. To study and understand AI and machine learning technologies for automation

Course Outcomes:

1) Demonstrate understanding of fundamentals of industrial automation and AI.
2) Design & develop pneumatic / hydraulic circuits.
3) Design and develop electro pneumatic circuits and PLC ladder logics.
4) Demonstrate understanding of robotic control systems and their applications.
5) Demonstrate understanding of various AI and machine learning technologies.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction**	1.1 Introduction to Automation Definition and fundamentals of automation, Elements of Automated system, Automation principles and strategies, Levels of automation, types of automation, Advanced automation functions 1.2 Introduction to Artificial Intelligence Introduction, Historical development, Intelligent Systems, Types of Intelligent Agents, Components of AI, Foundations of AI, Scope of AI, Current trends in AI, Relevance to Mechanical Engineering	09	CO1
II	**Pneumatic & Hydraulic Circuits**	2.1 Design of Pneumatic Circuits Design of Pneumatic sequencing circuits using Cascade method and Shift register method (up to 2 cylinders) 2.2 Design of Hydraulic Circuits	09	CO2

		Basic Hydraulic Circuits: Meter in, meter out and Bleed off circuits; Intensifier circuits, Regenerative Circuit, Counter balance valve circuit and sequencing circuits.		
III	**Electro-pneumatic Circuits**	3.1 Electro-pneumatic Circuits Design of Electro-Pneumatic Circuits using single solenoid and double solenoid valves; with and without grouping; 3.2 PLC Discrete Control Systems Design of Pneumatic circuits using PLC Control (ladder programming only) up to 2 cylinders, with applications of Timers and Counters and concept of Flag and latching.	13	CO3
IV	**Robotics**	Robots and their applications: Introduction to Robots, Types, Classifications, Selection of Robots, Robot Degrees of freedom, Robot configuration, Accuracy and repeatability, Specification of a Robot, Robot feedback controls: Point to point control and Continuous path control, Control system for Robot joint, Adaptive control, Drives and transmission systems, End effectors, Industrial robot applications, Nex-gen robots.	09	CO4
V	**Problem Solving**	(Concept and Algorithms, No programming or numerical) 5.1 Problem Solving: Tree and Graph Search, Uninformed v/s informed	09	CO5

		search, uninformed methods: depth first search, breadth first search, Informed search: heuristic search, Best first search, branch and bound 5.2 Machine Learning: Introduction, types of machine learning: supervised, unsupervised, reinforcement learning 5.3 Learning with Decision Trees: Introduction to Decision Trees, Classification and Regression Trees, K means clustering algorithm, K nearest neighbors algorithm, hierarchical clustering, Concept of ensemble methods: bagging, boosting, random forests		
VI	**Artificial Intelligence**	(Concept and Algorithms, No programming or numericals) 6.1 Learning with regression: Linear regression, Logistic regression 6.2 Artificial Neural Networks Concept of ANN, Basic Models of Artificial Neural Networks Important Terminologies of ANNs McCulloch-Pitts Neuron, NN architecture, perceptron, delta learning rule, backpropagation algorithm, Gradient Descent algorithm, feed forward networks, activation functions 6.3 Introduction to AI Technologies in the realm of Automation Concept of Natural Language Processing, Machine	09	CO5

		Vision, Deep learning, Expert systems, Genetic Algorithms, Industry 4.0		

Text / Reference Books:

1) **Applied Mechatronics- A. Smaili and F. Mrad, OXFORD university press**
2) **Mechatronics System Design , Shetty and Kolk, Cengage Learning, India Edition**
3) **Mechatronics - Electronic Control Systems in Mechanical Engineering , Bolton Pearson education**
4) **Introduction to Mechatronics, AppuKuttan K.K., OXFORD Higher Education**
5) **Electro-mechanical Engineering - An Integrated Approach , Fraser and Milne**
6) **Industrial Hydraulics: Pippenger**
7) **Mechatronics, Nitaigour Mahalik, Tata McGraw-Hill.**
8) **M.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education, New Delhi.**
9) **Yoram Korean, "Robotics for engineers", McGrew Hill Co.**
10) **Artificial Intelligence by Elaine Rich, Kevin Knight and Nair ISBN-978-0-07008770-5, TMH.**
11) **Artificial Intelligence & Machine Learning by Vinod Chandra .S.S. Anand Harindran. S. (PHI).**
12) **A first course in Artificial Intelligence – By Deepak Khemani. Mc GrawHill**

Online References:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/112/103/112103174/
2	https://nptel.ac.in/courses/112/103/112103293/
3	https://nptel.ac.in/courses/112/102/112102011/

4	https://nptel.ac.in/courses/112/101/112101098/
5	https://nptel.ac.in/courses/112/103/112103280/
6	https://nptel.ac.in/courses/106/106/106106139/

R-2025 Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEDLO 6023	Metal Forming Technology	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT 1+ IAT 2					
MEDL O6023	Metal Forming Technology	20	20	20	80	3	--	--	100

Course Objectives:

1. To conversant with the basic knowledge on fundamentals of metal forming processes
2. To study various metal forming processes
3. Understanding plastic deformation and technical analysis of forming processes

Course Outcomes:

1. Understand the concept of different metal forming process.
2. Approach metal forming processes both analytically and numerically
3. Design metal forming processes
4. Develop approaches and solutions to analyze metal forming processes and the associated problems and laws.

R-2025 Mechanical Engineering

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Metal Forming:**	Metallurgical aspects of metal forming, slip, twinning mechanics of plastic deformation, effects of temperature, strain rate, microstructure and friction in metal forming-yield criteria and their significance, Classification of Metal Forming Processes, Advantages and Limitations, Stress strain relations in elastic and plastic deformation, concept of flow stresses, deformation mechanisms, Hot and Cold Working Processes and Its Effect on Mechanical Properties.	**08**	**CO1**
II	**Rolling:**	Introduction and Classification, Types of Rolling Mills, Forces And Geometrical Relationships in Rolling, Calculation of Rolling Load, Roll Pass Design, and Defects in Rolled Products.	**07**	**CO2**
III	**Forging:**	Introduction and Classification, operation and principle of Forging Processes and Equipment, Methods of forging, Open and Close Die Forging Processes, Defects, Structure and Properties of Forged Products. Force Analysis in forging.	**08**	**CO3**
IV	**Extrusion:**	Introduction and Classification, Extrusion Equipment, Forces in extrusion, Analysis of Extrusion Process, Extrusion of components including Seamless, Pipes and Tubes. Extrusion of pipes by cold working,	**07**	**CO4**
V	**Drawing:**	Introduction and Classification, Wire Drawing, Rod Drawing, Tube Drawing, Deep Drawing, Analysis of Wire Drawing Process and Load Calculations.	**07**	**CO5**

VI	**Sheet Metal Forming:**	Principle, process parameters, equipment and application of the following processes: spinning, stretch forming, plate, V and edge bending, Curling, Ironing, Roll Bending, Metal Spinning. Press brake forming, explosive forming, Hydro forming, electro hydraulic forming, and magnetic pulse forming. High Velocity forming of metals and High energy Rate forming	**07**	**CO6**

Online References:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/112104211
2	https://onlinecourses.nptel.ac.in/noc21_ma74/preview
3	https://onlinecourses.nptel.ac.in/noc20_ma19/preview

Text/Reference Books: -

1. Lin D Balint M Pietrzyk, Microstructure Evolution in Metal Forming Processes 1st Edition
2. Amitabha Ghosh and Asok Kumar Mallick, Manufacturing Science, Affiliated East-West Press
3. Christian Brecher and Ozdemir , Advances in Production Technology, Springer Publications
4. P.C.Sharma , A Text Book on Production Engineering, S.Chand Publications
5. P. N. Rao, “Manufacturing Technology”, Tata McGraw Hill
6. Aviter, “Fundamental of Metal Working”, McGraw Hill Publisher
7. Dieter, “Mechanical Metallurgy”

R-2025 Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC651	Press Tool Design	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT 1+ IAT 2					
MEC651	Press Tool Design	20	20	20	80	3	--	--	100

Course Objectives:

1. To acquaint with various press working operations for mass production of sheet metal components
2. To familiarize with sheet metal working techniques for design of press tools
3. To inculcate knowledge about scrap minimization, safety aspects and automation in press working

Course Outcomes:

1. Demonstrate various press working operations for mass production of sheet metal parts.
2. Identify press tool requirements to build concepts pertaining to design of press tools
3. Prepare working drawings and setup for economic production of sheet metal components
4. Select suitable materials for different elements of press tools
5. Illustrate the principles and blank development in bent & drawn components
6. understand safety aspects and automation in press working

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Press Working**	Classification of common Press working operations, Benefits and limitations of using Press tools. Applications of pressed parts/components. Theory of Shearing in Press Working. Optimum Cutting clearance & its effect on tolerances of pressed components. Press working terminology, Functions of different elements of a press tool. material handling equipment, Methods of feeding the strip/coil material.	**07**	**CO1**
II	**Design Progressive die**	Calculations for Economic Strip Layout, Calculations of Cutting force and Stripping force, recommending minimum tonnage of a press, Methods of reducing cutting loads on press tools, Design aspects of Press tool elements viz. Punches & methods of mounting punches, types of Die block, Stripper, Pilot, stock guides, stock stops, Selection and arrangement of Hardware used in Press tools. Selection of steels and its hardness for different elements of Press tools. Centre of pressure, Different types Die sets and its selection, shut height of die, Problems based design of progressive die	**08**	**CO2**
III	**Bending and Drawing-**	Theory of Bending, Spring back and measures to control it, Calculations for Blank development of Simple Bent components, Minimum bend radius, Types of Bending dies, roller bending, bending force problems on bend length calculation and bending force,Theory of Drawing, Metal flow in Drawing & forming operations; reduction ratio and redrawing limits, draw clearance, drawing and blank holding forces for cylindrical draws only. Blank development of Cup, problems on drawing, Defects in drawn parts, Basic construction and working of Bending and Drawing dies	**08**	**CO3**

IV	**Miscellaneous Dies-**	Basic construction & working of Shaving dies, Trimming dies, Compound dies, Combination dies, Coining dies, Embossing dies, Simple Progressive & Compound Progressive dies, drop through and inverted die, curling die, transfer die	**08**	**CO4**
V	**Selection of Presses and its setting**	Classification of presses, Selection of Press and Press setting, calculation of shut press shut height and die shut height, Overloading of presses (load, energy considerations)	**08**	**CO5**
VI	**Introduction to Automation & Safety in Press shop**	Types of CNC Press, Types of CNC press controller, Basic hydraulic and pneumatic circuit used in press for stock feeding and ram movement, different types sensors used for hand protection, stock feeding etc., other safety equipment like break, clutch, face shield etc	**06**	**CO6**

Text/Reference Books

1. Die Design Fundamentals by J. R. Paquin, Industrial Press
2. Techniques of Press Working Sheet Metal by D F Eary and E A Reed
3. Press Tools Design and Construction by P H Joshi, S Chand Publishing
4. Tool Design by C. Donaldson and V C Goold, TMH
5. Production Engineering by P. C. Sharma, S Chand Publishing
6. Metal working ASM Handbook

Online References:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/112104211
2	https://onlinecourses.nptel.ac.in/noc21_ma74/preview
3	https://onlinecourses.nptel.ac.in/noc20_ma19/preview

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEL606	Machine Design	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT1 +IAT 2				
MEL606	Machine Design	--	--	--	--	25	25	50

Lab Objectives:

1. To study the basic of modelling software, part design and assembly making

2. To familiarize with use of design data books & various codes of practice

3. Based on design calculation preparation of working drawings of actual design model

4. To acquaint motion and power transmission

5. To acquaint with working principles and applications of governors

6. To acquaint with working principles and applications of gyroscope

Lab Outcomes:

1) Design shaft under various conditions

2) Design Knuckle Joint / cotter joint

3) Design Screw Jack.

4) Design Flexible flange couplings/ Leaf spring

5) Convert design dimensions into working/manufacturing drawing

6) Use design data book/standard codes to standardize the designed dimensions

List of Experiments. (Must use computer aided drawing on A3 size sheets)

Sr No	List of Experiments	Hrs
01	Knuckle Joint / cotter joint	
02	Couplings	
03	Shaft design (solid and hollow shaft)	
04	Leaf springs	

Sr No	List of Assignments / Tutorials	Hrs
01	Bolted and welded joints	
02	Bearings	
03	Gears	
04	Flywheel and Belts	

Part C

Course project on design and fabrication of any one mechanism for a group of maximum 4 students

Text / Reference Books:

1) Design of Machine Elements - V.B. Banadari, Tata McGraw Hill Publication

2) Design of Machine Elements - Sharma, Purohil. Prentice Hall India Publication

3) Machine Design -An Integrated Approach - Robert L. Norton, Pearson Education

4) Machine Design by Pandya & Shah, Charotar Publishing

5) Mechanical Engineering Design by J.E.Shigley, McGraw Hill

6) Machine Design by Reshetov, Mir Publication

7) Machine Design by Black Adams, McGraw Hill.

8) Fundamentals of Machine Elements by Hawrock, Jacobson McGraw Hill.

9) Machine Design by R.C.Patel, Pandya, Sikh, Vol-I & II C. Jamnadas& Co.

10) Recommended Data Books – Design Data: Data Book of Engineers by PSG College, KalaikathirAchchagam

Online Resources:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/112/105/112105268/
2	https://www.youtube.com/playlist?list=PLYRGB44zNZWVibVLmWANp-7obQzOhJLRt
3	http://www.nptelvideos.in/2012/12/kinematics-of-machines.html

Assessment:

Term Work: Term Work shall consist part (a) + (b) +(c).

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 5 Marks (Assignments)

+ 5 Marks (Course Project) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEL607	Turbo Machinery	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
MEL607	Turbo Machinery	--	--	--	--	25	--	25

Lab Objectives:

1. To familiarize with boilers, boiler mountings and accessories using models/cut sections.

2. To familiarize with hydraulic energy conversion devices.

3. To familiarize with thermal energy conversion devices.

Lab Outcomes:

1. Differentiate boiler, boiler mountings and accessories.
2. Conduct a trial on reciprocating compressor / centrifugal compressor.
3. Conduct a trial on impulse turbine and analyze its performance.
4. Conduct a trail on reaction turbine and analyze its performance.
5. Conduct a trial on Centrifugal pump and analyze its performance.
6. Conduct a trial on Reciprocating pump and analyze its performance.

List of Experiments.

Sr. No	List of Experiments	Hrs.
Group-A (conduct any 7 including S.N.10)		
01	Demonstration / e-learning of Boiler, Boiler mountings and accessories	02
02	Impact of jet	02
03	Trial on Impulse turbine (Pelton Wheel Turbine)	02
04	Trial on Reaction turbine (Francis Turbine)	02
05	Trial on Reaction turbine (Kaplan Turbine)	02
06	Trial on centrifugal pump (Single stage/Multistage)	02
07	Trial on reciprocating pump.	02
08	Trial on reciprocating / centrifugal air compressor	02
09	Trial on gear pump	02
10	Industrial visit to a power plant (compulsory)	02
Group –B (conduct any 3)		
01	Measurement of Hydrostatic Pressures	02
02	Verification of Archimedes' Principle	02
03	Calibration of Venturimeter/ Orifice meter/Nozzle/ Pitot tube	02
04	Determination the friction factor in Pipes	02
05	Determination of major and minor losses in Pipe systems	02
06	Verification of Bernoulli's Equation	02
07	Calculation of Lift and Drag over an aerofoil	02

Virtual Labs:

1. http://fm-nitk.vlabs.ac.in/# - Fluid Mechanics Lab, NITK Surathkal
2. https://fmc-nitk.vlabs.ac.in/fluid-machinery/ - Fluid Machinery Lab, NITK Surathkal

Assessment:

Term Work: Term work shall consist of all the experiments from the list, 3 assignments containing numerical based on Centrifugal Pump, Reciprocating Pump and centrifugal compressor and a visit report.

The distribution of marks for term work shall be as follows:

- Laboratory work (Experiments): 10 marks
- Assignments: 05 marks
- Visit report: 05 Marks
- Attendance: 05 marks

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEL608	Heating, Ventilation, Air conditioning and Refrigeration lab	–	2	-	–	1	-	1

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
MEL608	Heating, Ventilation, Air conditioning and Refrigeration	–	–	–	–	–	25	25	50

Rationale :

Thermodynamics concepts are useful in understanding and designing systems involving energy transfer and energy transformation.

Prerequisite: Basic Thermodynamics

Course Objectives:

1. To study working and operating principle of vapour Compression and vapour absorption system.
2. To study Controls and Components of refrigeration and Airconditioning system.
3. To design air conditioning systems using cooling load calculation.

Course Outcomes:

1. Aware of the roles and ethics of HVACR engineers in related industries.
2. Present the impact of professional engineering solutions in societal and environmental contexts.
3. performance of HVACR systems Evaluate
4. Develop awareness of the engineering and technological aspects in the HVACR industries.
5. Communicate effectively through the preparation of report and practical presentation.
6. Analyse design aspects of HVAC&R in various application

Prerequisite: calculus and integrals

DETAILED SYLLABUS: .

List of Experiments

1. Study and performance on simple vapour compressiontest rig .
2. Study and performance of heat pump test rig
3. Trial on Vapour absorption refrigeration test rig.
4. Perform humidification and dehumidification air conditioning process on air conditioning test rig
5. Study and performance of cooling tower based on the cooling load and approach to wet bulb temperature.
6. Study and performance of refrigeration cycle on Ice plant.
7. Performance analysis on watercooler system .
8. Cooling capacity analysis of the desert cooler.
9. Steady state Simulation of VCR system with developed code or any analytical software.
10. Calculate cooling load of a confined space

Part -B

Case studies through Seminar Poster presentation on

1. Chiller unit

2. Building Management system(Introduction)
3. Effect on Ozone depletion andGlobal warming,
4. Alternative Refrigerants.
5. Refrigerant Different Protocols used in
6. Variable refrigerant flow technology & its smart control

Term Work

Term work shall consist of

1. Minimum Six experiments
2. Industrial visit on any HVACR plant
3. Case study report

Distribution of Term work marks as follow

1. Experiments : 10 marks
2. Case study :5 marks
3. Industrial Visit Report : 5 Marks
4. Attendance (Theory + Practical) : 5 marks

End Semester Practical/Oral examination:

1. Pair of Internal and External Examiner should conduct practical/viva based on contents

2. Practical examination (in a group of not more than 5 students) duration is 2 hours

3. Distribution of marks for practical/viva examination shall be as follows:

   a. Practical performance ……15 marks

   b. Oral..... 10 marks

4.Evaluation of practical examination to be done based on the experiment performed and the output of the experiments during practical examination.

5. Evaluation of oral examination to be done based on the entire syllabus

6. Students work along with evaluation report to be preserved till the next examination

Virtual Labs

http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/refigeration/index.php - Refrigeration and Air Conditioning Virtual Lab, IIT Bombay

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEL6o9	**Measurement & Automation**	-	4	-	-	2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
MEL6o9	**Measurement & Automation**	--	--	--	--	25	25	50

Lab Objectives:

1. To study fundamentals of inspection methods and systems.
2. To study working of mechanical measurement system.
3. To familiarize with different types of control systems.
4. To study different hydraulic and pneumatic systems.
5. To study various design principles of robotics through kinematic analysis, workspace analysis and trajectory planning.

Lab Outcomes: Learner will be able to...

1. Apply inspection gauge to check or measure surface parameters.
2. Measure surface parameters using precision measurement tools and equipment.
3. Measure different mechanical parameters by using sensors.
4. Analyze the response of a control systems.
5. Demonstrate use of automated controls using pneumatic and hydraulic systems.
6. Implement program on PLC system and demonstrate its application

Prerequisite: Basic knowledge of Metrology, Mechanical Measurement System and Control Systems

Term Work:

Term work shall consist of minimum Nine Experiments. Three from each group mentioned above. There will be no theoretical assignment for the lab course. The distribution of marks for term work shall be as follows:

Laboratory work (Experiments): 20 marks

Attendance: 05 marks

Experiments:

The laboratory experiments should be based on the following:

Group A (Metrology):

1. Experiments on linear and angular measurement using Vernier caliper, micrometer and Bevel protractor.
2. Experiments on surface measurement by using Surface roughness tester.
3. Experiments on measurement of gear parameters using Gear tooth Vernier caliper / Parkinson gear tester.
4. Experiments on screw thread measurement using screw thread micrometer, Floating carriage micrometer / bench micrometer.

5. Experiments on linear / angular measurements of screw / gear /single point tool using Optical profile projector or Tool maker's microscope.
6. Experiment using Mechanical / Pneumatic type Comparator.
7. Experiments on flatness measurement by Autocollimator / Interferometry method

Group B (Mechanical Measurement):

1. Experiments on measurement of displacement by sensors like LVDT, Potentiometers etc. 2. Experiments on measurement of pressure by gauges or sensors like vacuum Gauges, pressure gauge, piezoelectric sensors, strain gauge sensors etc.
3. Experiments on measurement of vibration by accelerometers or NI.
4. Experiments on feedback control systems and servomechanisms
5. Experiment on frequency response system identification / transient state response of a control system.
6. Experiment on design of PID controller for a system or simulate and tune a PID controller using lab view.

Group C (Automation):

University of Mumbai B. E. (Mechanical Engineering), Rev 2019 64
1. Experiment on trainer kit (Any one)
a) Designing sequential operation for two cylinders using electro-hydraulic circuits. Or
b) Designing sequential operation for two cylinders using electro- pneumatic circuits.
2. Experiment on simulation using software like Festo, AutoSim etc.
a) Simulation of basic pneumatic and electro-pneumatic circuits.
OR
b) Simulation of hydraulic and electro-hydraulic circuits.
3. Experiments on Ladder programming
a) Experiments on Ladder programming on PLC for simple ON OFF control, timers,

counter, two motor system, and simple control applications with logic / timers/counters.

OR

b) Experiments on Ladder programming for Mechatronics system (e.g. bottle filling plant, control of electro-pneumatic or electro-hydraulic systems).

4. Experiments on Robotics

a) Demonstration and study of functions of components of robotics arm.

OR

b) Visualization of DH (Denavit–Hartenberg) parameters in Roboanalyzer (*Roboanalyzer is free software developed by IIT Delhi, available on www.roboanalyzer.com).

End Semester Practical/Oral Examination:

1. Pair of Internal and External Examiner should conduct practical and viva based on contents.

2. Practical examination (in a group of not more than 4 students) duration is 2 hours

3. Distribution of marks for practical/viva examination shall be as follows:

Practical performance: 15 marks

Oral: 10 marks

4. Evaluation of practical examination to be done based on the experiment performed and the output of the experiment during practical examination.

5. Students work along with evaluation report to be preserved till the next examination.

Virtual Labs:

http://ial-coep.vlabs.ac.in/ - Industrial Automation Laboratory, COEP

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEL610	Mini Project – 2B	-	4	-	-	2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
MEL610	Mini Project – 2B	--	--	--	--	25	25	50

Lab Objectives:

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Lab Outcomes:

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.

3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to lifelong learning.
9. Demonstrate project management principles during project work.

Prerequisite: Basic knowledge of Mechanical Engineering

Guidelines for Mini Project:

1. Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
2. Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
3. Students hall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
4. A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
5. Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
6. Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
7. Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
8. The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
9. With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters V and VI.
10. However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with

suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below:
    - **Marks awarded by guide/supervisor based on log book : 10 Marks**
    - **Marks awarded by review committee : 10 Marks**
    - **Quality of Project report : 05 Marks**

<u>Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.</u>

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
    - First shall be for finalization of problem
    - Second shall be on finalization of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
    - First review is based on readiness of building working prototype to be conducted.
    - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
    - Identification of need/problem

  - Proposed final solution
  - Procurement of components/systems
  - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
  - First shall be for finalization of problem and proposed solution
  - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project:

Mini Project shall be assessed based on following criteria:

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

- In one year, project, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In case of half year project all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

1. Report should be prepared as per the guidelines issued by the University of Mumbai.
2. Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.

3. Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points:

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication.

4.B.E Syllabus

B.E Sem VII

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC701	Design of Mechanical System	4	-	-	4	-	-	4

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
MEC701	Design of Mechanical System	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To familiarize with the concept of system and methodology of system design

2. To study system design of various systems such as Gear box, snatch block, belt conveyors, I. C. engine system and pumps

Course Outcomes:

1) Apply the concept of system design

2) Select appropriate gears for power transmission on the basis of given load and speed

3) Design material handling systems such as hoisting mechanism of EOT crane
4) Design belt conveyor systems
5) Design engine components such as cylinder, piston, connecting rod and crankshaft
6) Design pumps for the given applications

Prerequisite:

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction**	Methodology & Morphology of design, Optimum design, system concepts in design	**05**	**CO1**
II	**Design of Transmission Gear Box**	Single stage and Two stage Gear box with fixed ratio consisting of Design of spur, helical, bevel and worm and worm wheel gear pairs, Gear box housing layout and housing design	**14**	**CO2**
III	**Design of Hoisting Mechanism**	Design of Snatch Block Assembly including Rope Selection, Sheave, Hook, Bearing for hook, cross piece, Axle for sheave and shackle plate, Design of rope drum, selection motor with transmission system	**12**	**CO3**

IV	**Design of Belt Conveyors**	Power requirement, selection of belt, design of tension take up unit, idler pulley	**07**	**CO4**
V	**Engine Design (Petrol and Diesel)**	Design of cylinder, Piston with pin and rings, connecting rod & crank shaft with bearings	**12**	**CO5**
VI	**Design of Pump**	**6.1 Design of main components of gear pump** 1 Motor selection 2 Gear design 3 Shaft design and bearing selection 4 Casing and bolt design 5 Sizing of design of suction and delivery pipe **6.2 Design of main components of Centrifugal Pump:** 1 Motor selection 2 Suction and Delivery pipe 3 Design of Impeller, Impeller shaft 4 Design of Volute Casing	**10**	**CO6**

Text Books/ Reference:

1. "Machine Design Exercises", S.N.Trikha - New Delhi Khanna Publisher 1978.

2"Mechanical Engineering Design", Shigley J E and Mischke C R, 11th Edition 2019, McGraw Hill, ISBN: 9788184956207

3. "Design of Machine Elements", Bhandari VB, 5th Edition 2020, TMH, and ISBN: 9789390177479

4. "Engineering Design", Dieter G E, McGraw Hill Inc, ISBN: 9781260113297.

Online References:

Sr. No.	Website Name
1	https://onlinecourses.nptel.ac.in/noc22_me62
2	https://nptel.ac.in/courses/112/106/112106137/

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC702	Logistics and Supply Chain Management	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
MEC702	Logistics and Supply Chain Management	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To understand the fundamentals of supply chain management and Logistics

2. To develop an understanding related to Supply Chain Performance and related aspects

3. To understand Inventory management in supply chain

4. To learn tools and techniques used in logistics, transportation, warehousing and outsourcing decisions

5. To develop critical understanding towards digitization in supply chain management and sustainability

6. To develop analytical and critical understanding for planning and designing supply chain network

Course Outcomes:

1) Demonstrate a sound understanding of Logistics and Supply Chain Management concepts and their role in today's business environment
2) Identify the drivers of supply chain performance and risks in supply chain management
3) Apply various techniques of inventory management and rank the items using inventory management technique
4) Apply various strategies and techniques to minimize overall logistics cost
5) Understand the role of digitization in supply chain management leading to sustainability
6) Apply various mathematical models/tools to design the supply chain network

Prerequisite:

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction**	Objectives of a Supply Chain Management, Stages of Supply chain, Value Chain Process, Cycle view of Supply Chain Process, Key issues in SCM, logistics & SCM,	**06**	**CO1**

		Supply Chain Drivers /decisions and obstacles, Supply chain strategies, strategic fit, Best practices in SCM, Obstacles of streamlined SCM. Supplier Selection, Supplier quality audits, Contract management, Non Disclosure Agreement (NDA), Make & Buy Decision while in-out sourcing		
II	**Supply Chain Performance**	Bullwhip effect and reduction, Performance measurement: Dimension, Tools of performance measurement, SCOR Model. Demand chain management, Global Supply chain- Challenges in establishing Global Supply Chain, Factors that influences designing Global Supply Chain Network. Supply Chain Risk Management (Risks involved in supply chain which includes – Supplier Financial Risk, Performance Risk, Compliance Risk, Country specific Risk, Cyber Security. Supplier performance measurement – (Delivery & Quality performance, schedule adherence, Goods receipt compliance etc.), Supplier Capacity Analysis, Supplier Score card.	**10**	**CO2**

III	**Inventory management**	Definition of Inventory, Inventory types & functions; EOQ Model and Buffer Stock, Assumptions, Instantaneous Replenishment case, Demand and production rate are different, when backorders are allowed, Buffer Stock and ROL. Replenishment systems (Q and P system) Inventory Control- ABC Analysis, Numerical problems on ABC analysis, VED Analysis	**07**	**CO3**
IV	**Logistics Management and outsourcing**	Evolution, Objectives, Components and Functions of Logistics Management, Distribution related Issues and Challenges; Gaining competitive advantage through Logistics Management, Transportation- Functions, Costs, and Mode; Network and Decision, Containerization, Cross docking. Warehousing: Concept and types, Warehousing strategy, Warehouse facility location & network design Part Packaging, Use of Returnable pallets, ASN – Advance Shipment Notification. Reverse logistics: Outsourcing - Nature and concept, Strategic decision to Outsourcing, Third party logistics (3PL), and	**08**	**CO4**

		Fourth party logistics (4PL), Cold chain operations in Supply chain.		
V	**Digitization in supply chain Management and Sustainability**	IT in supply chain - Role of IT in a supply chain, The supply chain IT framework, Application of Bar coding, Significance of SAP/RFID, The future of IT in the supply chain, Supply chain IT in practice, TMS (Transport Management System), WMS (Warehouse Management System) Green supply chain management, Supply Chain sustainability, Supply Chain sustainability index measurement with case studies. Social aspects of supply chain (CSR), Environment aspects of supply chain (CO2 emission), resource utilization, recycling	**06**	**CO5**
VI	**Supply Chain Network Design**	Factors influencing distribution network design, Supply chain resilience, Design options for distribution network, Introduction to mathematical modelling, considerations in modelling SCM systems, Overview of the models, Models on transportation, Transportation problem, Vehicle routing problem, Travelling salesman problem, Capacitated	**08**	**CO6**

		transshipment problem, shortest path problem. Value Stream Mapping (VSM), Order Fulfillment Process Flow, understanding the terms related to Supply chain- Lead Time, Takt Time ,Minimum Order Quantity (MOQ), Manufacturing Critical Path Time (MCT)		

Text Books/ Reference:

1. R.P. Mohanty, S.G. Deshmukh, "Essentials of Supply Chain management", 1st Edition 2004, Jaico Publishing House.

2. S.K. Bhattacharya, "Logistics Management", 3rd Edition, Pearson Publication ISBN: 9788131768624

3. Sunil Chopra, P. Meindl, "Supply Chain Management", 6th Edition 2016, Pearson Education Asia

4. Martin Christopher, "Logistics and Supply Chain Management", 4th Edition 2010, Pitman Publishing.

Online References:

Sr. No.	Website Name
1	https://onlinecourses.nptel.ac.in/noc22_mg74/preview
2	https://onlinecourses.swayam2.ac.in/cec22_mg22/preview

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC731	Renewable Energy Sources	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
MEC731	Renewable Energy Sources	20	20	40	60	2.5	--	--	100

Rationale :

This subject aims to provide fundamental knowledge of various renewable energy sources such as solar, wind, biomass, hydrogen, geothermal, and ocean energy. It emphasizes the working principles, technologies, and practical applications of renewable systems.

The course also introduces energy management and auditing concepts to promote efficient and sustainable energy usage. With a focus on current global and national energy scenarios, it equips students with the skills to analyze, implement, and evaluate green energy solutions for a sustainable future.

Course Objectives:

1. To study working principles of various renewable energy sources and their utilities.
2. To study design and installation criteria of various equipment's to convert the renewable energy into useful energy.
3. To study economics of harnessing energy from renewable energy sources.

Course Outcomes:

1. Describe the need for renewable energy and its potential for the development of a sustainable environment.
2. Analyze different solar collectors using geometrical parameters and photovoltaics for generation of solar energy.
3. Identify and analyze various wind turbine energy harnessment techniques.
4. Design biogas plant for harnessing energy from organic waste.
5. Describe significance of hydrogen energy to fulfill present and future energy needs.
6. Describe the operating principle of geothermal energy and ocean energy and their role in sustainable development.

Prerequisite: Thermodynamics, Heat Transfer, Fluid Mechanics

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Renewable Energy and Solar Radiation**	**1.1: Introduction to Renewable Energy** Sources and Solar Radiation: Global and National current energy scenarios, Prospects of renewable energy sources and renewable	06	CO1

		energies role in developing sustainable model. **1.2: Solar radiation terms**, solar geometry, earth sun angles, attenuation and measurement of solar radiation on horizontal and inclined surfaces, methods of solar radiation estimation.		
II	**Solar Thermal Energy**	**Solar Thermal Energy:** **2.1: Introduction and working** principle of flat plate collectors, thermal performance analysis of flat plate collectors, concentrating collectors, Installation and maintenance criteria of solar thermal systems. **2.2: Solar thermal devices-** Solar air heater and different types of solar air heaters, solar water heater and different types of solar water heaters, solar dryers, solar pond, solar distillation, solar still, solar cooker. 2.3: Solar space heating & cooling, solar refrigerator, solar thermal energy storage systems. Case Study: Solar thermal power plant working operation.	08	CO2
III	**Solar Photovoltaic Energy**	**Solar Photovoltaic Energy:** **3.1:** Introduction and working principle of a solar PV systems, types of solar PV cells, solar tracking systems, controls and measurement methods of solar PV systems. **3.2:** Methods to improve the efficiency of PV cells, parameters which affect the efficiency and life cycle of PV cells. Case Study: Installation of 1 kW of solar PV plant.	08	CO3

IV	**Wind Energy**	**4.1: Basic components and working** principle of wind energy conversion systems, wind data and site selection considerations, various types of wind energy conversion systems, constructional features of horizontal and vertical axis wind machines, performance analysis of horizontal and vertical axis wind machines. **4.2: Estimation of power output**- betz limits, Environmental impacts of wind energy.	07	CO4
V	**Energy from Biomass and Hydrogen Technologies**	**5.1: Energy from Biomass:** Introduction of bioenergy, conversion technologies, types of biogas generation plants, design and construction details of biogas plant (KVIC), site selection, digester design consideration, filling a digester for starting, maintaining biogas production, utilization of biogas. **5.2: Hydrogen Energy:** Introduction and application, General introduction to infrastructure requirement for hydrogen production, storage, dispensing & utilization. Principles of fuel cells, types of fuel cells, power generation by fuel cells, applications of fuel cells.	08	CO5

VI	**Geothermal, Ocean Energy and Sustainable Energy Practices**	**6.1: Geothermal Energy:** Introduction to geothermal technologies and methods of extracting geothermal energy, prospects of geothermal energy in India. **6.2: Energy from the ocean**: Wave energy characteristics and wave energy conversion devices, tide energy conversion devices, Ocean Thermal Energy Conversion (OTEC) systems. **6.3: Energy management and economics:** Energy conservation, energy security, energy economics, energy audit- definition, need, types of energy audit, Energy management (audit) approach-understanding energy costs, Energy conservation in Buildings: Energy Conservation Building Codes (ECBC): Green Building, LEED rating.	08	CO6

Text / References Books:

1. "Non-conventional Energy Sources", G.D. Rai, 6th Edition, Khanna Publishers, ISBN: 978-81-7409 073-7
2. "Renewable Energy: Power for a Sustainable Future", Edited by Godfrey Boyle, 3rd Edition 2012, Oxford University Press, ISBN: 978-0199681273
3. "Solar Energy: Principles of Thermal Collection and Storage", SP Sukhatme and J K Nayak, 4th Edition, Tata McGraw Hill Publishing Co. Ltd.
4. "Solar Energy: Fundamentals and Applications", H.P. Garg& Jai Prakash, First Revised Edition, Tata McGraw-Hill Education.

5. "Wind Power Technology", Joshua Earnest, 2nd Edition, PHI Learning, 2015.
6. "Solar Engineering of Thermal Processes", John A. Duffie and William A Bechman, 4th Edition, Wiley Publications.
7. "Renewable Energy Sources", J W Twidell& Anthony D. Weir, 3rd Edition 2015, ELBS Pub, ISBN: : 978-1-315-76641-6
8. "Energy Conversion Systems", Rakosh Das Begamudre, New Age International (P) Ltd., Publishers, New Delhi, 2007, ISBN: 9788122412666
9. "Solar Photovoltaics: Fundamentals, Technologies and Applications", C S Solanki, 3rd Edition, PHI Learning.
10. "Biomass Regenerable Energy", D. D. Hall and R. P. Overend, John Wiley, New York, ISBN:047190919X
11. "Wind and Solar Power Systems", Mukund R Patel, 2nd Revised Edition, CRC Press, ISBN: 9780429114960
12. "Wind Energy Explained: Theory, Design and Application", J F Manwell, J.C. McGowan, A. L. Rogers,2nd Edition 2009, John Wiley and Sons.

Online References:

Sr. No.	Links for online NPTEL/SWAYAM courses
1	https://nptel.ac.in/courses/103103206
2	https://nptel.ac.in/courses/103107157
3	https://nptel.ac.in/courses/115105127

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC732	Vehicle Systems	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
MEC732	Vehicle Systems	20	20	40	60	2.5	--	--	100

Rationale :

This subject provides comprehensive knowledge of automobile engineering by covering all essential systems and subsystems involved in vehicle operation. It introduces power flow layouts, clutch mechanisms, various transmission types, and driveline components for different drive configurations.

Steering systems, suspension types, braking technologies, and wheel-tyre dynamics are detailed to develop an understanding of vehicle handling and safety. The course also includes the study of automotive electrical systems such as batteries, ignition, starting, and lighting circuits. Students learn about body engineering, aerodynamics, and structural loads acting on vehicles.

Course Objectives:

1. To study basic and advanced vehicle systems.
2. To study basic and advanced vehicle electrical systems.
3. To study different chassis structures components.
4. To familiarize with the latest technological developments in automotive technology.

Course Outcomes:

1. Understand the working of different Vehicle Systems and Subsystems.
2. Understand the working of different Vehicle Electrical systems and subsystems.
3. Understand different Vehicle Body systems and layouts.
4. Illustrate working, functions of different vehicle mechanical, electrical, and chassis systems.
5. Understand the effect of aerodynamics on the functioning of a vehicle.
6. Comprehend the different technological advances in vehicle systems.

Prerequisite: Basic physics, Engineering Mechanics, Strength of Materials, Basic Electrical and Electronics Engineering

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Automobile Power Transmission Systems**	**Power Flow Layout:** FE FWD, FE RWD, RE FWD, RE RWD, Underfloor Engine **Clutches:** Necessity of clutch in an automobile, Working and Construction of Single plate, Multi plate, Centrifugal, Semi	08	CO1

		Centrifugal, electromagnetic clutches, Fluid Flywheel **Transmission:** Purpose and Elements of Gear Box, Characteristic Curves, Types Sliding mesh, Constant Mesh, Synchromesh, Planetary Gear set, Torque Converter, Semi-Automatic and Automatic **Drive Line:** UV joint, CV joint, Propeller Shaft construction and arrangement, Elements of drive line, 2WD, 4WD, Part time and Full time 2WD and 4WD.		
II	**Automobile Transmission, Steering, and Braking Systems**	**Final Drive:** Types of Final drive; spiral, bevel, Hypoid and worm drives. **Differential:** Necessity of differential, Working of differential, Conventional and non-slip differential. **Axles:** Types of live axles; semi, three quarter and full floating axles. Types of Front Stub Axles; Elliot, Reverse Elliot, Lamoine and Reverse Lamoine **Steering:** Requirement, Types of Steering Gear Box, Steering Geometry, Wheel Alignment and Wheel balancing, Power Steering **Brakes:** Principle, Types; Hydraulic, Air, Electric, Exhaust, Regeneration ,Brake lining materials, ABS, EBD	09	CO2
III	**Automobile Suspension, Wheels, and Tyres**	**Suspension:** Requirement and Types- Independent, Dependent, Air. Types of Shock absorbers, Leaf spring types	07	CO3

		Wheels and Tyres: Tyre requirement, tire characteristics, Constructional detail, , tyre dimensions and specifications, Types of wheels and Hubs		
IV	**Automotive Electrical and Electronic Systems**	**Batteries:** Construction, Types: Lead Acid, Alkaline, Nickel Metal Hydride, Lithium Ion, Battery Ratings, Battery Charging **Starting:** Requirement, Starter Motor Drives, cold cranking Amperes **Charging:** Requirement, Principle and Construction of Dynamo and Alternator **Ignition:** Mechanical and Electronic Ignition and Electronic Engine Control **Lighting and Wiring:** Types of Lamps, Gauges, Cable Sizes, Color Codes, Multiplex Wiring systems **Accessories:** Electric Horn, Wipers, Fuel Pumps, Power operated windows, Fuel Gauges, OBD systems	09	CO4
V	**Body Engineering & Vehicle Aerodynamics**	**Body Engineering:** Chassis types and Structure types - Open, Semi Integral and Integral, Loads acting on chassis, Basic Dimensions and Visibility **Vehicle Aerodynamics :** Aerodynamic drag: Aerodynamic lift and Pitching moments, Side force, Yawing & Rolling moments.	07	CO5

VI	**Recent Technological Developments in Automobile**	**Recent Technological Developments in Automobile:** Telematics, Intelligent Vehicles 03 systems, V2V communication. Scope of AI in Automobile Vehicle	05	CO6

Text Books:

1. Automobile Engineering, Kirpal Singh, Vol I & II, Standard publishers Distributors, Delhi
2. J Powloski, "Vehicle Body Engineering", Business Books Ltd., London
3. Automobile Mechanics, N. K. Giri, 8thEdition, Khanna Publishers
4. P. L. Kohli, "Automotive Chassis & Body", Papyrus Publishing House, New Delhi.
5. Tom Denton, Automobile Electrical and Electronics System, Elsevier Third Edition,2003

References Books:

1. John Fenton, "Vehicle Body Layout & Analysis", Hutchinson, London.
2. Bosch Automotive Handbook, 6thEdition, SAE Publications
3. Automotive Mechanics by William H. Crouse and Donald L. Anglin, 10th Edition, McGraw Hill
4. "A Course in Internal Combustion Engines" by M. L. Mathur & R.P. Sharma, Dhanpat Rai Publications

Online References:

Sr. No.	Links for online NPTEL/SWAYAM courses
1	https://nptel.ac.in/courses/107106088
2	https://nptel.ac.in/courses/107103084
3	https://nptel.ac.in/courses/113106082

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC741	Machinery Diagnostics	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
MEC741	Machinery Diagnostics	20	20	40	60	2.5	--	--	100

Rationale :

Machinery diagnostics introduces the fundamentals of vibration and its application in machine condition monitoring. It equips students with the ability to understand vibration behavior through time and frequency domain analysis. Emphasis is placed on fault diagnosis using FFT, sensor selection, and signal interpretation.

Students gain knowledge of vibration transducers, data acquisition systems. The course also provides practical insights into detecting faults like unbalance, misalignment, and bearing defects. Case studies reinforce real-world application in industries such as turbines, sugar mills, and pumps. This subject is crucial for predictive maintenance and enhancing equipment reliability.

Course Objectives:

1. To study basic concepts of Vibration Monitoring.
2. To study different Vibration Measuring Instruments.
3. To study fault detection in Machines using vibration spectrum.

Course Outcomes:

1. Understand basic vibration concepts and principles of vibration-based condition monitoring.
2. Explain vibration measurement tools and sensor selection techniques.
3. Analyze machine signals using FFT and data acquisition settings for condition monitoring.
4. Identify common machine faults such as unbalance, misalignment, and mechanical looseness using natural frequency tests and time-frequency domain analysis.
5. Diagnose faults in bearings, gearboxes, pumps, fans, and blowers.
6. Evaluate real-world machinery faults through case studies using appropriate sensor selection, data analysis, and fault identification techniques.

Prerequisite: Basic Electrical and Instrumentation, Strength of Materials, Mathematics

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Fundamentals of Vibration and Condition Monitoring**	**1.1 Basics of Vibration** Periodic and random motion, Spectral Amplitude Scaling: RMS, Peak and Peak to-Peak Conversion and Selection, Time and frequency domain analysis, Phase analysis, Orbit analysis, Understanding signal pattern,	08	CO1

		Importance of speed in accurate diagnosis, Importance of side bands in frequency spectrums. **1.2 Introduction to Vibration based Condition Monitoring** Maintenance Principles, Vibration based fault Prognosis, Goal of Vibration Monitoring, Steps in Vibration Monitoring, Benefits of Vibration based condition monitoring.		
II	**Vibration Measurement**	Vibration measuring instruments: displacement, velocity, acceleration; Force measurement, Laser based measurements: laser vibrometer Sensor Selection Criteria , Sensor – Mounting Locations and Techniques	08	CO2
III	**Data Acquisition & Signal Processing**	Classification of signals, Signal analysis, Fast Fourier Transform (FFT), Essential Settings in Data Acquisition System (Plot Formats, Frequency Span and Frequency Resolution, Average Types and Number of Averages, Windowing, Spectrum Scaling), Signal conditioning	08	CO3
IV	**Machinery Fault Diagnosis-I**	Natural frequency and resonance tests (Practical approach), Time and Frequency domain analysis to identify unbalance, bent shaft, Misalignment, Soft foot conditions, Mechanical looseness	07	CO4

V	**Machinery Fault Diagnosis-II**	Rolling element bearing and Journal Bearing fault diagnosis, Faults related to Gearbox, vane defects in pumps, Fault in Fans and Blowers	07	CO5
VI	**Applications of Condition Monitoring**	Case studies related Balancing Problems in Turbines, Condition Monitoring in Sugar mills, Health Monitoring of Journal Bearing, Condition Monitoring of Industrial Pumps. (Aspects to be covered : Selection of sensors, recommended location of sensor, direction of measurement, selection of plot type, Data validation and Identification of Faults)	07	CO6

Text / References Books:

1. R.B. Randall, "Vibration-based Condition Monitoring", Wiley2021, ISBN: 978-1-119-47755-6
2. A.R. Mohanty, "Machine Condition Monitoring: Principles and Practices", CRC Press 2017, ISBN: 9781138748255
3. R.A. Collacott, "Mechanical Fault Diagnosis and Condition Monitoring",1st Edition, Chapman and Hall, ISBN: 978-94-009-5723-7
4. J.S. Rao, "Vibratory Condition Monitoring of Machine", Narosa Publishing House.

Online References:

Sr. No.	Links for online NPTEL/SWAYAM courses
1	https://nptel.ac.in/courses/112105232 – Machinery Fault Diagnosis and Signal Processing, IIT, Kharagpur

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC742	Advanced Vibration	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
MEC742	Advanced Vibration	20	20	40	60	2.5	--	--	100

Rationale :

Advanced Vibration helps analyze and control complex vibrations in machines and structures, improving performance, safety, and reliability in engineering applications. Random and nonlinear vibration study prepares them for advanced diagnostics. Measurement tools and sensor selection guide practical condition monitoring.

Course Objectives:

1. To study the Multi-degree of freedom system.
2. To study different vibration measurement and control methods, and required instruments.
3. To study basic concepts of Random Vibrations.

4. To study the basic concepts of nonlinear vibrations.

Course Outcomes:

1. Estimate natural frequency of mechanical element / system.
2. Understand the concepts of Vibration Isolation and Control.
3. Analyze vibratory response of mechanical element / system.
4. Analyze vibration of Continuous system.
5. Analyze Random Vibrations.
6. Analyze Non-Linear Vibrations.

Prerequisite: Basic Vibration Theory, Basic Engineering Mechanics, Mathematics

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Multi Degree of Freedom System**	**Undamped free vibration:** Free vibration equation of motion, Influence coefficients (stiffness and flexibility), Reciprocity theorem, Generalized Coordinates, and Coordinate Coupling, Lagrangian equations, Rayleigh and Dunkerley method, two rotors and geared systems **Eigen Values and Eigen vectors:** for translatory and torsional two d.o.f. systems, Matrix method, Holzer's method (translatory and torsional unbranched systems)	07	CO1

II	**Vibration Isolation and Control**	Introduction, Vibration isolation theory, Vibration isolation and motion isolation for harmonic excitation, practical aspects of vibration analysis, vibration isolation, Dynamic vibration absorbers, and Vibration dampers, Passive, semi-active, and active vibration control	07	CO2
III	**Vibration Measurement & Modal Analysis for Condition Monitoring**	**Vibration Measurement:** Introduction, Transducers, Vibration pickups, Frequency measuring instruments, Vibration exciters, Signal analysis. **Modal analysis and Condition Monitoring:** Dynamic Testing of machines and Structures, Experimental Modal analysis, Machine condition monitoring and diagnosis.	07	CO3
IV	**Vibration of Continuous Systems**	Vibration of string, Longitudinal vibration of rods, Torsional vibration of rods, Euler equation for beams.	08	CO4
V	**Random Vibrations**	Random phenomena, Time averaging and expected value, Frequency response function, Probability distribution, Correlation, Power spectrum and power spectral density, Fourier transforms and response.	08	CO5

VI	**Non-Linear Vibrations**	Introduction, Sources of nonlinearity, Phase plane, Conservative systems, Stability of equilibrium, Method of isoclines, Perturbation method, Method of iteration, Self-excited oscillations, Runge-Kutta method.	08	CO6

Text / References Books:

1. W.T. Thomson and M.D. Dahleh, "Theory of Vibration with Applications", 3rd Edition 2002, Pearson Education
2. G.K. Grover, "Mechanical Vibrations", 5th Edition 2009, Nem Chand and Bros, ISBN: 978 8185240565
3. W.W. Seto, "Mechanical Vibrations- Schaum's Outline Series", McGraw Hill, ISBN: 9780070563278
4. S.S. Rao, "Mechanical Vibrations", 5th Edition 2004, Pearson Publications
5. Leonard Meirovitch, "Fundamentals of Vibration", 1st Edition 2010, McGraw Hill, ISBN: 978 1577666912.

Online References:

Sr. No.	Links for online NPTEL/SWAYAM courses
1	https://nptel.ac.in/courses/112107212 – Introduction to Mechanical Vibration, IIT Roorkee
2	https://nptel.ac.in/courses/112103111 – Mechanical Vibrations, IIT Guwahati

3	https://nptel.ac.in/courses/112103022 – Nonlinear Vibration, IIT Guwahati
4	https://nptel.ac.in/courses/112104211 – Principles of Vibration Control, IIT Kanpur

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7501	Disaster Management and Mitigation Measures	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
OEC7501	Disaster Management and Mitigation Measures	20	20	40	60	2.5	--	--	100

Rationale :

In recent decades, the frequency and severity of both natural and manmade disasters have increased significantly, impacting human lives, infrastructure, and the environment. Understanding disaster management is essential for developing effective strategies for preparedness, mitigation, response, and recovery.

This course equips students with the knowledge of disaster types, causes, effects, and the institutional frameworks involved in disaster response and risk reduction. It also introduces modern tools like GIS and

Remote Sensing for efficient disaster management. With growing urbanization, industrialization, and climate change concerns, this subject prepares students to contribute proactively to disaster-resilient communities and systems.

Course Objectives:

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster.
5. To understand application of GIS in the field of disaster management.
6. To understand the emergency government response structures before, during and after disaster.

Course Outcomes:

1. Understand disasters, hazards, their impacts, and their link with climate change.
2. Identify various natural and manmade disasters and understand their causes, impacts, and the influence of human activities on their occurrence.
3. Understand disaster management policies, administrative mechanisms, and rescue operation procedures in the Indian context.
4. Understand the institutional framework of disaster management in India and the role of technology in effective disaster response.
5. Understand the financial, legal, and organizational aspects of disaster relief, and the roles of national and international aid agencies.
6. Understand preventive and mitigation measures for disasters, including structural and non-structural strategies, preparedness, and effective relief implementation.

Prerequisite: Basic understanding of geography, environmental science, and social structures; awareness of natural and human-induced events and their impact on society.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction**	**1.1** Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	05	CO1
II	**Natural Disaster and Manmade disasters**	**2.1 Natural Disaster**: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion **2.2 Manmade Disasters:** Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09	CO2
III	**Disaster Management Policies and**	**3.1 Disaster management:** meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management.	07	CO3

	Administrative Framework	**3.2 Policy and administration:** Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.		
IV	**Institutional Framework for Disaster Management in India**	**4.1** Importance of public awareness, Preparation and execution of emergency management program. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. **4.2** Use of Internet and software's for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	08	CO4
V	**Financing Relief Measures**	**5.1** Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams.	09	CO5

		5.2 International relief aid agencies and their role in extreme events.		
VI	**Preventive and Mitigation Measures**	**6.1** Pre-disaster, during disaster and post-disaster measures in some events in general **6.2** Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication **6.3** Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 6.4 Do's and don'ts in case of disasters and effective implementation of relief aids.	07	CO6

Text / References Books:

1. 'Disaster Management' by Harsh K. Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O. S. Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications

7. Concepts and Techniques of GIS – C. P. Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.

(Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7502	Management Information System	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
OEC7502	Management Information System	20	20	40	60	2.5	--	--	100

Rationale :

Information Systems (IS) are essential for enhancing organizational efficiency and competitiveness in today's digital world. This course introduces the basics of computer-based IS, highlighting their impact on organizations and society. It enables students to understand how IS supports business strategy and offers competitive advantages. The course covers data management, big data, and business intelligence for informed decision-making.

Ethical, privacy, and security concerns related to IS are also addressed. Students learn about social computing, e-commerce, and mobile commerce applications in modern business. Networking concepts, including wired/wireless technologies and cloud computing, are explored. The course also examines the

role of ERP and functional systems in business processes. Students gain insight into acquiring IS through various System Development Life Cycle (SDLC) models. Overall, the course prepares students to effectively apply IS knowledge in real-world professional environments.

Course Objectives:

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built.
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage.
4. Identify the basic steps in systems development.

Course Outcomes:

1. Understand the fundamentals of Information Systems, their impact on organizations, and how they support competitive advantage and societal development.
2. Understand data management concepts, including databases, big data, and business intelligence tools used for effective decision-making and knowledge management.
3. Understand ethical, privacy, and security issues in information systems, including threats and corresponding security controls.
4. Explore the role of social computing, CRM, and evolving web technologies in business, marketing, and e-commerce including mobile commerce.
5. Understand the fundamentals of wired and wireless networks, and explore pervasive computing and cloud computing models.
6. Understand the role of various information systems within organizations and the process of acquiring and developing them through system development life cycle models.

Prerequisite: Basic knowledge of computer fundamentals, internet usage, and organizational structure. Familiarity with elementary programming.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Information Systems and Strategic Role of IT**	Introduction to Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS	06	CO1
II	**Data, Knowledge Management, and Business Intelligence**	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	08	CO2
III	**Information Security, Ethics, and Privacy in Information Systems**	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	08	CO3
IV	**Social Computing and E-Commerce Applications**	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	08	CO4

V	**Computer Networks and Cloud Computing Technologies**	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	07	CO5
VI	**Organizational IS and System Development**	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	08	CO6

Text / References Books:

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEL706	DESIGN OF MECHANICAL SYSTEMS LAB	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of 2 Tests				
MEL706	DESIGN OF MECHANICAL SYSTEMS LAB	--	--	--	--	25	25	50

Lab Objectives:

1. To familiarize with the concept of system and methodology of system design

2. To study system design of various systems such as Gear box, snatch block, belt conveyors, I. C. engine system and pumps

3. To familiarize with the standard codes of professional practices in designing the various systems

Lab Outcomes:

1) Apply the concept of system design
2) Design of Gear box
3) Design of hoisting mechanism of EOT crane.
4) Design belt conveyor systems
5) Design engine components such as cylinder, piston, connecting rod and crankshaft
6) Design pumps for the given applications

List of Experiments. (Computer aided Design and detailed assembly drawing)

Sr No	List of Experiments	Hrs
01	Design of hoisting mechanisms	
02	Design of belt conveyors	
03	Design of Engine	
04	Design of Gear box	
05	Design of pumps	

Sr No	List of Assignments / Tutorials	Hrs
01	Methodology & Morphology of design	
02	Design of gearbox (As mentioned in theory)	
03	Design of Hoisting mechanism	
04	Design of Belt conveyor	
05	Engine design (SI/CI engine)	
06	Design of Pump	

Part C

Students in a group of two to four should be able to apply and integrate the knowledge gained during the course. Design and preparation of working drawings of any system having minimum 5 to 6 components is expected. Course project may be given as development of software program using python, VB, C++, EXCEL etc. for mechanical systems

Text / Reference Books:

1) Design of Machine Elements - V.B. Banadari, Tata McGraw Hill Publication

2) Design of Machine Elements - Sharma, Purohil. Prentice Hall India Publication

3) Machine Design -An Integrated Approach - Robert L. Norton, Pearson Education

4) Machine Design by Pandya & Shah, Charotar Publishing

5) Mechanical Engineering Design by J.E.Shigley, McGraw Hill

6) Machine Design by Reshetov, Mir Publication

7) Machine Design by Black Adams, McGraw Hill.

8) Fundamentals of Machine Elements by Hawrock, Jacobson McGraw Hill.

9) Machine Design by R.C.Patel, Pandya, Sikh, Vol-I & II C. Jamnadas& Co.

10) Design of Machine Elements by V.M.Faires.

11) Design of Machine Elements by Spotts.

12) Recommended Data Books – Design Data: Data Book of Engineers by PSG College, KalaikathirAchchagam

Online Resources:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/112/105/112105268/
2	https://www.youtube.com/playlist?list=PLYRGB44zNZWVibVLmWANp-7obQzOhJLRt
3	http://www.nptelvideos.in/2012/12/kinematics-of-machines.html

Assessment:

Term Work: Term Work shall consist part (a) + (b) +(c).

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Exercise) + 5 Marks (Assignments)

+ 5 Marks (Course Project) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEL707	Maintenance Engineering Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT1 +IAT 2				
MEL707	Maintenance Engineering Lab	--	--	--	--	25	25	50

Lab Objectives:

1) To familiarize with Maintenance Procedures and Strategies.
2) **To acquaint with the process of Condition Monitoring and Machinery Fault Diagnosis.**

R-2025- Mechanical Engineering

Sr No	List of Experiments	Hrs
01	Identifications of different Tools used for maintenance (Spanner, Plier, Screw Driver, Allen Keys, Puller etc.)	
02	Dismantling and assembly of any one mechanical system (Gearbox, pumps, Injector, Fuel Pump, Tailstock etc.) (One job in a group of 4-5 students)	
03	Case studies based on Maintenance strategies (Breakdown, preventive, predictive and proactive)	
04	Machinery Servicing (Greasing, Oiling, Cleaning etc.)	
05	Condition Monitoring and Machinery Fault Diagnosis – Unbalance	
06	Condition Monitoring and Machinery Fault Diagnosis – Misalignment	
07	Condition Monitoring and Machinery Fault Diagnosis – Bent Shaft	
08	Condition Monitoring and Machinery Fault Diagnosis – Mechanical Looseness	
09	Condition Monitoring and Machinery Fault Diagnosis – Bearing Defects	
10	Condition Monitoring and Machinery Fault Diagnosis – Defects in gears	
11	Condition Monitoring and Machinery Fault Diagnosis – Defects in pumps	
12	Condition Monitoring and Machinery Fault Diagnosis – Defects in fans	
13	Condition Monitoring and Machinery Fault Diagnosis – Defects in blowers	

Note :

1. First four experiments are mandatory. At least four experiments to be performed from the remaining.

2. A visit of students to an automobile service station/any other machinery maintenance workshop shall be arranged as a part of the above exercises.

Assessment:

Distribution of marks for term work

Laboratory work 20 Marks

Attendance 05 Marks

End Semester Practical/Oral Examination:

1. Pair of Internal and External Examiner should conduct practical/viva based on contents

2. Distribution of marks for practical/viva examination shall be as follows:

a. Practical performance 15 marks

b. Viva 10 marks

3. Evaluation of practical examination to be done based on the experiment performed and the output of the experiment during practical examination

4. Students work along with evaluation report to be preserved till the next examination.

References:

1. A.R. Mohanty, "Machine Condition Monitoring: Principles and Practices", CRC Press

2. R.A. Collacott, "Mechanical Fault Diagnosis and Condition Monitoring", Chapman and Hall

NPTEL

https://nptel.ac.in/courses/112105232 – Machinery Fault Diagnosis and Signal Processing, IIT Kharagpur

R-2025 Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEL701	Industrial Skills	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT 1+ IAT 2				
MEL701	Industrial Skills	--	--	--	--	25	25	50

Lab Objectives:

1. To familiarise mechanical engineering students with basiccomputer/IT skillsin the industry.
2. To practise soft skills and communication to be industry-ready.
3. To inculcate critical thinking and problem-solving abilities for efficient team and project outcomes.
4. To be prepared for campus placements by practising aptitude, logical reasoning, Group discussion and personal interview rounds.

Lab Outcomes:

1. Skilfully prepare and edit documents and slides on MS Word and MS PowerPoint etc.
2. Execute functions on MS Excel.
3. Learn how to navigate tasks and execute functions in G-suite.
4. Understand and practice metacognitive skills of creativity and problem solving.
5. Hone team building and leadership skills.

List of Experiments. (Computer aided Design and detailed assembly drawing)

Sr No	List of Experiments	Hrs
I.	**Basics of Computers- Desktop/Laptop operations** **Microsoft Office** MS Word- Assignment to Create and use various commands in a Word document (Page setup, text formatting, templates, SmartArt, Title and Ribbon bar, Editing etc.) MS Excel- Assignment to Create and tabulate a spreadsheet (Excel- data analysis, charts, pivot tables, VBA, etc.) MS- Power point- Assignment to design and use a Presentation Software(MSPPT, Prezi, etc. – Presentation	6
II.	**Aptitude and Logical Reasoning** Aptitude – Aptitude training, types of questions, mock tests Logical Reasoning – Verbal and Non-verbal reasoning, Types of questions, Mock tests	6
III.	**Developing Metacognitive skills** Task orientation and Goal setting (can be based on Final year Project):Creativity and Problem-solving	6
IV.	**Collaborative Techniques:Team building skills** Activities on Team building,Case studies on Leadership, Decision making and Team building	6
V.	**GD – PI** Group Discussion – Factual, Strategic, Abstract, Case study, Picture Based, Personal Interview–Types of Interview Questions, Strategies, Sample answers, Mock Interviews	6

Assignments: Assignments and activities should enable a steady progress in developing the aforementioned skills.A record of the conducted activities can be attached in journal as image printouts, and write up of case studies.

1. Application of MS Office skills (Individual)

Create and edit Word documents

Create and execute MS Excel functions

Create and enhance MS PPT

2. Writing a simple document in LATEX editor and running the typesetter program to produce finished document

3. Aptitude and Logical reasoning tests/practice sheets

Team building skills: Activities/Tasks to be performed as a team of 3 or 4 students.
5. Group Discussions
Case studies on problem-solving to be done as a team activity.
Personal Interview questions log book
Assessment: Total – 50 Marks
Marks distribution will be as follows:
FINAL TERM WORK – 25 Marks
Assignments (Journal) – 20 Marks
Attendance - 05 Marks
ORALS/Written – 25 Marks
1. Aptitude Test (Written) - 15 Marks
2. Mock Interview (Orals) – 10 Marks
Books recommended/References/ Resources:
1. Meenakshi Raman, Prakash Singh. Business Communication, Oxford University Press, 2012
2. Claudyne Wilder. The Presentations Kit: 10 steps for Selling Your Ideas, John Wiley & Sons, 1994.
3. Lesikar, Flatley. Basic Business Communication: Skills for Empowering the Internet Generation, Tata McGraw Hill, 2008.
4. Flavell, J. H. Cognitive development: Past, present, and future. 1992.
5. Thorpe, Edgar and Showick Thorpe. Objective English, Pearson, 2013. (7 th edition Amazon)
6. Thorpe, Edgar. Test of Reasoning: for All Competitive Examination. 7 th edition., Amazon
7. Sinha, Nishit K., Reasoning, Pearson.
8. Aggarwal, R.S., A Modern Approach to Logical Reasoning, S. Chand.
9. Weblinks - https://cambridge-community.org.uk/professional-development/gswmeta/index.html
10. Various Quantitative aptitude books and websites list
11. https://eduly.in/best-quantitative-aptitude-books/
12. https://prepinsta.com/learn-aptitude/

Online Resources:

Sr. No.	Website Name
1	**Creativity https://nptel.ac.in/courses/109101017**
2	**MS Excel https://www.coursera.org/projects/introduction-microsoft-excel**
3	**Problem solving https://www.coursera.org/learn/problem-solving**

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEL709	Major Project I	-	6	-	-	2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
MEL709	Major Project I	--	--	--	--	50	--	50

Objectives:

The Project work facilitates the students to develop and prove Technical, Professional and Ethical skills and knowledge gained during graduation program by applying them from problem identification, analyzing the problem and designing solutions.

Outcomes:

1. Students will be able to develop the understanding of the problem domain through extensive review of literature.
2. Students will be able to identify and analyze the problem in detail to define its scope with problem specific data.
3. Students will be able to identify various techniques to be implemented for the selected problem and related technical skills through feasibility analysis.

4. Students will be able to design solutions for real-time problems that will positively impact society and environment.
5. Students will be able to develop clarity of presentation based on communication, teamwork and leadership skills.
6. Students will be able to inculcate professional and ethical behavior.

Guidelines for Major Project:

1. Project Topic Selection and Allocation:

- Project topic selection Process to be defined and followed:
  - Project orientation can be given at the end of sixth semester.
  - Students should be informed about the domain and domain experts whose guidance can be taken before selecting projects.
  - Student's should be recommended to refer papers from reputed conferences/ journals like IEEE, Elsevier, ACM etc. which are not more than 3 years old for review of literature.
  - Students can certainly take ideas from anywhere, but be sure that they should evolve them in the unique way to suit their project requirements. Students can be informed to refer Digital India portal, SIH portal or any other hackathon portal for problem selection.
- Topics can be finalized with respect to following criterion:
  - **Topic Selection:** The topics selected should be novel in nature (Product based, Application based or Research based) or should work towards removing the lacuna in currently existing systems.
  - **Technology Used:** Use of latest technology or modern tools can be encouraged.
  - Students should not repeat work done previously (work done in the last three years).
- **Project work must be carried out by the group of at least 2 students and maximum 4.**
- The project work can be undertaken in a research institute or organization/Industry/any business establishment. (out-house projects)
- The project proposal presentations can be scheduled according to the domains and should be judged by faculty who are expert in the domain.

- Head of department and senior staff along with project coordinators will take decision regarding final selection of projects.
- Guide allocation should be done and students have to submit weekly progress report to the internal guide.
- Internal guide has to keep track of the progress of the project and also has to maintain attendance report. This progress report can be used for awarding term work marks.
- In case of industry/ out-house projects, visit by internal guide will be preferred and external members can be called during the presentation at various levels.

2. Project Report Format:

At the end of semester, each group need to prepare a project report as per the guidelines issued.

A project report should preferably contain at least following details:

- Abstract
- Introduction
- Literature Survey
- Survey of Existing systems
- Limitations of Existing systems or research gaps
- Motivation (Challenges that are encouraging to choose the problem)
- Problem Statement and Proposed Solution
- Scope of the system
- Proposed System
    - General Workflow/Block diagram
- Analysis and Modeling (only applicable diagrams)
- Design
    - Architectural View
    - Algorithms/ Methodology

- Experimental Set up
  - Details of Database or details about input to systems or selected data
  - Performance Evaluation Parameters (for Validation)
  - Software and Hardware Set up
- Implementation Plan for Next Semester
  - Timeline Chart for Term1 and Term-II (Project Management tools can be used.)
- Summary
- References

Desirable:

Students can be asked to undergo some Certification course (for the technical skill set that will be useful and applicable for projects).

3. Term Work:

Distribution of marks for term work shall be done based on following:

Sr. No.	Component	Marks	Justification
1.	Weekly Log Report	10	Evaluates consistency, individual involvement, and regular documentation.
2.	Project Work Contribution	15	Assesses technical input, innovation, teamwork, and problem-solving ability.
3.	Project Report (Spiral Bound, Both Side Print)	10	Judges structure, clarity, formatting, and eco-friendly submission.
4.	Term End Presentation (Internal)	15	Tests presentation skills, concept clarity, Q&A handling, and teamwork.

The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

4. Term work evaluation:

Term work evaluation for Project I should be conducted by **Internal examiner on continuous basis**

throughout the semester.

Suggested quality evaluation parameters are as follows:

- Quality of problem selected
- Clarity of problem definition and feasibility of problem solution
- Relevance to the specialization / industrial trends
- Originality
- Clarity of objective and scope
- Quality of analysis and design
- Quality of written and oral presentation 8. Individual as well as team work

B.E SEM VIII

R 2025 Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC801	Operations Planning and Control	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
MEC801	Operations Planning and Control	20	20	40	60	2.5	--	--	100

Rationale :

This course provides a comprehensive foundation in Production and Operations Management, essential for managing manufacturing and service operations efficiently. Forecasting, capacity, and aggregate planning help in matching demand with resources, while scheduling techniques enhance workflow in both job shop and project environments.

Material Requirement Planning (MRP), ERP systems, and facility layout design streamline production logistics and resource utilization. Line balancing ensures efficient assembly operations, and modern philosophies like JIT, Lean, Agile, and Synchronous manufacturing emphasize waste reduction, flexibility, and responsiveness. This curriculum equips students with the analytical tools and strategic insight necessary for effective decision-making in contemporary production and service systems.

Course Objectives:

1. To provide an exposure to Operations Planning & Control (PPC) and its significance in manufacturing and service organizations.

2. To appraise about need and benefits of planning functions related to products and processes.
3. To provide exposure to production scheduling, sequencing and project management so as to optimize resources.
4. To provide insights into MRP and ERP to minimize the total cost and to manage operations functions in a better way.
5. To demonstrate different techniques used for facility planning and assembly line balancing.
6. To develop an understanding of JIT, Lean, Agile and Synchronous Manufacturing system.

Course Outcomes:

1. Illustrate operations functions and manage operations in a better way.
2. Apply various strategies to develop aggregate production plan based on the demand forecasting.
3. Apply various algorithms in scheduling and sequencing of manufacturing and service operations.
4. Develop Material Requirements Plans (MRP) to estimate the planned order releases.
5. Apply various techniques for facility layout planning and line balancing to optimize the resources.
6. Demonstrate the importance of implementation of JIT, Lean, Agile and Synchronous manufacturing in manufacturing and service organizations.

Prerequisite: Basic knowledge of Industrial Engineering, Fundamentals of Statistics and Mathematics, Analytical thinking and problem-solving

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Production and Operations Strategy**	**1.1 Introduction:** Production and Operations Function, Production systems, make to stock, make to order, assemble to order and Engineer to order, type of layouts, Phases in OPC like Preplanning, Planning, Action & Control. **1.2 Strategic Planning for Operations and Services:** Approaches like Forced Choice model and Operations Model, Quality and Productivity strategy, Technology strategy.	07	CO1

		Operations Strategies for Services, Types or Service Operations: Quasi manufacturing, Customer as participants, Customer as product, Classification of Services, Service capacity.		
II	**Forecasting and Capacity Planning in Operations**	**2.1 Forecasting:** Forecasting and Prediction, need for forecasting, role of forecasting in OPC, Methods of forecasting, Qualitative methods, Quantitative methods like time series analysis, least square method, moving average method, and exponential smoothing method. Forecasting Error; Mean Absolute Deviation, Forecasting Bias **2.2 Capacity Planning:** Measurement of capacity, Measures of operating capacity, Factors influencing effective capacity, factors favoring over capacity and under capacity, short range, medium range and long range capacity planning. Capacity requirement Planning (CRP) **2.3 Aggregate planning:** Concept of aggregate planning, Pure Strategy; Mixed Strategy; Level Strategy, Rough cut capacity planning, Aggregate planning for Services; Optimal Models for Aggregate Planning; Linear Programming; Linear Decision Rules Master Production Schedule	09	CO2
III	**Scheduling Techniques in Manufacturing and Projects**	**3.1 Job shop/Intermittent Manufacturing Scheduling:** Factors influencing scheduling, Inputs for scheduling, Forward Scheduling, Backward Scheduling, Stages in Scheduling: Product sequencing, Loading and Dispatching, dispatching, progress report & expediting and control. Basic scheduling problems, Priority Sequencing, Gantt Charts, Johnson's Rule for optimal sequence of N jobs on 2 machine. Process N Jobs on 3 Machines (N/3 problem) and Jackson	09	CO3

		Algorithm. Processing of 2 Jobs on M Machine (2/M) problem, **3.2 Project scheduling:** Network analysis - PERT & CPM, cost analysis & crashing, resource leveling and smoothening.		
IV	**Material and Enterprise Resource Planning**	**4.1 Material Requirement Planning:** Introduction, Limitations of conventional EOQ, Objectives of MRP, Inputs of MRP-I, Outputs of MRP, MRP lot sizing and Estimation of planned order releases, Manufacturing resource planning (MRP-II) **4.2 Enterprise Resource Planning (ERP):** Evolution, features, purpose of modeling an enterprise, ERP model for OPC, Modules in ERP, ERP Implementation Life Cycle, ERP packages like SAP-R3/Baan/PeopleSoft	07	CO4
V	**Facility Layout and Line Balancing Techniques**	**5.1 Facility layout planning:** Factors influencing Plant Layout, Material Flow Patterns, Tools and Techniques used for Plant Layout Planning. **5.2 Line Balancing:** Objectives, constraints, terminology in assembly line, heuristic methods like Kilbridge-Wester, Largest Candidate rule, Rank positional weight	07	CO5
VI	**Modern Manufacturing Approaches: JIT, Lean, and Agile**	Introduction to JIT system, Lean, Agile and Synchronous manufacturing: Concept, Characteristics, Components and Implementation.	06	CO6

Text / References Books:

1. "Production and Operations Management", K. Aswathappa & K. Shridhara Rao, Himalaya Publishing House, Revised 2nd Edition (2008)
2. "Industrial Engineering and Production Management", Martand Telsang, S. Chand, New Delhi

(2009)

3. "Modern Production Operations Management", Elwood S Buffa and Rakesh K Sarin, 8th Edition, Wiley Eastern, New York (1999) ISBN: 978-0471819059
4. "Production and Operations Management", Panneer Selvan R, 3rd Edition 2002Prentice Hall India, New Delhi, ISBN: 978-8120345553
5. "Production Planning and Control", Samuel Eilon, Universal Publication, ISBN: 9788185027548
6. "Production Planning and Control", L C Jhamb ,12th Edition 2010, Everest Pub House.
7. "Production Planning and Control", W. Boltan-Longman Scientific & Technical (1994), ISBN: 978-0582228207
8. "Production Systems- Planning, Analysis & Control", James. L. Riggs, John, 4th Edition 1987, Wiley & Sons, ISBN: 9780471847939
9. Manufacturing Planning and Control Systems, Thomas E. Vollman, William L. Berry & Others,4th Edition 1997, McGraw Hill Pub, ISBN: 978-0786312092
10. "Manufacturing Process Planning and Systems Engineering", Anand Bewoor, Dreamtech Press 2009, ISBN: 978-8177229967
11. "Production and Operations Management", S.N. Chary, 3rd Edition 2004, TMH publishing company, ISBN: 978-0070583559
12. Modernization & Material Management, L.C. Jhamb - Everest Publishing House

Online References:

Sr. No.	Links for online NPTEL/SWAYAM courses
1	https://youtube.com/playlist?list=PLLy_2iUCG87A-kHGx4YUY97ShTTqBfA6-&feature=shared
2	https://youtube.com/playlist?list=PLSGws_74K01_MBJaKLVaP0iCupVawlL6i&feature=shared

R-2025-Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC821	Composite Materials	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT 1+ IAT 2					
MEC821	Composite Materials	20	20	40	60	2.5	--	--	100

Rationale:

Composite Materials is introduced in the final semester to equip students with knowledge of advanced materials that offer high strength-to-weight ratios, corrosion resistance, and design flexibility. This subject prepares students for modern engineering challenges in aerospace, automotive, and structural applications, bridging theoretical material science with practical industry needs.

Course Objectives:

1. To study the manufacturing methods of composite material.
2. To study the behaviour of composite materials, both at micro and macro levels.
3. To study the procedure of designing a composite laminate and structure as a whole for the given application.
4. To study the applicability of composite materials for various industrial/loading applications
5. To study the damage detection and damage repair methods for composite materials.

Course Outcomes:

1. Select the type of material for the fibres and matrix in a composite material for the given application.
2. Relate stresses and strains through the elastic constants for a given lamina.
3. Evaluate elastic properties of a lamina based on the properties of its constituents.
4. Predict failure of a lamina under the given loading condition.
5. Select the number of laminae and their stacking sequence in a composite material for the given loading condition.
6. Identify the type of damage occurring in a composite structure and select an appropriate method to repair it.

Prerequisite: Basic understanding of engineering materials and its applications

DETAILED SYLLABUS:

R-2025-Mechanical Engineering

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction**	Introduction Classifications based on fibres and matrix, Advantages, Applications, Terminology, Manufacturing Methods: Hand layup, Spray layup, Vacuum bagging, Prepregs, Industrial autoclave, Filament winding, Pultrusion, Resin transfer moulding, Vacuum Infusion Processing, Powder metallurgy route for ceramic and metal matrix composites	**08**	**CO1**
II	**Analysis of Lamina**	Analysis of Lamina Hooke's law for different types of materials, Plane stress assumption, Hooke's law for a two-dimensional unidirectional lamina, Relationship of compliance and stiffness matrix to engineering elastic constants of a lamina, Hooke's law for a two-dimensional angle lamina, Engineering constants of an angle lamina	**08**	**CO2**
III	**Lamina Failure Theories**	Introduction, Maximum stress failure theory, Maximum strain failure theory, Tsai- Hill failure	**08**	**CO3**

		theory, Tsai-Wu failure theory, Strength ratio, Failure envelopes		
IV	**Introduction to Micromechanics of Lamina and Laminate Design**	Prediction of mechanical properties of lamina based on properties of its constituents (fibre and matrix), Laminate types and their codes, Overview of laminate design (no problems on this topic)	**08**	**CO4**
V	**Inspection of Composites**	Different types of damages in composites, Non-destructive testing of composites: Ultrasonics inspection, Acoustography, Low frequency Methods, Radiographic inspection, Shearography, Acoustic emission, Thermography	**06**	**CO5**
VI	**Repair of Composites**	Restitution and repair of composites: Selection of Repair method, Repair criteria, Generic repair designs, Matrix cracks, Delamination, Holes and Fiber fracture, Damage removal and surface preparation	**07**	**CO6**

Text Books/ Reference:

1. M.Balasubramanian, "Composites materials processing" ,1st edition, CRC press 2013.
2. A.K. Kaw, "Mechanics of Composite Materials", Taylor and Francis Group, ISBN:

9780815351481
3. Ajay Kapadia, "Non Destructive Testing of Composite Materials", National Composites Network
4. R.B. Heslehurst, "Defects and Damage in Composite Materials and Structures", CRC Press 2014.
5. R.M. Jones, "Mechanics of Composite Materials", 2nd Edition,Taylor and Francis, Inc,ISBN: 9781138571075
6. I.M. Daniel and O. Isai, "Engineering Mechanics of Composite Materials", 2nd Edition 2005,Oxford University Press, ISBN: 9780195150971
7. D. Gay, S.V. Hoe, and S.W. Tsai, "Composite Materials: Design and Applications", 3rd Edition 2014, CRC Press, ISBN: 978-1466584877
8. R.B. Heslehurst, "Defects and Damage in Composite Materials and Structures", CRC Press 2014.
9. M.M. Schwartz, "Composite Materials: Properties, Nondestructive Testing, and Repair", Prentice Hall PTR (1997), ISBN: 9780133000474

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/112104251
2.	https://nptel.ac.in/courses/112104168
3.	https://nptel.ac.in/courses/112104034
4.	https://swayam.gov.in/nd1_noc23_me16/preview
5.	https://swayam.gov.in/nd1_noc22_me01/preview

R-2025-Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC822	Smart Materials	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT 1 + IAT 2					
MEC822	Smart Materials	20	20	40	60	2.5	--	--	100

Rationale:

Smart materials are capable of sensing and responding to external stimuli like stress, temperature, or electric fields. This subject helps students to understand the types, properties, and applications of materials like piezoelectrics, shape memory alloys, ferrofluids, and nanomaterials. It prepares students to use these materials in modern engineering fields such as aerospace, biomedical, robotics, and energy systems.

Course Objectives:

1. To **introduce** the classification and selection criteria of smart materials based on their functions and properties.
2. To **develop** understanding of the fundamental concepts and working principles of various smart materials.
3. To **study** the synthesis, sensing, and actuation mechanisms of piezoelectric, magnetostrictive materials, shape memory alloys, and electroactive polymers.
4. To **explore** the behavior and applications of ferrofluids, magnetorheological fluids, soft matter, carbon nanostructures, and thermoelectric materials.
5. To **examine** smart materials used for energy storage and harvesting applications.
6. To **highlight** the role and applications of composite and nanocomposite materials in smart systems.

Course Outcomes:

1. **Classify** and **select** different types of smart materials for specific engineering applications.
2. **Explain** the key concepts and working principles of various smart material systems.
3. **Analyze** the synthesis, sensing, and actuation mechanisms of piezoelectric, magnetostrictive materials, shape memory alloys, and electroactive polymers.
4. **Evaluate** the functional behavior of ferrofluids, magnetorheological fluids, soft matter, carbon nanostructures, and thermoelectric materials.
5. **Select** and **justify** the use of smart materials in energy storage and energy harvesting systems.
6. **Identify** and **classify** advanced composite and nanocomposite materials based on application needs.

Prerequisite: Basic understanding of engineering materials and its applications

DETAILED SYLLABUS:

R-2025-Mechanical Engineering

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Smart Materials**	Overview of the different types of Smart Materials, Smart materials used in structures, smart material for sensors, actuators controls, memory and energy storage and their interrelationships, concept of High bandwidth- low strain generating materials (HBLS), and Low Bandwidth High Strain Generating Materials (LBHS), Nano Composite Materials	**08**	**CO1**
II	**Important Concepts of Smart Materials**	artificial skins, artificial muscles, biomimetic materials, materials with tuneable responses, nonlinear properties, self-healing materials, adaptive structures, self-replicating materials/structures, self-assembly, inch worm devices, hysteresis, integrated sensing and actuation	**08**	**CO2**
III	**Synthesis, constitutive/governing relationships- Part 1**	Overview of the following materials with focus on synthesis, constitutive/governing relationships, strengths and weaknesses, and applications (both sensing and actuation etc) 1. Piezoelectric Materials 2. Magneto strictive Materials 3. Shape Memory Alloys 4. Electroactive Polymers	**08**	**CO3**

IV	**Synthesis, constitutive/governing relationships- Part 2**	Overview of the following materials with focus on synthesis, strengths and weaknesses, and applications 1.Ferrofluids and Magneto rheological Fluids and applications in dampers 2.Soft Matter and its applications as smart skins, smart textiles etc 3.Carbon Nanotubes and Carbon nanostructures and its applications 4.Thermoelectric Materials and Peltier devices	**07**	**CO4**
V	**Smart Materials for Energy Applications**	Materials used for energy storage, Hydrogen Storage Materials, Energy harvesting, Energy scavenging from vibrations	**06**	**CO5**
VI	**Manufacturing techniques for smart materials**	Micromanufacturing, high resolution lithography, LIGA process, Generative manufacturing processes such as STL, SLS, SPB, BPM, LOM, SGC, FDM, BIS, BPM, Self-assembly process, Ion beam processes,	**08**	**CO6**

Text Books/ Reference:

1. M.V. Gandhi and B.S. Thompson, "Smart Materials and Structures", Chapman & Hall, London; New York, 1992 (ISBN: 0412370107)
2. Mel Scwartz, "Encyclopedia of Smart Materials Vol. I and II", John Wiley & Sons SenolUtku, "Theory of Adaptive Structures : Incorporating Intelligence into Engineered Products", CRC Press (1998), ISBN: 9780849374319
3. A.V. Srinivasan, "Smart Structures: Analysis and Design", Cambridge University Press,Cambridge; New York, 2001 (ISBN: 0521650267)
4. G. Gautschi, "Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic Emission

Sensors, Materials and Amplifiers", Springer, Berlin; New York, 2002 (ISBN:3540422595)

5. K. Uchino, "Piezoelectric Actuators and Ultrasonic Motors", Kluwer Academic Publishers, Boston, 1997 (ISBN: 0792398114)
6. G. Engdahl, "Handbook of Giant Magneto strictive Materials", Academic Press, San Diego, Calif.; London, 2000 (ISBN: 012238640X)
7. K. Otsuka and C.M. Wayman, "Shape Memory Materials", Cambridge University Press, Cambridge; New York, 1998 (ISBN: 052144487X)
8. Eric Udd, "Fibre Optic Sensors: An Introduction for Engineers and Scientists", John Wiley & Sons, New York, 1991 (ISBN: 0471830070)
9. André Preumont, "Vibration Control of Active Structures: An Introduction", 2nd Edition, Kluwer Academic Publishers, Dordrecht; Boston, 2002 (ISBN: 1402004966)
10. HojjatAdeli, "Control, Optimization, and Smart Structures: High-Performance Bridges and Buildings of the Future", John Wiley, New York, 1999 (ISBN: 047135094X)
11. T.T. Soong, "Passive Energy Dissipation Systems in Structural Engineering", Wiley, Chichester; New York, 1997 (ISBN: 0471968218)

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/112108148
2.	https://nptel.ac.in/courses/112104224
3.	https://swayam.gov.in/nd1_noc21_mm18/preview
4.	https://nptel.ac.in/courses/117106115
5.	https://swayam.gov.in/nd1_noc19_ee55/preview

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC831	Product Design and Development	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
MEC831	Product Design and Development	20	20	40	60	2.5	--	--	100

Rationale:

This course emphasizes the importance of product development to meet customer needs and market expectations. It integrates engineering and industrial design with systematic design processes and models.

Students learn to apply tools like QFD to translate user needs into technical specifications. Creative thinking methods foster innovation in concept generation. Industrial design principles and DFMA ensure usability, sustainability, and manufacturability. Prototyping techniques bridge the gap between design and real-world application.

Course Objectives:

1. To understand the basic concepts of engineering design and product design & development, focusing on the front-end processes.
2. To demonstrate an understanding of the overview of all the product design & development processes.
3. To demonstrate knowledge of concept generation and the selection of tools.
4. To study the applicability of product design & development in industrial applications.

Course Outcomes:

1. Describe the need, process, and societal relevance of product design and development.
2. Employ design models, concept evaluation methods, and product architecture principles in the development of engineering design solutions
3. Create product design specifications by applying customer needs analysis, QFD, and competitive benchmarking techniques.
4. Demonstrate creative thinking and problem-solving techniques to generate and develop innovative design concepts.
5. Fabricate product design models incorporating industrial design principles, human factors, and environmental considerations.
6. Work collaboratively to apply DFMA principles and prototyping techniques using computer-aided tools for product development.

Prerequisite: Basic knowledge of manufacturing processes and CAD modeling, Knowledge of basic market research methods and product requirement analysis, Basic engineering and design awareness.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Product Design Process and Market Relevance in Engineering**	Need for developing products, The importance of Engineering and Industrial design, The design process, Relevance of product lifecycle issues in design, Societal considerations in Engineering and Industrial Design, Generic product development process, Various phases of product development, Planning for products, Establishing markets - market segments - relevance of market research.	08	CO1
II	**Design Processes: From Concept Generation to Product Architecture**	The design processes, Descriptive and prescriptive design models, Concept development & evaluation, Pugh's total design activity model, Concept generation and selection method, Embodiment design, Product architecture, and Steps in developing product architecture.	08	CO2
III	**Human-Centered Design: Needs, Benchmarking, and QFD**	Identifying customer needs, Voice of Customer (VoC), Customer populations, Hierarchy of human needs, Need gathering methods, Establishing engineering characteristics, Competitive benchmarking, Quality Function Deployment (QFD), House of Quality (HoQ), Product design specification, Development of product	08	CO3

		design with specifications using QFD, Relevant case studies.		
IV	**Creativity and Innovation in Engineering Design**	Creative thinking, Creativity and problem-solving methods, Creative thinking methods, Brainstorming technique, Gorden technique, Check listing technique, Synectic technique, Morphological Analysis, and Attribute Listing technique. Generating design concepts, Systematic methods of designing.	07	CO4
V	**Aesthetic and Functional Aspects of Industrial Design**	Industrial design, Basic forms & elements, Integrating basic forms & elements such as balance, rhythm, proportion, The golden rule of proportions, human factors, and design, User-friendly design, Design for serviceability, Design for environment.	07	CO5
VI	**Rapid Prototyping and DFMA in Modern Product Design**	Concept of Design for Manufacturing and Assembly (DFMA). Role of computers in product design and manufacturing process, Prototyping techniques such as Stereolithography (SLA), Selective laser sintering (SLS), Fused disposition Modelling (FDM), Laminated object manufacturing (LOM), 3-D printing, and Ballistic Particle Manufacturing (BPM).	07	CO6

Text Books:

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development," 4th Edition, 2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9.
2. Kevin Otto, Kristin Wood, "Product Design," Indian Reprint 2004, Pearson Education, ISBN

9788177588217.

References Books:

1. Clive L. Dym, Patrick Little, "Engineering Design: A Project-based Introduction," 3rd Edition, John Wiley & Sons, 2009, ISBN 978-0-470-22596-7.
2. George E. Dieter, Linda C. Schmidt, "Engineering Design," 4th Edition, McGraw-Hill International Edition, 2009, ISBN 978-007-127189-9.
3. Yousef Haik, T. M. M. Shahin, "Engineering Design Process," 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141.

Online References:

Sr. No.	Links for online NPTEL/SWAYAM courses
1	https://youtube.com/playlist?list=PLSGws_74K018yZOnbSaqWJZ837QyBB7vu&feature=shared – Product Design and Development, IIT, Roorkee
2	https://youtube.com/playlist?list=PLp6ek2hDcoNALWidcTcFur34atzXNYHjD&feature=shared - Product Design and Development, IIT, Delhi

B.E. Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC832	Total Quality Management	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
MEC832	Total Quality Management	20	20	40	60	2.5	--	--	100

Rationale:

This course introduces the fundamentals and evolution of Quality Management and TQM. It emphasizes customer satisfaction, supplier collaboration, and cost of quality for performance improvement. Students learn key quality philosophies, TQM principles, and tools like PDCA and QC/QA tools. Concepts of Statistical Quality Control, control charts, and sampling plans are covered.
Continuous improvement methods such as TPM, QFD, Kaizen, and Taguchi are included. The course also explores ISO certifications and quality awards. Emerging trends like Six Sigma, sustainability, and quality analytics are discussed. Application across manufacturing, services, and modern sectors is highlighted.

Course Objectives:

1. To understand the importance of Quality Management and principles of TQM.
2. To understand seven basic QC tools and advanced QM tools.
3. To understand the concept of Statistical Quality Control.

4. To understand the concept of Continuous Improvement and TQM implementation.
5. To understand different Quality Systems and Quality Standards.
6. To understand the future trends in TQM and TQM strategies.

Course Outcomes:

1. Apply QM and principles of TQM in organizational development process.
2. Apply the QC & QM tools in process improvement.
3. Apply SQC techniques to improve process quality.
4. Apply Six Sigma project in TQM Implementation.
5. Apply QMS and Certification for Quality Accreditation.
6. Apply the advanced tools for Quality Sustainability.

Prerequisite: Basic knowledge of manufacturing processes, engineering materials, statistical methods

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Quality Management**	**Introduction to Quality Management:** **A)** Definitions of Quality, product quality and service quality; the evolution of quality; need for Quality Management, Quality statements and Policy, Customer orientation & satisfaction, Customer complaints, customer retention; Supplier partnership, Supplier rating & selection, CSI, Costs of Quality, Prevention, appraisal and failure aspects, Use of COQ for improving quality and performance, Designing for quality, Quality of design, Quality of conformance. **B)** Basic concepts of TQM, TQM framework, Contributions of Deming, Juran	08	CO1

		and Crosby, Juran Triology , PDCA Cycle, Barriers to TQM; TQM principles; Strategic Quality Planning; Quality councils; employee involvement, motivation; Empowerment; Team and Teamwork; recognition and reward, performance appraisal.		
II	**QC Tools**	**QC Tools:** **A) Seven QC Tools:** Check Sheet, Histogram, Pareto Chart, Fishbone Diagram, Run Charts, Scatter Diagram, Process Flow Chart. **B) Seven QM Tools:** Program Decision Process Chart, Tree Diagram, Affinity Diagram, Prioritization Matrix, etc. Bench Marking Types – Process, Product, Quality Improvement Tools: Why-Why Analysis, Root Cause Analysis, Poka Yoke (Mistake Proofing)	08	CO2
III	**Statistical Quality Control**	**Statistical Quality Control:** 100% Inspection versus Sampling Inspection, Reasons for SQC. **A) Acceptance Sampling:** Concept of Producer Risk and Consumers Risk. Operating Characteristics Curve. Sampling Plan – Single Sampling Plan versus Double Sampling Plan. Design Sampling Plan on the basis of MIL, ASQ Standards. **B) Statistical Process Control:** Variations – Concept, Causes – Random & Assignable, Difference – Process in Control versus Process is Capable, Control Charts, X-Bar, R, P and C Charts, Process Capability (Cp) & Process Capability Index (Cpk), Sigma Limits. Applications of Control Charts in Mass Production, Process Production.	08	CO3
IV		**A) Continuous Improvement:** Quality Circles, Quality Function Development		

	Continuous Improvement & TQM Implementation	(QFD), Taguchi quality loss function, Parameter Design, Robust Design; TPM-concepts, 5S, Kaizen, FMEA- stages, Zero Defect. **B) TQM Implementation**: Manufacturing and Service sectors, Introduction to Six Sigma: Definition, Concept, Methodology. Six Sigma Approaches – Design for Six Sigma (DFSS) Approach & DMAIC Approach, Six Sigma Tools: Applications to manufacturing and service sector including IT, ITeS, and E Com.	07	CO4
V	**Quality Management System & Certification**	**Quality Management System & Certification:** **A) QMS**: Elements and documentation, Quality auditing, Necessity for Certification & Certification Process, Benefits of Certification. Certifying Bodies & Accreditation Agencies, ISO 9000-2015 (5th Edition), Introduction to TS16949: Technical Specifications, QS9000, ISO14000- concepts, requirements and benefits. Case studies of TQM implementation in manufacturing and service sectors including IT and Environmental management systems- ISO 14000 Series Standards, Integration of ISO 14000 with ISO 9000. **B) Quality Awards:** Malcom Baldrige National Quality Award and Rajiv Gandhi National Quality award.	07	CO5

VI	**Future Trends in TQM**	**Future Trends in TQM:** Strategic approach to leadership, Customer centric endeavors, Involvement & empowerment of all employee's / stake holders, Decision making based on real time facts, Win-Win policy with suppliers, New paradigms of Green & sustainability, TQM beyond Manufacturing i.e. Healthcare, Education, Finance. Accountability through new tools and technologies, Quality Analytics.	07	CO6

Text Books:

1. Besterfield D. H. et al.: Total quality Management, 3rd Edition, Pearson Education Asia, 2006.
2. Janakiraman B. and Gopal R.K.: Total Quality Management, Prentice Hall India, 2006.
3. Poornima M. Charantimath: Total Quality Management, 2nd Edition, Pearson Education Asia, 2006.
4. N. Logothetis: Managing for Total Quality, 6th Edition, Prentice Hall of India Pvt. Ltd. 2003.
5. Suganthi L. and Samuel A.: Total Quality Management, Prentice Hall India, 2006.
6. Evans J.R. and Lindsay W.M.: The Management and Control of Quality, 8th Edition, 1st Indian Edition, Cengage Learning, 2012.

References Books:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 6th Edition, South-Western (Thomson Learning), 2005.
2. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, 3rd Edition, 2003.

Online References:

Sr. No.	Links for online NPTEL/SWAYAM courses

B.E. Mechanical Engineering

1	https://youtube.com/playlist?list=PLPjSqITyvDeUUUwunyiwq41yJZofQEzMI&feature=shared – Total Quality Management-I, IIT, Kanpur
2	https://youtube.com/playlist?list=PLueDbnzoKDZ-ZIJigjav-j8ZWz5CEoz-0&feature=shared - Total Quality Management-II, IIT, Kanpur

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8401	Finance Management	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT -2	IAT-1 + IAT-2					
OEC8401	Finance Management	20	20	40	60	2.5	--	--	100

Rationale:

Finance Management is a vital course designed to equip engineering students with essential financial literacy and decision-making skills. Understanding the Indian financial system, corporate finance principles, and investment appraisal techniques enables learners to make informed business and project-related decisions. The course integrates theoretical concepts such as risk-return analysis, time value of money, and capital budgeting with practical aspects like working capital, financing options, and dividend policies. This holistic knowledge prepares students to effectively manage resources, evaluate financial performance, and contribute strategically to organizational goals, making them industry-ready professionals in both technical and managerial roles.

Course Objectives:

1. Overview of Indian financial system, instruments and market.
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management.
3. Knowledge about sources of finance, capital structure, dividend policy.
4. To develop analytical skills for evaluating investment decisions using capital budgeting

techniques.

5. To understand the importance of working capital and its effective management.
6. To explore the impact of dividend decisions on shareholder value through different theoretical approaches.

Course Outcomes:

1. Understand Indian finance system and corporate finance.
2. Take investment, finance as well as dividend decisions.
3. Apply capital budgeting techniques (NPV, IRR, Payback, etc.) for investment appraisal.
4. Analyze and manage components of working capital including inventory, receivables, and cash.
5. Evaluate sources of finance and formulate optimal capital structure.
6. Compare and apply various dividend policy models like Gordon's, Walter's, and MM approach.

Prerequisite: Basic understanding of mathematics and analytical reasoning.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Understanding of Simple Interest, Compound Interest, Geometric Progression		CO1
I	**Overview of Indian Financial System**	. **Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills.	8 hours	CO1

		Financial Markets: Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market **Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges		
II	**Returns and Risks**	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	8 hours	CO2
III	**Overview of Corporate Finance**	Objectives of Corporate Finance; Functions of Corporate Finance— Investment Decision, Financing Decision, and Dividend Decision. Overview of Financial Statements— Balance Sheet, Profit and Loss Account, and Cash Flow Statement **Financial Ratio Analysis:** Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure	8 hours	CO3

		Ratios; Stock Market Ratios; Limitations of Ratio Analysis.		
IV	**Capital Budgeting**	Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) **Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	8 hours	CO4
V	**Sources of Finance**	Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. **Capital Structure:** Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	7 hours	CO5
VI	**Dividend Policy**		6 hours	CO6

		Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach		

Text Books / References:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Assessment:

Internal Assessment (IA) for 20 marks:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

Question paper format

Question Paper will comprise of a total of **six questions each carrying 15 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**

Remaining questions will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)

A total of **four questions** need to be answered

R-2025- B.E. Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8402	Environmental Management	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
OEC8402	Environmental Management	20	20	40	60	2.5	--	--	100

Rationale :

In today's world, sustainability and environmental responsibility are critical components of engineering practice. The inclusion of Environmental Management in the curriculum of Semester 8 for Mechanical Engineering students is both timely and essential. This subject aims to equip future engineers with the knowledge, awareness, and tools necessary to address environmental challenges while practicing responsible engineering.

Course Objectives:

1. Understand and identify environmental issues relevant to India and global concerns.
2. Learn concepts of ecology.
3. Familiarize environment related legislations.

Course Outcomes:

1. Understand the basics of environment, sustainability, and their relevance to management.
2. Identify major global environmental concerns and their impact on ecosystems and human life.
3. Understand ecological concepts and the interdependence within ecosystems.
4. Understand the scope of environmental management and the roles of government and industry in ensuring environmental responsibility.
5. Understand Total Quality Environmental Management and the significance of ISO-14000 and EMS

certification.

6. Gain awareness of key environmental legislations and their relevance to environmental protection.

Prerequisite: Basic understanding of science and environmental studies, including ecosystems and pollution. Awareness of current environmental issues

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Environment and Sustainable Development**	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities, Environmental issues relevant to India, Sustainable Development, the Energy scenario	11	CO1
II	**Global Environmental Issues and Challenges**	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	07	CO2
III	**Ecology and Ecosystem Dynamics**	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	06	CO3
IV	**Environmental Management and Governance**	Scope of Environment Management, Role and functions of Government as a planning and regulating agency Environment Quality Management and Corporate Environmental Responsibility	11	CO4
V	**Environmental Standards and Quality Management**	Total Quality Environmental Management, ISO-14000, EMS certification.	06	CO5

VI	**Environmental Laws and Regulations**	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	04	CO6

Text / References Books:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management V Ramachandra and Vijay Kulkarni, TERI Press
4. Indian Standard Environmental Management Systems — Requirements with Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEL805	Product Design and Development	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
MEL805	Product Design and Development	--	--	--	--	25	25	50

Lab Objectives:

1. To familiarize concepts in PD&D for practical implementation.
2. To acquaint with the applicability of PD&D in industrial applications.

Lab Outcomes:

1. Identify the need for developing products
2. Select suitable PD&D processes.
3. Apply the creativity & industrial design methods to design & develop the chosen product.
4. Work collaboratively in a team to complete a PD&D project.
5. Effectively communicate the results of projects and other assignments both in a written and oral

format.

Prerequisite: Basic knowledge of manufacturing processes and CAD modeling, Knowledge of basic market research methods and product requirement analysis, Basic engineering and design awareness

List of Assignments:

Total **3 to 4 assignments** have to be given.
Assignments **III and IV are compulsory** and shall be **treated like mini-projects**. Two more could be covered from the remaining as case studies.

I. Based on Module No. 1 and 2.

1. Select any one consumer product, such as
    a) a mobile
    b) a laptop
    c) a pencil sharpener
    d) a table and chair
    e) a stool
    f) a bicycle
    g) a pen
    h) a storage device of any household items
    i) a cupboard etc.…. anything

Assume that you want to go for re-development of any one of the products. How would you tackle by answering any 3 or 4 points that are given below?

Q1. How do you identify the need for developing the product?

Q2. What are the changes that you would like to incorporate?

Q3. Would it be Engineering Design or Industrial design factors or both?

Q4. What are the generic PD&D processes that you would like to adopt?

Q5. What are the methods that you would adopt for Market research?

Q6. If you would like to develop which design process you would like to adopt?

Q7. If you select descriptive design… then why? If you select prescriptive design… then why?

Q8. What are the steps that you would like to adopt while developing the product?

II. Based on Module No. 3.

2. Select any one consumer product, such as

    a) a mobile

    b) a laptop

    c) a pencil sharpener

    d) a table and chair

    e) a stool

    f) a bicycle

    g) a pen

    h) a storage device of any household items

    i) a cupboard etc….. anything

Assume that you want to go for re-development of any one of the above products. How would you tackle by answering any 3 or 4 points that are given below?

Q1. How do you identify the customer needs for developing the product?

Q2. How do you ascertain/select the attributes that are to be tackled?

Q3. Would you like to go for Engineering Design factors or Industrial design factors or both?

Q4. How do you develop a correlation matrix?

Q5. How do you "Construct House of Quality"?

Q6. What are the generic PD&D processes that you would like to adopt in re-designing it using House of quality?

Q7. What are the methods that you would adopt for Market acceptance?

Q8. How do you document the entire design process?

III. Based on Module No. 4.

3. Select any one consumer product, such as

a) a mobile
b) a laptop
c) a pencil sharpener
d) a table and chair
e) a stool
f) a bicycle
g) a pen
h) a storage device of any household items
i) a cupboard etc….. anything

Assume that you want to go for re-development of any one of the above products.

How would you apply the creativity method to design the chosen product using any one creativity methods? Develop the product and document the entire process by answering some of the questions as shown in I or II.

IV. Based on Module No. 5.

4. Select any one consumer product, such as
   a) a mobile
   b) a laptop
   c) a pencil sharpener
   d) a table and chair
   e) a stool
   f) a bicycle
   g) a pen
   h) a storage device of any household items
   i) a cupboard etc….. anything

Assume that you want to go for re-development of any one of the above products.

How would you apply the principles of Industrial Design methods to design the chosen product?

Develop the product and document the entire process by answering some of the questions as shown in I or II.

V. Based on Module No. 6

5. Select any one consumer product, such as
    a) a mobile
    b) a laptop
    c) a pencil sharpener
    d) a table and chair
    e) a stool
    f) a bicycle
    g) a pen
    h) a storage device of any household items
    i) a cupboard etc….. anything

Assume that you want to go for re-development of any one of the above products.

How would you apply the principles of DFMA to design the chosen product?

Develop the exploded view of the product and document the entire process by answering some of the questions as shown in I or II.

Text / References Books:

1. Baker, M. & Hart S. (2007), Product Strategy and Management, (2nd. Ed.) Edinburgh: Pearson Education.
2. Ulrich, K. & Eppinger, S. (2012), Product Design and Development. (5th. Ed.) Los Angeles: McGraw Hill Education.
3. Yousef Haik, T. M. M. Shahin (2010), Engineering Design Process, (2nd. Ed. Reprint), Cengage

Learning, ISBN 0495668141.

4. Kevin Otto, Kristin Wood (2004), Product Design, (Indian Reprint), Pearson Education, ISBN 9788177588217.

Assessment:

Term work:

The distribution of marks for term work shall be as follows:

Assignments/Case studies:	**10 marks**
Mini Project:	**10 marks**
Attendance:	**05 marks**

End Semester Practical/Oral Examination:

1. Pair of Internal and External Examiner should conduct practical/viva based on contents.
2. **Distribution of marks for practical/viva examination shall be as follows:**
   - **Practical performance: 15 marks**
   - **Oral: 10 marks**
3. Evaluation of practical examination to be done based on the practical performed.
4. Students work along with evaluation reports to be preserved till the next examination.

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C)
MEL806	Laboratory based on IoT	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
MEL806	Laboratory based on IoT	--	--	--	--	25	25	50

R-2025 Mechanical Engineering

Lab Objectives:

1. To learn microcontroller programming using 8051 and Arduino Development Board.
2. To acquaint with interfacing of simple peripheral devices to a microcontroller.
3. To acquaint with exchange of data using wireless communication.
4. To familiarize with logging the data on cloud platform.
5. To learn different transfer protocols
6. To familiarize different open-source dashboards

Lab Outcomes:

1. **Develop** simple embedded applications using 8051 and Arduino microcontrollers. *(Apply)*
2. **Interface** peripheral devices such as sensors and actuators with microcontrollers. *(Apply)*
3. **Utilize** microcontroller-based embedded platforms for implementing IoT solutions. *(Apply)*
4. **Demonstrate** wireless data communication using wireless peripherals (e.g., Bluetooth, Wi-Fi). *(Understand / Apply)*
5. **Configure** cloud platforms to **collect and log** sensor data effectively. *(Apply / Analyze)*
6. **Troubleshoot** and **debug** basic issues in microcontroller-based embedded systems. *(Analyze)*

List of Experiments.

Sr No	List of Experiments	Hrs
01	Interfacing experiments using 8051 Trainer kit and interfacing modules a. display (LCD/LED/Seven Segment) b. Stepper / DC Motor	2
02	Introduction to Arduino platform and programming	4
03	Simple Applications using Arduino Development Board (Any two) a. Simple LED Blinking using development board b. Building IOT Smart Switch using IOT c. Pulse Width Modulation d. Analog to Digital / Digital to Analog Conversion	4
04	Interfacing Arduino with a Sensor (Any one): Temperature Sensor / PIR/ Ultrasonic sensor/ IR Sensor/ Flame Sensor/ MQ6 Sensor/ Humidity sensor/ Raindrop Sensor, magnetometers, cameras, accelerometers etc.	4
05	Interfacing Arduino with an Actuator (Any One): Motors / solenoids / Controllers etc.	4
06	Communication using Wireless Medium (Any One): WiFi / Bluetooth / Zigbee / RFID etc.	8
07	Setting up and Cloud Platform and logging Sensor Data on the platform.	6

Text Books / References:

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, and Rolin D. McKinlay, *The 8051 Microcontroller and Embedded Systems: Using Assembly and C*, Pearson Education, 2nd Edition
2. Simon Monk, *Programming Arduino: Getting Started with Sketches* McGraw-Hill Education, 2nd Edition
3. Raj Kamal, *Internet of Things: Architecture and Design*, McGraw-Hill Education, 1st Edition

Online Resources:

Sr. No.	Website Name
1	https://www.tinkercad.com
2	https://spoken-tutorial.org/watch/Arduino/Introduction+to+IoT/English/
3	https://toptechboy.com/#google_vignette

Assessment:

Term Work: Term Work shall consist of at least 7 practicals based on the above list. Also, Term work Journal must include one project based on IoT

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 10 Marks (Project) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEP807	Major Project II	-	12	-	-	4	-	4

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
MEP807	Major Project II	--	--	--	--	100	50	150

Objectives:

The Project work facilitates the students to develop and prove Technical, Professional and Ethical skills and knowledge gained during graduation program by applying them from problem identification to successful completion of the project by implementing the solution.

Outcomes:

1. Students will be able to implement solutions for the selected problem by applying technical and professional skills.
2. Students will be able to analyze impact of solutions in societal and environmental context for sustainable development.
3. Students will be able to collaborate best practices along with effective use of modern tools.
4. Students will be able to develop proficiency in oral and written communication with effective

leadership and teamwork.

5. Students will be able to nurture professional and ethical behavior.
6. Students will be able to gain expertise that helps in building lifelong learning experience.

Guidelines:

1. **Internal guide has to keep track of the progress of the project and also has to maintain attendance report. This progress report can be used for awarding term work marks.**

2. **Project Report Format:**

At the end of semester, each group need to prepare a project report as per the guidelines issued by the University of Mumbai. Report should be submitted in hardcopy. Also, each group should submit softcopy of the report along with project documentation, implementation code, required utilities, software and user Manuals.

A project report should preferably contain at least following details:

- Abstract
- Introduction
- Literature Survey/ Existing system
- Limitation Existing system or research gap
- Problem Statement and Objective
- Proposed System
    - Analysis/Framework/ Algorithm
    - Design details
    - Methodology (your approach to solve the problem) Proposed System
- Experimental Set up
    - Details of Database or details about input to systems or selected data
    - Performance Evaluation Parameters (for Validation)
    - Software and Hardware Set up
- Results and Discussion

- Conclusion and Future Work
- References
- Appendix – List of Publications or certificates

Desirable:

- Students should be encouraged
  - to participate in various project competition.
  - to write minimum one technical paper & publish in good journal.
  - to participate in national / international conference.

3. Term Work:

Distribution of marks for term work shall be done based on following:

Sr. No.	Component	Marks	Justification
1.	Weekly Log Report	15	Tracks regularity, effort, and individual contributions throughout the semester.
2.	Completeness of the project and Project Work Contribution	40	Evaluates innovation, technical depth, execution, teamwork, and project outcomes.
3.	Project Report (Black Book) (both side print)	20	Assesses structure, documentation quality, technical content, and eco-friendly submission.
4.	Term End Presentation (Internal)	25	Judges communication skills, understanding of the project, visual aids, and handling of queries.

The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

4. Oral & Practical:

Oral &Practical examination (Final Project Evaluation) of Project II should be conducted by **Internal and External examiners at the end of the semester**.

Suggested quality evaluation parameters are as follows:

- Relevance to the specialization / industrial trends
- Modern tools used
- Innovation
- Quality of work and completeness of the project
- Validation of results
- Impact and business value
- Quality of written and oral presentation
- Individual as well as team work Quality of written and oral presentation
- Individual as well as team work