COURSE STRUCTURE AND SYLLABUS

OF
BACHELOR OF TECHNOLOGY

(MECHANICAL ENGINEERING)

Effective from

Session: 2024-2025

Department of Mechanical Engineering
Faculty of Engineering and Technology
Jamia Millia Islamia,
New Delhi, INDIA

Department of Mechanical Engineering

Faculty of Engineering &Technology

Vision:

To Establish the Department as a hub of quality education, research with innovation and recognition at National and International level.

Mission:

1. To transfer the knowledge through quality education which can develop skills, inculcate values and improve research with innovative methods.
2. To re-engineer the engineering education and to create leadership qualities with futuristic vision.
3. To produce young engineers who can be useful in New Technological Design, areas of Environment, space and sustainable technologies.
4. To develop Teaching-Learning methods which can produce socially committed good professional human being who can contribute effectively in Nation building and represent Country Internationally.

Programme Educational Objectives (PEOs)

1. The graduates will be well prepared for successful careers in industry/consultancy/research & development/teaching/allied areas and will be academically prepared to lead organizations they join or start related to the subjects of mechanical engineering.
2. The graduates will engage in professional and extension activities in the field of mechanical engineering and its allied areas and contribute to the profession and society at large by pushing the frontiers in technology.
3. The graduates will be successful in higher education in mechanical and allied areas and in management, if pursued, leading to masters and research programs
4. The graduates will be, through this academic programme groomed as professional engineers

enabling them to contribute effectively to the growth and development of the knowledge body.

Programme Outcomes (POs)

1. **Engineering Knowledge:** Apply the knowledge of Mathematics, Science and Engineering Fundamentals, and an engineering specialization to solution of complex engineering problems.
2. **Problem formulation and Analysis:** Identify, formulate, research literature, and analyze engineering problems so that substantiated conclusions can be reached using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/ development of solutions:** Design of solution for engineering problems and identify/design of system components or processes that meet the specified needs with appropriate considerations of public health and safety, and cultural, societal, and environmental considerations.
4. **Conduct investigation of Complex problems:** Use of research-based methods including design of experiments, analysis and interpretation of data and synthesis of information leading to logical conclusions.
5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling related engineering activities with an understanding of limitations.
6. **Engineer and Society**: Apply reasoning within the contextual knowledge to access societal, health, safety, legal, and cultural issues and assume responsibilities of a professional engineering practitioner.
7. **Environment awareness and responsibility:** Understanding the impact of the professional engineering solutions in the environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments.
8. **Ethical behavior:** Apply ethical principle and show commitment towards professional ethics and responsibilities and norms of engineering practice.
9. **Individual and team work:** Function effectively as an individual independently and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on different engineering activities with the engineering community and with society at large such as being able to comprehend and write effective report and design documentation, make effective oral presentations, and give and receive clear instructions.
11. **Project Management and Finance:** Demonstrate knowledge and understanding of engineering management principles and apply those to one's own work as a member and leader of a team to manage projects in multidisciplinary environments.
12. **Life- long learning:** Recognize the need for, and have the preparation and ability to engage

in independent and life-long learning in the broadest context of new development. Can take masters and research program in the area and allied areas.

Program Specific Outcomes (PSOs)

PSO1: Shall have acquired the ability of entrepreneurship to start an industry based on mechanical engineering in the areas of production, manufacturing and allied areas.

PSO2: After graduation the graduate shall have gained the experience to be attracted toward design and consultancy.

PSO3: Shall have gained the knowledge to pursue higher level of understanding by way of research in relevant areas of mechanical engineering.

PSO4: Shall have gained the knowledge base to enable employment in infrastructure development.

Credits per Semester at a Glance

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	24	23	22	20	22	20	20	12	**163**

*** L**: Lectures, **T**: Tutorials; **P**: Practical; **C**: Credits; **Hrs**: Hours

B.TECH. (MECHANICAL ENGG.) I SEMESTER (Common to all branches)

	S. No.	Course Number	COURSE NAME	Course Type	Credits	L*	T	P	Hrs
I SEMESTER	1	AST-101	Communication Skills	HSMC	2	2	0	0	2
	2	ASB-101	Engineering Physics I	BSC	3	3	0	0	3
	3	ASB-102	Engineering Chemistry	BSC	3	3	0	0	3
	4	ASB-103	Engineering Mathematics I	BSC	3	3	0	0	3
	5	EES-101	Basics of Electrical Engineering	ESC	3	3	0	0	3
	6	CSS-101	Fundamentals of Computing	ESC	3	3	0	0	3
	7	ASM-101	Environmental Science	MC-I	2	2	0	0	2
	i	ASL-101	Language Laboratory	HSMC	1	0	0	2	2
	ii	ASL-102	Engineering Physics Laboratory I	BSC	1	0	0	2	2
	iii	ASL-103	Engineering Chemistry Laboratory	BSC	1	0	0	2	2
	iv	MEL-104	Engineering Graphics & Design	BSC	2	0	0	4	4
				Total	**24**	**19**	**0**	**10**	**29**
II SEMESTER	1	ASB-201	Engineering Physics II	BSC	3	3	0	0	3
	2	ASB-202	Engineering Mathematics II	BSC	3	3	0	0	3
	3	ASB-203	Biology for Engineers	BSC	3	3	0	0	3
	4	ECS-201	Basics of Electronics & Communication Engineering	ESC	3	3	0	0	3
	5	MES-201	Basics of Mechanical Engineering	ESC	3	3	0	0	3
	6	CES-201	Basics of Civil Engineering	ESC	3	3	0	0	3
	7	ASM-201	Constitution of India	MC-I	0 (Audit)	2	0	0	2
	i	ASL-201	Engineering Physics Laboratory II	BSC	1	0	0	2	2
	ii	MEL-201	Workshop Practice	ESC	2	0	0	4	4
	iii	MEL-202	Engineering Mechanics Laboratory	ESC	1	0	0	2	2
	iv	MEL-201	Design Thinking & Idea Lab	ESC	1	0	0	2	2
				Total	**23**	**20**	**0**	**10**	**30**

B.Tech. (Mechanical Engineering) Course Structure as per AICTE norms:

	S. No.	COURSE NUMBER	COURSE NAME	COURSE TYPE	Credits	L	T	P	Hrs
III SEMESTER	1	ASM-301	Universal Human Values	MC-II	3	3	0	0	3
	2	ASB-301	Engineering Mathematics III	BSC	3	3	0	0	3
	3	MEC-301	Mechanics of Solids	PCC	3	3	0	0	3
	4	MEC-302	Fluid Mechanics	PCC	3	3	0	0	3
	5	MEC-303	Manufacturing Processes	PCC	3	3	0	0	3
	6	MEC-304	Material Science	PCC	3	3	0	0	3
	7	ASM-302	Essence of Indian Traditional Knowledge	MC-IV (Audit)	0	2	0	0	2
	i	MEL-301	Mechanics of Solids Laboratory	PCC	1	0	0	2	2
	ii	MEL-302	Fluid Mechanics Laboratory	PCC	1	0	0	2	2
	iii	MEL-303	Manufacturing Processes Laboratory	PCC	1	0	0	2	2
	iv	MEL-304	Material Science Laboratory	PCC	1	0	0	2	2
				Total	**22**	**20**	**0**	**8**	**28**
	1	MEC-401	CAD and FEM	PCC	3	3	0	0	3
	2	MEC-402	Production Engineering-I	PCC	3	3	0	0	3
	3	MEC-403	Heat and Mass Transfer	PCC	3	3	0	0	3
	4	AST-401	Operations Research	HSMC (OEC I)	3	3	0	0	3
	5	AST-402	Economics	HSMC (OEC II)	3	3	0	0	3
	i	MEL-401	CAD, FEM and Computer aided Machine Drawing Laboratory	PCC	1	0	0	2	2
	ii	MEL-402	Production Engineering Laboratory	PCC	1	0	0	2	2
	iii	MEL-403	Heat & Mass Transfer Laboratory	PCC	1	0	0	2	2
	iv	ASL-401	Numeric and Scientific Computing Lab.	ESC	2	0	0	4	4
				Total	**20**	**15**	**0**	**10**	**25**
V SEMESTER	1	MEC-501	Advanced Fluid Mechanics & Control Engg.	PCC	3	3	0	0	3
	2	MEC-502	Applied Thermodynamics	PCC	3	3	0	0	3
	3	MEC-503	Theory of Mechanisms and Machines	PCC	3	3	0	0	3
	4	MEC-504	Design of Mechanical Components	PCC	3	3	0	0	3
	5	MEC-505	Production Engineering-II	PCC	3	3	0	0	3
	6	MEE-501	Mechatronics	PEC	3	3	0	0	3
	i	MEL-501	Instrumentation, Measurement & Control Laboratory	PCC	1	0	0	2	2
	ii	MEL-502	Theory of Mechanisms and Machines Laboratory	PCC	1	0	0	2	2
	iii	MEL-503	Design of Mechanical Components Practice Laboratory	PCC	1	0	0	2	2

	iv	MEL-504	Mechatronics Laboratory	PCC	1	0	0	2	2
				Total	**22**	**18**	**0**	**8**	**26**

	S. No.	COURSE NUMBER	COURSE NAME	COURSE TYPE	Credits	L	T	P	Hrs
VI SEMESTER	1	MEC-601	Fluid Machines	PCC	3	3	0	0	3
	2	MEC-602	Refrigeration and Air conditioning	PCC	3	3	0	0	3
	3	MEC-603	Design of Mechanical System	PCC	3	3	0	0	3
	4	MEC-604	Computer Aided Manufacturing	PCC	3	3	0	0	3
	5	MEE-601	Electro-Mechanical Energy Conversion	PEC	3	3	0	0	3
	i	MEL-601	Fluid Machines Laboratory	PCC	1	0	0	2	2
	ii	MEL-602	Refrigeration and Air Conditioning Lab	PCC	1	0	0	2	2
	iii	MEL-603	Design of Mechanical Systems Practice Laboratory	PCC	1	0	0	2	2
	iv	MEL-604	Computer Aided Manufacturing Lab	PCC	1	0	0	2	2
	v	MEP-601	Seminar (Literature Review)	PROJ	1	0	0	2	2
				Total	**20**	**15**	**0**	**10**	**25**
VII SEMESTER	1	MEE-701	Industrial Engineering	PEC	3	3	0	0	3
	2	MEE-702	I. C. Engines	PEC	3	3	0	0	3
	3	MEE-703	Machinery Dynamics & Vibration	PEC	3	3	0	0	3
	4	MEO-701	Elective (THERMAL & FLUID)	OEC	3	3	0	0	3
	i	MEL-701	Industrial Engineering Laboratory	OEC	3	3	0	0	3
	ii	MEL-702	Heat Engines & Solar Energy Laboratory						
	iii	MEL-703	Machinery Dynamics & Vibration Laboratory						
	iv	MEP-701	Summer Internship	PROJ	2	0	0	4	4
	v	MEP-702	Project	PROJ	3	0	0	6	6
				Total	**20**	**15**	**0**	**10**	**25**
VIII SEMESTER	1	MEO-801	Elective (Machine Design)	OEC	3	3	0	0	3
	2	MEO-801	Elective (Production & Industrial)	OEC	3	3	0	0	3
	i	MEP-801	Project	PROJ	6	0	0	12	12
				Total	**12**	**6**	**0**	**12**	**18**

***In case of semester long project work done in industry or internship, the OECs in VIII semester may be offered in online mode/NPTEL on SWAYAM.**

Minor Degree & Honors Degree

Honours Degree in Numerical Heat Transfer & Fluid Mechanics

IV Semester									
S. No.		**COURSE NO. & NAME**	**COURSE TYPE**		**Credits**	**L**	**T**	**P**	**HRS**
1	MEH-411	Advanced Thermodynamics	Theory		3	3	0	0	3
V Semester									
S. No.		**COURSE NO. & NAME**	**COURSE TYPE**		**Credits**	**L**	**T**	**P**	**HRS**
2	MEH-511	Computational Fluid Dynamics	Theory		3	3	0	0	3
i	MEL-521	Lab 1	Lab		1	0	0	2	2
VI Semester									
S. No.		**COURSE NO. & NAME**	**COURSE TYPE**		**Credits**	**L**	**T**	**P**	**HRS**
3	MEH-611	Numerical Methods in Heat Transfer	Theory		3	3	0	0	3
ii	MEL-621	Lab 2	Lab		1	0	0	2	2
VII Semester									
S. No.		**COURSE NO. & NAME**	**COURSE TYPE**		**Credits**	**L**	**T**	**P**	**HRS**
4	MEH-711	Turbomachines	Theory		3	3	0	0	3
iii	MEL-721	Lab 3	Lab		1	0	0	2	2
VIII Semester									
S. No.		**COURSE NO. & NAME**	**COURSE TYPE**		**Credits**	**L**	**T**	**P**	**HRS**
5	MEH-811	Advanced Fluid Mechanics	Theory		3	3	0	0	3
				Total	18	15	0	6	21

Honours Degree in Materials & Manufacturing

IV Semester									
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
1	MEH-421	Automation in manufacturing	Theory		3	3	0	0	3
V Semester									
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
2	MEH-521	Advanced materials	Theory		3	3	0	0	3
i	MEL-522	Lab 1	Lab		1	0	0	2	2
VI Semester									
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
3	MEH-621	Finishing and Superfinishing Processes	Theory		3	3	0	0	3
ii	MEL-622	Lab 2	Lab		1	0	0	2	2
VII Semester									
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
4	MEH-721	Additive manufacturing	Theory		3	3	0	0	3
iii	MEL-722	Lab 3	Lab		1	0	0	2	2
VIII Semester									

S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
5	MEH-821	Micro-nano manufacturing	Theory		3	3	0	0	3
				Total	18	15	0	6	21

Honours Degree in Tribology

IV Semester									
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
1	MEH-431	Introduction to Tribology	Theory		3	3	0	0	3
V Semester									
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
2	MEH-531	Tribology of Advanced Materials	Theory		3	3	0	0	3
i	MEL-523	Mechanical Properties of Composites Lab	Lab		1	0	0	2	2
VI Semester									
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
3	MEH-631	Condition Monitoring & Fault Analysis	Theory		3	3	0	0	3
Ii	MEL-623	Machine Condition Monitoring Lab	Lab		1	0	0	2	2
VII Semester									
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
4	MEH-731	Green & Nano Tribology	Theory		3	3	0	0	3
Iii	MEL-723	Tribological System Design Lab	Lab		1	0	0	2	2
VIII Semester									
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
5	MEH-831	Mechanics of Bio-tribology	Theory		3	3	0	0	3
				Total	18	15	0	6	21

Minor Degree in Engineering Management

		IV Semester							
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
1	MED-411	Financial Management	Theory		3	3	0	0	3
		V Semester							
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
2	MED-511	Supply chain Modelling and Management	Theory		3	3	0	0	3
I	MEL-524	Supply chain Modelling and Analytics Lab	Lab		1	0	0	2	2
		VI Semester							
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
3	MED-611	Technology Management	Theory		3	3	0	0	3
Ii	MEL-624	Project Management Lab	Lab		1	0	0	2	2
		VII Semester							
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
4	MED-711	Product Management	Theory		3	3	0	0	3
Iii	MEL-724	Data Science Lab	Lab		1	0	0	2	2
		VIII Semester							
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
5	MED-811	Marketing Management	Theory		3	3	0	0	3
				Total	18	15	0	6	21

Minor Degree in Design Thinking & Innovation

		IV Semester							
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
1	MED-421	Design Thinking	Theory		3	3	0	0	3
		V Semester							
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
2	MED-521	Human Centered Design	Theory		3	3	0	0	3
I	MEL-525	Design Thinking lab.	Lab		1	0	0	2	2
		VI Semester							
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
3	MED-621	Product Design I	Theory		3	3	0	0	3
Ii	MEL-625	Ideation Lab.	Lab		1	0	0	2	2
		VII Semester							
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
4	MED-721	Innovative Product Design	Theory		3	3	0	0	3
iii	MEL-725	Design Prototyping Lab.	Lab		1	0	0	2	2
		VIII Semester							
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
5	MED-821	Start-Up formation	Theory		3	3	0	0	3
				Total	18	15	0	6	21

Minor Degree in Robotics &Automation

		IV Semester							
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
1	MED-431	Introduction to Robotics	Theory		3	3	0	0	3
		V Semester							
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
2	MED-531	Mechatronics	Theory		3	3	0	0	3
I	MEL-526	Mechatronics Lab	Lab		1	0	0	2	2
		VI Semester							
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
3	MED-631	Hydraulic & Pneumatic Drives in Automation	Theory		3	3	0	0	3
Ii	MEL-626	Hydraulic & Pneumatic Lab	Lab		1	0	0	2	2
		VII Semester							
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
4	MED-731	Industrial Automation	Theory		3	3	0	0	3
Iii	MEL-726	Automation Lab	Lab		1	0	0	2	2
		VIII Semester							
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
5	MED-831	Robot Safety and Maintenance	Theory		3	3	0	0	3
				Total	18	15	0	6	21

Minor Degree in Robotics & AI

		IV Semester							
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
1	MED-441	Introduction to Robotics	Theory		3	3	0	0	3
		V Semester							
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
2	MED-541	Wireless Networks, Machine Learning & Microcontrollers	Theory		3	3	0	0	3
I	MEL-527	Microcontrollers & Robot Programming Lab	Lab		1	0	0	2	2
		VI Semester							
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
3	MED-641	Sensors -Actuators & Control systems for Robotics	Theory		3	3	0	0	3
Ii	MEL-627	Sensors -Actuators & Control systems Lab	Lab		1	0	0	2	2
		VII Semester							
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
4	MED-741	Hydraulic & Pneumatic Drives for Robots	Theory		3	3	0	0	3
Iii	MEL-727	Hydraulic & Pneumatic Lab	Lab		1	0	0	2	2
		VIII Semester							
S. No.		COURSE NO. & NAME	COURSE TYPE		Credits	L	T	P	HRS
5	MED-841	Advances in Robotics and Artificial Intelligence	Theory		3	3	0	0	3
				Total	18	15	0	6	21

PROGRAM ELECTIVES								
S. No.	**Course Number**	**COURSE NAME**	**Course Type**	**Credit**	**L**	**T**	**P**	**Hrs**
Machine Design								
1.	ME-801	Robotics	Program Elective II (Machine Design)	3	2	1	0	3
2.	ME-802	Engineering System Design Optimization						
3.	ME-803	Vehicle Dynamics						
4.	ME-804	Modal Analysis						
5.	ME-805	Introduction to Human Body Mechanics						
6.	ME-806	Innovative Product Design						
7.	ME-807	Fracture Mechanics						
8.	ME-808	Composite Materials						
9.	ME-809	Engineering Tribology						
10.	ME-810	Simulation of Mechanical Systems						
11.	ME-811	Artificial Intelligence and Robotics						
12.	ME-812	Machinery Fault Diagnostics &Signal Processing						
13.	ME-813	Applied Elasticity and Plasticity						
Thermal & Fluid								
1.	ME-704	Energy Sources	Program Elective I (Thermal & Fluid)	3	2	1	0	3
2.	ME-705	Environmental Pollution and Abatement						
3.	ME-706	Theory of Combustion and Emission						
4.	ME-707	Nuclear Power Generation and Supply						
5.	ME-708	Computational Fluid Dynamics						
6.	ME-709	Gas Dynamics						
7.	ME-710	Fuels and Combustion						
8.	ME-711	Cryogenics						
9.	ME-712	Design of Pump, Blowers and Fans						
10.	ME-713	Fluid Controls						
11.	ME-714	Design of Heat Exchanger Equipment						
12.	ME-715	Non-Conventional Energy Sources						
13.	ME-716	Environmental Engineering						
Production& Industrial								
1.	ME-830	Ergonomics	Program Elective III (Production& Industrial)	3	2	1	0	3
2.	ME-831	Welding Technology						
3.	ME-832	Supply Chain Management-Planning						
4.	ME-833	Quality Assurance and Reliability						
5.	ME-834	Non-Destructive Evaluation & Testing						
6.	ME-835	Technology of Surface Coating						
7.	ME-836	Quantity Production Methods						
8.	ME-837	Engineering Risk–Benefit Analysis						
9.	ME-838	Infrastructure Systems Planning						
10.	ME-839	Managing Innovation and Entrepreneurship						
11.	ME-840	Global Strategy and Technology						
12.	ME-841	Knowledge Management						
13.	ME-842	Mechanical Handling Systems &Equipment						
14.	ME-843	Maintenance Management						
15.	ME-844	Supportability and Life cycle analysis						

Course Syllabi

B.Tech.(Mechanical Engineering)

THIRD Semester

THIRD Semester

III Semester- Course Details

S. No.	COURSE NUMBER	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	ASM-301	Universal Human Values	Theory	MC-II	3	3	0	0	3
2	ASB-301	Engineering Mathematics III	Theory	BSC	3	3	0	0	3
3	MEC-301	Mechanics of Solids	Theory	PCC	3	3	0	0	3
4	MEC-302	Fluid Mechanics	Theory	PCC	3	3	0	0	3
5	MEC-303	Manufacturing Processes	Theory	PCC	3	3	0	0	3
6	MEC-304	Material Science	Theory	PCC	3	3	0	0	3
7	ASM-302	Essence of Indian Traditional Knowledge	Theory	MC-IV (Audit)	0	2	0	0	2
i	MEL-301	Mechanics of Solids Laboratory	Lab	PCC	1	0	0	2	2
ii	MEL-302	Fluid Mechanics Laboratory	Lab	PCC	1	0	0	2	2
iii	MEL-303	Manufacturing Processes Laboratory	Lab	PCC	1	0	0	2	2
iv	MEL-304	Material Science Laboratory	Lab	PCC	1	0	0	2	2
				Total	**22**	**20**	**0**	**8**	**28**

III Semester- Theory Courses

S. No.	COURSE NUMBER	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	ASM-301	Universal Human Values	Theory	MC-II	3	3	0	0	3
2	ASB-301	Engineering Mathematics III	Theory	BSC	3	3	0	0	3
3	MEC-301	Mechanics of Solids	Theory	PCC	3	3	0	0	3
4	MEC-302	Fluid Mechanics	Theory	PCC	3	3	0	0	3
5	MEC-303	Manufacturing Processes	Theory	PCC	3	3	0	0	3
6	MEC-304	Material Science	Theory	PCC	3	3	0	0	3
7	ASM-302	Essence of Indian Traditional Knowledge	Theory	MC-IV (Audit)	0	2	0	0	2

ASM-301	Universal Human Values	MC-II	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

This course explores the Universal Human Values, aiming to equip individuals with a foundational understanding of themselves, their relationships, society, and nature. It encourages self-exploration to recognize innate human aspirations and the means to fulfil them through right understanding and harmonious living at various levels. The course also touches upon personality assessments and basic health principles. Ultimately, it envisions the application of these values in professional ethics and the creation of a humanistic and sustainable world order.

COURSE OBJECTIVES:

1.	Develop a holistic perspective by understanding the interconnectedness of the individual, family, society, and nature.
2.	Gain self-awareness through self-exploration, recognizing their inherent human values and aspirations.
3.	Understand the foundations of harmonious relationships based on trust, respect, and other universal human values.
4.	Develop an understanding of the harmony in nature and the importance of co-existence and sustainability.
5.	Inculcate ethical human conduct and its relevance in personal and professional life, envisioning a humanistic world order.

PREREQUISITES: NIL

CONTENT:

Unit I **Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; Personality Traits- Self Excellence, "Natural Acceptance" and Experiential Validation- as the process for self-exploration, Adaptability, Belief and Understanding- Self discipline
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.
7. Myers-Briggs Type Indicator (MBTI) Personality test

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

Unit II **Understanding Harmony in the Human Being - Harmony in Myself!**

1. Understanding human being as a co-existence of the sentient „I‟ and the material „Body‟
2. Understanding the needs of Self („I‟) and „Body‟ - happiness and physical facility
3. Understanding the Body as an instrument of „I‟ (I being the doer, seer and enjoyer)- Habits and Hobbies, SWOT Analysis (Activity)
4. Understanding the characteristics and activities of „I‟ and harmony in „I‟– Dalai Lamas‟ Tibetan Personality Test – Dr. Menninger‟s Psychometric Test.
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure Sanyam and Health.
7. Epidemiology- Definition of health, Social and Preventive Medicine, Personal hygiene and handling stress, WHO Guidelines

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one‟s own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

Unit III **Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship**

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, Friends and Foes, Empathy, False Prestige.
4. Concept of an Ideal family- Marriage as an Institution
5. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
6. Visualizing a universal harmonious order in society- Undivided Society, Universal Human Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students‟ lives

Unit IV **Understanding Harmony in the Nature and Existence - Whole existence as Coexistence**

1. Understanding the harmony in the Nature and its Equanimity, Respect for all, Nature as Teacher
2. Interconnectedness and mutual fulfillment among the four orders of nature-recyclability and self-regulation in nature
3. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
4. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Unit V **Implications of the above Holistic Understanding of Harmony on Professional Ethics**

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Vision for the Holistic alternatives, UHVs for entrepreneurship
7. Strategy for transition from the present state to Universal Human Order:
   (a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers,
   (b) At the level of society: as mutually enriching institutions and organizations – Right understanding and dilemmas of professional ethics in today's world.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions, e.g. To discuss the conduct as an engineer or scientist etc.

TEXTBOOKS:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

REFERENCE BOOKS:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)
14. Life Skills by KVSG Murali Krishna

COURSE OUTCOMES (COs):

CO1	Will be able to understand and analyze the essentials of human values and skills, self-exploration, happiness and prosperity.

CO2	Will be able to evaluate coexistence of the "I" with the body.
CO3	Will be able to identify and evaluate the role of harmony in family, society and universal order.
CO4	Will be able to understand and associate the holistic perception of harmony at all levels of existence.
CO5	Will be able to develop appropriate technologies and management patterns to create harmony in professional and personal lives.

ASB-301	Engineering Mathematics III	BSC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

This course explores advanced mathematical concepts, including multiple integrals, vector calculus, Laplace and Fourier transforms, difference equations, and higher calculus. It focuses on practical applications in physics and engineering, such as calculating areas, volumes, mass distribution, and solving differential and boundary value problems.

COURSE OBJECTIVES:

To understand Mathematics for Solving Engineering Problems

PREREQUISITES:

Engineering Mathematics – I & II, AS-104 & IIT Objective, Mathematics and handling of Scientific Calculator

CONTENT:

Unit I Application of Multiple integrals and Vector Calculus: Application of Double and Triple integrals (two dimensional Cartesian, polar Coordinates; three dimensional Cartesian, cylindrical and spherical coordinates) in finding the plane area, mass, centre of gravity, moment of inertia, product of inertia, centre of pressure, curved surface area and volume. Problems of Green's theorem in x-y plane, Gauss divergence theorem, stoke's curl theorem (Cartesian form without proofs)

Unit II Application of Laplace Transforms: Application of Laplace Transforms in finding the particular solutions of ordinary linear differential equations of higher order with constant and variable coefficients, system of simultaneous differential equations, integral equations, integro-differential equations and differential equations.

Unit III Fourier series and Fourier Transforms: Fourier's series (full range and half range) for arbitrary period, Representations of a function in terms of Fourier integral, Fourier Sine integral and Fourier Cosine integral, infinite complex Fourier transform, finite and infinite Fourier Sine and Cosine transforms and their inverse transforms, Properties of transforms and associated theorems and their application in integral equations and boundary value problems.

Unit IV Difference Equations and Z-Transforms: Complementary function, particular integral and general solution of linear difference equations with constant and variable coefficients; Z-transforms, inverse Z-transforms and their application in particular solutions of linear difference equations with constant coefficients and simultaneous difference equations.

Unit V Higher Calculus: Extremals of functional (by means of Euler-Poisson equations), Isoperimetric problems, Beta and Gamma functions, Fractional derivative, Dirichlet's and Lowville's multiple integrals, Representation of a definite integral in Legendre and Jacobi forms of Elliptic integrals of First, second and third kinds.

TEXTBOOKS:

1. A Textbook of Engineering Maths. & Advanced Engineering Mathematics by A.B. Mathur & V.P. Jaggi, Khanna Publisher

2. Elementary Engineering Maths & Higher Engineering Maths by B.S. Grewal, Khanna Publishers.
3. Advanced Engineering Mathematics by Erwin Kreyszig, John Willey and Sons, Inc.

REFERENCE BOOKS:

1. Higher Engineering Mathematics by B.V. Ramana, Tata Mc-Graw Hill
2. Advanced Engineering Mathematics by R.K. Jain and S.R.K. Vol. I & II BY Rakesh Dubey, Narosa, Publishing House.

Computer Usage / Software required:

- MATLAB, EXCEL, MAXIMA, MATHEMATICA, etc.

Other details regarding this course:

- Problem solving will enable students to become better engineers.

COURSE OUTCOMES (COs):

CO1	Understanding solid geometry and methods of evaluation of multiple integrals.
CO2	Studying various methods of ordinary and partial differential equations.
CO3	Analysis of Complex Functions.
CO4	Building basics and applying Laplace transforms.
CO5	Studying Infinite series and their convergent and divergent behavior.

MEC-301	Mechanics of Solids	PCC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

This course is to serve as an introduction to mechanics of deformable solid bodies. The primary course objective is to equip the students with the tools necessary to solve mechanics problems, which involves:

- Review and application of the principles of static equilibrium to the analysis of structures such as pressure vessels, beams, and torsion members.
- Analysis of different types of stresses and strains within various structures.
- Formulation of solutions to problems requiring the application of stress-strain relationships, strain rosettes and the physical properties of materials.

COURSE OBJECTIVES:

1	Review and apply the principles of static equilibrium to the analysis of structures such as beams, and torsion members
2	Formulate solutions to problems requiring the application of suitable stresses and strains.
3	To acquire knowledge of mechanical testing and measurement of stresses and strains.

PREREQUISITES:

- Engineering Mechanics
- Elements of Civil Engineering

CONTENT:

Unit I Introduction: Concept of stress at a point, Principal stress and strain due to combination of stresses. Elastic Constants.
Torsion: Stresses and strains in pure torsion of solid circular shafts and hollow circular shafts. Derivation of Torsion Equation. Power transmitted by shafts; combined bending and torsion. Composite shaft-series connection.
Free-body diagrams.

Unit II Shear force & Bending Moment: Types of beams, Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, UDL, uniformly varying loads and combination of these loads. Concept of Shear Centre.
Flexural Stresses: Theory of simple bending, Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections.

Unit III Deflection of Beams: Area moment method. Application of area moment method to cantilever, simply supported and indeterminate beams. Advantages and disadvantage of fixed and continuous beams. Macaulay method. Castigliano's theorem and calculations of deflection of beams under single and several loads.

Unit IV Columns & Struts: Stability of columns. Critical loads for columns under different end conditions. Euler's and Secant formulae. Rankine formula. Design of columns under centric load Eccentrically loaded columns and their design. Kernel of a section. Laterally loaded columns.

Unit V Experimental Stress Analysis: Effect of strain gradient, Strain Sensitivity, Types of

	strain gauges: Characteristics & Applications, Temperature strains. Gauge factor. Strain Rosette: Types of Strain Rosettes and their Analysis. Material properties and Testing: Properties in tension, shear and compression. Testing of Hardness and Impact Strength.

TEXTBOOKS:

1. Introduction to Solid Mechanics by Shames, Prentice Hall of India Pvt. Ltd
2. Mechanics of Solids by Abdul Mubeen, Pearson Education

REFERENCE BOOKS:

1. Experimental Stress Analysis by Dally & Riley, McGraw -Hill Book Co.
2. Advanced Mechanics of Materials by Steel and Smith, John Wiley and Sons
3. Engineering Mechanics of Solids by Egor P Popov, Pearson Education India; 2nd edition (January 2015)
4. Experimental Stress Analysis by Abdul Mubeen, Dhanpat Rai and Sons.

Computer Usage / Software required:
ANSYS, SOLIDWORKS, MATLAB, CATIA.

Other details regarding this course

- Practice Problems using MATLAB

COURSE OUTCOMES (COs):

CO1	Will be able to determine different types of stresses and strains of various parts.
CO2	Will be able to determine shear force, bending moment, flexural and bending stresses of various parts.
CO3	Will be able to apply different theories of deflection to determine deflection of beams
CO4	Will be able to analyze the columns under different loading and end conditions.
CO5	Will be able to determine strains using different experimental methods.

MEC-302	Fluid Mechanics	PCC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

This course provides a comprehensive study of fluid mechanics, encompassing fundamental principles, analytical methods, and engineering applications. It covers the classification and properties of fluids, fluid statics, buoyancy, and rigid-body motion. Fluid kinematics and kinetics are examined through velocity fields, stream functions, vorticity, and governing equations such as Euler's and Bernoulli's equations. The course further explores flow measurement techniques, pipe flow analysis, dimensional analysis using Buckingham Pi theorem, and similitude. Additionally, open-channel flow concepts, including Chezy's formula, specific energy, and hydraulic jump, are discussed to develop a foundational understanding of fluid behavior in various engineering applications.

COURSE OBJECTIVES:

Knowledge and understanding of the basic principles and concepts of fluid mechanics are essential to analyse any system in which a fluid is the working medium. The design of all means of transportation requires application of the principles of fluid mechanics. In recent years Vehicle manufacturers have given more consideration to aerodynamic design. The design of propulsion systems for space flight is based on the principles of fluid mechanics. It is commonplace today to perform model studies to determine the aerodynamic forces on, and flow fields around, buildings and structures.

PREREQUISITES:

- Vector algebra and calculus,
- Differential equations,
- Particle and rigid body dynamics, and
- Thermodynamics.

CONTENT:

Unit I Introduction, Review of basic concepts and Fluid Properties, Basic laws of Fluid Motion, Internal Stresses and External forces on Fluid Element.
Fluid Kinematics: The velocity field, Types of fluid flow, The substantial derivative, Acceleration field of a fluid, The stream function, Equation of streamline, Translation, Rotation and Rate of deformation, Angular velocity, Vorticity, Circulation, Velocity potential function, Irrotational flows, Differential equation of conservation of mass.

Unit II **Ideal Fluid Flow:** Euler's equation of motion, Generalized form of Bernoulli's equation, Limitations, Bernoulli equation versus Steady flow energy equation (SFEE). Elementary plane flows, uniform flow, source, sink, vortex and doublet, Superposition of elementary plane flows; flow past a half-body, flow past a Rankine body, flow past a cylinder, flow past a rotating cylinder, Magnus effect, Aerofoil theory.

Unit III **Applications of Bernoulli's equation:** Flow through Orifice and Mouthpiece, Hydraulic coefficients, Velocity and Discharge measurement devices; Pitot-static tube, Venturi-meter, Nozzle-meter, Orifice-meter, Elbow-meter, Notches and Weirs, Impact of free jets.

Unit IV **Flow through pipes:** Fully developed flow, The Reynolds number, Laminar and turbulent flows, Laminar flow in pipe, Smooth and rough pipes, Pressure drop and head loss, Major and minor losses, The Moody's chart, Pipes in series and parallel, Hydraulic power transmission, Pipe flow problems.

Unit V	**Dimensional analysis and similitude:** Nature of dimensional analysis, Buckingham Pi theorem, determining the Pi groups, Significant dimensionless groups in Fluid Mechanics. Concept and types of Similarity, Modelling and Similitude. **Open-channel flow:** Chezy's formula, Specific energy, Critical depth, Hydraulic jump.

TEXTBOOKS:

1. Introduction to Fluid Mechanics by Fox & McDonald, John Wiley & Sons, Inc.
2. Fluid Mechanics by Frank M White, Tata McGraw-Hill Pub. Company Ltd.

REFERENCE BOOKS:

1. Introduction to Fluid Mechanics by Fox & McDonald, John Wiley & Sons, Inc.
2. Fluid Mechanics by Frank M White, Tata McGraw-Hill Pub. Company Ltd.
3. Fluid Mechanics and Its Applications by Vijay Gupta & Santosh K Gupta, New Age Int. Publishers.
4. Introduction to Fluid Mechanics and Fluid Machines by S K Som & G Biswas, Tata McGraw-Hill Pub.
5. Fluid Mechanics by Yunus A. Cengel & John M. Cimbala, McGraw-Hill Education Pvt. Ltd.

Computer Usage / Software required:

- MATLAB, EXCEL, EES etc.

Other details regarding this course:

- This is a basic course on fluid mechanics

COURSE OUTCOMES (COs):

CO1	Will be able to analyze fluid properties, fluid statics, kinematics, and dynamics to describe fluid motion and related stresses.
CO2	Will be able to apply Bernoulli's equation and Euler's equations to ideal and real fluid flows, including applications to aerofoils and practical flow problems.
CO3	Will be able to determine discharge, velocity, and energy loss using flow measuring devices such as Venturi-meter, orifice-meter, notches, weirs, and Pitot tubes.
CO4	Will be able to evaluate laminar and turbulent flows in pipes, compute major and minor losses, and analyze hydraulic power transmission systems.
CO5	Will be able to apply dimensional analysis, similitude, and open-channel flow principles for modelling and solving practical fluid flow problems.

MEC-303	Manufacturing Processes	PCC	L	T	P	C
		3Hrs	3	0	0	3

COURSE OBJECTIVE:

To understand and analyse the major manufacturing processes including cutting, casting, joining and their supporting tools.

PREREQUISITES:

- Workshop Practice

CONTENT:

Unit I Introduction: Machine tool: Classification and function, operations and working principles. Basic elements of machine tool; Machine tool drives. Types of Machine tools, Machine Axes, Power, Drives, Slides, Cutting Fluids, Tool Geometry, Tool Material and Machinability.

Unit II Lathe and Milling: Tools, Classification, tool geometry, speed, feed and depth of cut, effect of machining parameters on surface roughness. Lathe operations; Facing, Turning, shouldering of cylindrical shapes, drilling, reaming, boring, taper turning by different methods, thread cutting, method of cutting multiple thread.
Milling Machine, working principle, milling operations (slab, end, slot milling), cutting speed and feed, estimating machining time, different types of indexing methods.

Unit III Welding: Different types of welding; welding principle, principles of fusion welding, Heat Source. Emission and ionization of electric arc, Arc structure, Characteristic and power of electric arc, Modes of metal transfer in Arc welding. TIG, MIG, Resistance, Electro-slag, spot, Thermit, Friction stir welding and Laser beam welding.

Unit IV Casting Processes: Introduction, Pattern and mould, Pattern allowances, types of patterns, types of mould, Testing of moulding sand, Preparation of mould, various stages in casting processes. Different types of casting processes (Die, Centrifugal, Continuous, and investment casting).

Unit V Gating and risering system design with numerical problems. Solidification process, Microstructure, Defects, Non-Destructive Testing and Post heat treatment processes in Casting and Welding.

TEXTBOOKS:

1. Manufacturing Science-A. Ghosh and A.K. Malik, Affiliated East Press, New-Delhi.

REFERENCE BOOKS:

1. Campbell, J.S., Principles of Manufacturing Materials and Processes, McGraw-Hill, New-York,
2. De Garmo, E.P., Materials and Processes in Manufacturing, Collier Macmillan, New York.
3. Lindberg, R.A., Processes and Materials of Manufacturing, Allyn and Bacon, Boston, 1
4. Schey, J.A., Introduction to Manufacturing Processes, McGraw-Hill, New-York.

Other details regarding this course:

- Visit to manufacturing organization will help broaden the horizon.

COURSE OUTCOMES (COs):

CO1	Will be able to comprehend various metal cutting operations and working principles of machine tools.
CO2	Will be able to identify and apply the different machining operations using lathe and milling machines in producing a product.
CO3	Will be able to identify and apply the material joining process using different welding processes.
CO4	Will be able to understand the different casting processes and recommend suitable process for different products.
CO5	Will be able to design gating and rising system for different types of mould and apply the post treatments.

MEC-304	Material Science	PCC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

COURSE DESCRIPTION:

This course covers fundamental and advanced concepts in thermodynamics and its applications in power cycles, turbines, compressors, and internal combustion engines. It begins with a review of thermodynamic laws, energy conservation, and entropy analysis. Various thermodynamic cycles, including Carnot, Otto, Diesel, and Rankine cycles, are explored along with steam power plant operations. The course also examines steam turbines, condensers, compressors, and their performance characteristics. Additionally, it discusses internal combustion engines, combustion phenomena, fuel requirements, and engine performance calculations.

COURSE OBJECTIVES:

- To establish the basic structure/property relationships in materials through an exploration of bonding, crystalline structure, defects and diffusion phenomena. •
- To gain an understanding of properties, processing, and applications of metallic, ceramic, polymeric and electronic materials.

PREREQUISITES:

- Physics and Chemistry

CONTENT:

Unit I	**Introduction**: Materials, their type, properties and application. Crystalline and Amorphous metals, Common crystal structures, Atomic packing factor and density. Bravais lattice and Miller indices. Imperfections, Defects & Dislocations concept of slip in pure and real crystals, role of dislocation, Schmids factors and strengthening mechanism in crystalline materials.
Unit II	**Ferrous materials**: Alloying of Iron, Fe-C and Fe-Fe3C phase diagram, Various types of carbon steels, alloy steels and cast irons, its properties and uses. Non-Ferrous metals and alloys: Non-ferrous metals such as Cu, Al, etc. and their applications. Various type Brass, Bronze, bearing materials, and Super Alloys. Comparative study of microstructure of various metals & alloys such as Mild steel, CI, Brass. Phase Diagram and Equilibrium Diagram: Uniary and Binary diagrams, Phase rules. Types of equilibrium diagrams: Solid solution type, eutectic type and combination type. Iron-carbon equilibrium diagram. Time Temperature Transformation (TTT) diagrams.
Unit III	**Mechanical properties and Testing**: True and Engineering Stress strain diagrams, Ductile & brittle material. Toughness, Hardness, Fracture, Fatigue and Creep. Tensile testing, Strength testing, Hardness testing, Impact testing, Fatigue testing Creep testing, Non-destructive testing (NDT). Micro structural Exam: Principle of optical Microscopy Preparation of samples and Microstructure examination and grain size determination. Heat Treatment: Various types of heat treatment such as Annealing, Normalizing, Quenching, Tempering, Case and age hardening.
Unit IV	**Ceramics**: Structure types and properties and applications of ceramics. Mechanical/Electrical behaviour. Plastics: Various types of polymers/plastics and their applications. Mechanical behaviour and processing of plastics. Future of plastics.

	Composite Materials: Types of composites, fibre and particle reinforced composites and their uses. Brief introduction to Smart materials Refractory materials.
Unit V	**Magnetic properties**: Concept of magnetism – Dia, para, ferro, magnetism Hysteresis. Soft and hard magnetic materials, Magnetic storages. Electric properties: Energy band concept of conductor, insulator and semi-conductor. Intrinsic & extrinsic semi-conductors.

TEXTBOOKS:

1. W.D. Callister, Jr, – Material Science & Engineering Addition-Wesley Publication.

REFERENCE BOOKS:

1. Van Vlash – Elements of Material Science & Engineering John Wiley & Sons.
2. V. Raghvan – Material Science, Prentice Hall.
3. Narula – Material Science, TMH.

COURSE OUTCOMES (COs):

CO1	Will be able to understand the different materials and corelate material structure with the properties.
CO2	Will be able to conduct comparative analysis of different ferrous and non-ferrous metal and alloys for suitability for a particular application.
CO3	Will be able to perform various material property tests.
CO4	Will be able to conduct comparative analysis of different types of ceramics, polymers, composite materials and refractory.
CO5	Will be able to understand and interpret different material properties (magnetic, electric) on the performance.

ASM-302	Essence of Indian Traditional Knowledge	MC-IV	L	T	P	C
		3Hrs	2	0	0	2

COURSE DESCRIPTION:

The course Essence of Indian Traditional Knowledge (ASB-302) provides a comprehensive understanding of India's classical knowledge systems and their continued relevance in the modern world. It examines ancient centres of learning, Ayurveda, architecture, astronomy, science, and Sufi traditions, situating them within historical, cultural, and philosophical frameworks. Emphasizing critical inquiry, comparative perspectives, and interdisciplinary engagement, the course aligns with the National Education Policy (NEP) 2020 by promoting holistic education, cultural rootedness, and intellectual appreciation of India's heritage in a global context.

COURSE OBJECTIVES:

The objective of this course is to:

1.	**Explain and contextualize** the nature, scope, and historical significance of Indian traditional knowledge systems across education, healthcare, architecture, science, and spiritual traditions.
2.	**Critically analyze and evaluate** the philosophical, cultural, and scientific contributions of these traditions, assessing their relevance in contemporary society.
3.	**Apply and synthesize** insights from traditional knowledge systems to develop holistic, interdisciplinary perspectives.

PREREQUISITES:

- Basic familiarity with Indian history and culture at the school level.
- Ability to comprehend and communicate ideas in English at an undergraduate academic level.

CONTENT:

Unit I Introduction to Traditional Knowledge Systems

1. Concept of Indian Traditional Knowledge (ITK)
    - Nature and characteristics
    - Scope and importance in contemporary context
2. Ancient Schools of Education
    - Nalanda: features, subjects taught, global influence, alumni
    - Takshashila: features, curriculum, notable scholars and visitors
    - Other centres of learning
3. Kautilya's Classification of Schools
    - Trayi (Vedas, rituals, spiritual knowledge)
    - Varta (trade, agriculture, commerce)
    - Danda-niti (politics, governance, law)
    - Anviksiki (logic, philosophy, critical inquiry)

Unit II Ayurveda and Holistic Healthcare

1. History and Origins of Ayurveda
    - Foundational texts (Charaka Samhita, Sushruta Samhita)
    - Principles of balance and doshas
2. Scope and Significance
    - Preventive and curative aspects
    - Ayurveda's role in public health
3. Contemporary Relevance
    - Integration into modern healthcare
    - Holistic and global recognition

Unit III

Ancient Indian Architecture

1. Historical Development
    - Indus Valley to Classical Indian architecture
    - Temples, stupas, forts, palaces
2. Importance and Symbolism
    - Cultural, religious, and philosophical meaning
3. Modern Perspective
    - Continuities in design and eco-friendly architectural wisdom

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Unit IV

Astronomy, Astrology, and Science & Technology

1. Astronomy and Vedic Astrology
    - Conceptual foundations
    - Role in daily life and rituals
2. Planetary Movements and Cosmology
    - Solar-centric world and heliocentrism in Indian thought
    - Shape and diameter of Earth
3. Ancient Indian Contributions to Science & Technology
    - Mathematics (zero, decimals, algebra)
    - Metallurgy, medicine, engineering innovations

Unit V

Sufism and Spiritual Traditions

1. Sufism in India
    - Historical emergence and role
    - Core principles and practices
2. Cultural and Social Impact
    - Music (Qawwali, Sufi poetry)
    - Poetry as philosophy and devotion
3. Dhyaan (Meditation) and Mysticism
    - Indian traditions of meditation
    - Influence on art, music, and literature

TEXTBOOKS:

1. Knowledge Traditions Practices Of India Part-1 Textbook for Class XI- NCERT

2. An Essence of Indian Traditional Knowledge by Dr.S.MD.Azash, Dr. Mamatha G.M, Dr. M A Shah

REFERENCE BOOKS:

1. Cultural Heritage of India by Satish Chandra & S. P. Gupta
2. Traditional Knowledge in Indian Society by Amitabha Sarkar, A. V. Arakeri, and Suresh Patil

COURSE OUTCOMES (COs):

CO1	Describe the scope, nature, and historical significance of Indian traditional knowledge systems, including education, Ayurveda, architecture, science, and spiritual traditions.
CO2	Explain and illustrate the contributions of ancient Indian institutions such as Nalanda, Takshashila, and the role of Ayurveda, architecture, astronomy, and Sufism.
CO3	Analyze the philosophical, cultural, and scientific principles embedded in Indian traditional knowledge systems, and their continuing relevance in the modern world.
CO4	Evaluate the impact of Indian knowledge traditions on contemporary global discourses in science, healthcare, architecture, and spirituality.
CO5	Integrate and synthesize insights from traditional systems to develop holistic and interdisciplinary perspectives in alignment with NEP 2020.

III Semester- Laboratory Courses

S. No.	COURSE NUMBER	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
i	MEL-301	Mechanics of Solids Laboratory	Lab	PCC	1	0	0	2	2
ii	MEL-302	Fluid Mechanics Laboratory	Lab	PCC	1	0	0	2	2
iii	MEL-303	Manufacturing Processes Laboratory	Lab	PCC	1	0	0	2	2
iv	MEL-304	Material Science Laboratory	Lab	PCC	1	0	0	2	2

MEL-301	Mechanics of Solids Laboratory	PCC	L	T	P	C
		2Hrs	0	0	2	1

COURSE OBJECTIVES:

1.	Understand crystal structures, Bravais lattices, and their influence on material properties.
2.	Examine microstructures and the effects of heat treatment on material properties.
3.	Develop practical skills in operating mechanical testing equipment for evaluating material behavior.

LIST OF EXPERIMENTS:

1.	To draw the Free-body diagrams of the given Mechanical systems.
2.	To find and compare the angle of twist of a ductile and brittle material using Torsion Testing Machine.
3.	To draw the stress strain diagram and find the ultimate tensile strength of the given specimen using Hounsfield Tensometer.
4.	To find the Shear force and bending moment of a simply supported beam using simulation
5.	To find the shear strength of the given material using Hounsfield Tensometer
6.	To Find the bending strength of the given specimen using Hounsfield Tensometer.
7.	To find the and compare the Rockwell Hardness of different Engineering materials using Rockwell Hardness Tester
8.	To find the impact strength of the given specimen using Charpy and Izod Testing Machine.
9.	To apply and test the continuity of an electrical wire strain gage.
10.	To find the critical load of a column with four different types of end supports using simulation.

REFERENCE BOOKS:

1. Introduction to Solid Mechanics by Shames, Prentice Hall of India Pvt. Ltd
2. Experimental Strength of Materials by Abdul Mubeen, Khanna Publishers

COURSE OUTCOMES (COs):

CO1	Will be able to formulate and evaluate the parameters of the Torsion Equation
CO2	Will be able to apply the concept of Shear force and Bending moment and formulating flexural and bending stresses using simulation techniques.
CO3	Will be able to apply the concept of columns and design it using simulation.
CO4	Will be able to determine the different types of mechanical properties of different materials.
CO5	Will be able to measure strain using strain gages under different configuration of strain rosettes.

MEL-302	Fluid Mechanics Laboratory	PCC	L	T	P	C
		2Hrs	0	0	2	1

COURSE OBJECTIVES:

1.	To understand fundamental fluid flow phenomena by visualizing different flow regimes, stability of floating bodies, and energy principles.
2.	To develop experimental skills in determining flow parameters such as discharge coefficients, velocity profiles, and frictional characteristics.
3.	To apply theoretical principles of fluid mechanics through laboratory experiments and validate them with experimental data.

LIST OF EXPERIMENTS:

1.	To visualize a fluid flow using Reynolds experiment and distinguish a laminar and turbulent flow
2.	To study the stability of a floating body and determine its metacentric height.
3.	To verify the Bernoulli's theorem by evaluating different components of mechanical energy possessed by flowing fluid
4.	To find the coefficient of discharge for a Venturi-meter and draw its calibration chart.
5.	To find the coefficient of discharge for an Orifice-meter and draw its calibration chart.
6.	To find the coefficient of discharge for a Triangular notch and draw its calibration chart.
7.	To find the coefficient of discharge for a rectangular notch and draw its calibration chart.
8.	To draw a velocity profile in pipe flow for laminar and turbulent conditions using Pitot-static tube.
9.	To study the frictional characteristics of a fully developed laminar and turbulent flow in pipeline.
10.	To evaluate the performance parameters, namely, coefficient of velocity, coefficient of discharge and coefficient of contraction for a free jet flowing through an orifice.

REFERENCE BOOKS:

1. Fluid Mechanics by Yunus A. Cengel& John M. Cimbala, McGraw-Hill Education Pvt. Ltd.
2. Fluid Mechanics and Its Applications by Vijay Gupta & Santosh K Gupta, New Age Int. Publishers.

COURSE OUTCOMES (COs):

CO1	Will be able to visualize the different fluid flows using Reynolds experiment and will be able to distinguish between laminar and Turbulent flows.
CO2	Will be able to establish the stability condition of floating bodies using the concept of meta-centric height.
CO3	Will be able to verify the Bernoulli's theorem.
CO4	Will be able to experimentally determine the coefficient of discharge for venture meter, orifice meter, triangular notch and rectangular notch.
CO5	Will be able to generate velocity profile and determine the functional characteristics of flow in pipes.

MEL-303	Manufacturing Processes Laboratory	PCC	L	T	P	C
		2Hrs	0	0	2	1

COURSE OBJECTIVES:

1.	Acquire hands-on skills in performing various metal cutting operations using machine tools.
2.	Develop the ability to estimate machining time and measure key tool geometry parameters.
3.	Identify ferrous materials through spark testing and understand the use of work/tool holding devices

LIST OF EXPERIMENTS:

1.	To estimate machining time for turning using two different process plans and to compare it with the actual machining time.
2.	To estimate machining time for shaper machine using two different process plans and to compare it with the actual machining time.
3.	To Perform single start and multi start thread cutting operation on lathe machine.
4.	To perform drilling and boring operations on lathe machine.
5.	To study in detail the various work and tool holding devices.
6.	To measure different angels of a single Point cutting tool with the help of combination sets.
7.	To classify given specimens of ferrous materials by spark test on a grinding machine.
8.	To study the different types of single point and multipoint cutting tools.

REFERENCE BOOKS:

1. Manufacturing Engineering and Technology, Serope Kalpakjian , Pearson Education; Seventh edition (2018)
2. Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Mikell P. Groover, John Wiley & Sons; 4th Edition (2010)

COURSE OUTCOMES (COs):

CO1	Will be able to estimate the machining time for different machining operations.
CO2	Will be able to perform different metal cutting operations on different machine tool.
CO3	Will be able to conduct measurements of different tool angles of single point/Multi-point cutting tool.
CO4	Will be able to classify given specimen of ferrous materials by spark test.
CO5	Will be able to understand the application of various work and tool holding devices.

MEL-304	Material Science Laboratory	PCC	L	T	P	C
		2Hrs	0	0	2	1

COURSE OBJECTIVES:

1.	To understand crystal structures, crystallographic parameters, and their influence on material properties through experimental models.
2.	To develop skills in metallographic specimen preparation, microstructural analysis, and evaluation of grain size and distribution in metals and alloys.
3.	To analyze the effects of heat treatment processes and mechanical testing on the microstructure and properties of engineering materials.

LIST OF EXPERIMENTS:

1.	To study the crystalline structure of BCC, FCC and HCC using ball models.
2.	To find the APF and CN of BCC, FCC and HCC structured material.
3.	To study the Bravais Lattices and evaluate the miller indices with the help of models.
4.	To prepare microstructure specimen by following standard metallographic procedure.
5.	To study the microstructure, grain size and grain distribution of metals and alloys specimens.
6.	To study the microstructure, grain size and grain distribution of welded joint.
7.	To study the effect of heat treatment processes (hardening, tempering and quenching) on microstructure, grain size and grain distribution of (i)- High carbon steel (ii) - Medium carbon steel
8.	To study the effect of heat treatment on material properties (hardness, Tensile strength) of (i)- High carbon steel (ii) - Medium carbon steel
9.	To determine the hardness of specimens (MS, Al- alloy, Cu- alloy and Stainless steel) using Rockwell hardness testing machine.
10.	To study the Fe-C diagram.

REFERENCE BOOKS:

1. W.D. Callister, Jr, – Material Science & Engineering Addition-Wesley Publication.
2. V. Raghvan – Material Science, Prentice Hall.

COURSE OUTCOMES (COs):

CO1	Will be able to understand and detrimne APF, CN, Bravais Lattices and miller indices of different structured material.
CO2	Will be able to prepare microstructure specimen by following standard metallographic procedure.
CO3	Will be able to study microstructure, grain size and grain distribution of metal alloys and welded joint.
CO4	Will be able to effect of heat treatment on microstructure, grain size and grain distribution of (i)- High carbon steel (ii) - Medium carbon steel and material properties (hardness, Tensile strength) of (i)- High carbon steel (ii) - Medium carbon steel
CO5	Will be able to determine the hardness of specimens (MS, Al- alloy, Cu- alloy and Stainless steel) using Rockwell hardness testing machine.

Course Syllabi

B.Tech.(Mechanical Engineering)

FOURTH Semester

IV Semester- Course Details

S. No.	COURSE NUMBER	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	MEC-401	CAD and FEM	Theory	PCC	3	3	0	0	3
2	MEC-402	Production Engineering-I	Theory	PCC	3	3	0	0	3
3	MEC-403	Heat and Mass Transfer	Theory	PCC	3	3	0	0	3
4	AST-401	Operations Research	Theory	HSMC (OEC I)	3	3	0	0	3
5	AST-402	Economics	Theory	HSMC (OEC II)	3	3	0	0	3
I	MEL-401	CAD, FEM and Computer aided Machine Drawing Laboratory	Lab	PCC	1	0	0	2	2
Ii	MEL-402	Production Engineering Laboratory	Lab	PCC	1	0	0	2	2
Iii	MEL-403	Heat & Mass Transfer Laboratory	Lab	PCC	1	0	0	2	2
Iv	ASL-401	Numeric and Scientific Computing Lab.	Lab	ESC	2	0	0	4	4
				Total	**20**	**15**	**0**	**10**	**25**

IV Semester- Theory

S. No.	COURSE NUMBER	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	MEC-401	CAD and FEM	Theory	PCC	3	3	0	0	3
2	MEC-402	Production Engineering-I	Theory	PCC	3	3	0	0	3
3	MEC-403	Heat and Mass Transfer	Theory	PCC	3	3	0	0	3
4	AST-401	Operations Research	Theory	HSMC (OEC I)	3	3	0	0	3
5	AST-402	Economics	Theory	HSMC (OEC II)	3	3	0	0	3

MEC-401	CAD and FEM	PCC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

This course introducing various concepts of CAD (Computer Aided Design) as applied to Engineering design problems. Topics include solid modelling, assembly, creating detailed drawing of solid models Computer-aided design (CAD) is the use of computer in design processes. It is the science of using computer-based software to create, modify, analyze, and optimize product designs. Computer-aided design (CAD) is defined as the process of digitally creating design simulations of real-world goods and products in 2D or 3D, complete with scale, precision, and physics properties, to optimize and perfect the design – often in a collaborative manner – before manufacturing.

COURSE OBJECTIVES:

Computers play an important role in Engineering design and analysis. This course gives an overview of analytical treatment on of the use of computers in design and analysis to increase the overall performance of the system

PREREQUISITES:

- Engineering Graphics
- Machine Drawing
- Engineering Mathematics

CONTENT:

Unit I	**Introduction:** Definition of CAD/CAM, Industrial Look at CAD/CAM, CAD/CAM System Evaluation Criteria, CAD/CAM Input/output devices. Basic Definitions, Software Module, CAD/CAM Software. **Geometric transformations:** Introduction, Transformation of Geometric Models, Translation, Scaling, Reflection, Rotation, Homogeneous Representation, Concatenated Transformation.
Unit II	**Wire frame Modelling:** Introduction, Wire-frame Model, Wire-frame Entities, Curve Representation, Parametric Representation of Analytic curves- Line, Circle, and Ellipse. Parametric Representation of Synthetic curves-Hermite Cubic Spline, Bezier curve, B-Spline curve **Surface Modelling:** Introduction, Surface Models, Surface Entities, Surface Representation. Parametric Representation of Analytic Surface-Plane Surface Ruled Surface, Surface of revolution. Parametric Representation of Synthetic Surface-Hermite Bi cubic Surface, Bezier Surface, B-Spline Surface
Unit III	**Solid Modelling:** Introduction, Solid Models, Solid Entities, Boundary Representation-Introduction, Basic elements, Euler Equation Application. Constructive Solid Geometry-Introduction, CSG Tree. Sweep Representation-Introduction to Linear, Non-Linear& Hybrid Sweep. **Visual Realism & CAD data exchange files:** Introduction to Model-Cleanup, Hidden line and surface removal, Shading & colouring Models. Evolution of Data Exchange formats, Shape-Based Format, Product Data Based Format, ISO

	Standards-IGES
Unit IV	**Introduction of FEM& Concepts**: Basic steps in FEM. Elements, nodes and degree of freedom. Element characteristic matrix. Different methods to derive an element characteristic matrix. Direct method to develop element stiffness matrix. Types of elements, one-dimensional elements, two-dimensional elements and their classification. Three-dimensional elements. Related problems. Iso parametric concepts. Shape functions of one-dimensional element, Linear, Quadratic, cubic and quadric bar elements, shape functions of two-dimensional elements (Lagrangian and Serendipity family), shape functions of triangular elements, Derivative of shape. functions, Jacobian matrix [J]
Unit V	**Analysis of Plane Truss and Heat Transfer Using FEML**: Solution of the plane truss, Deriving element stiffness matrix (Truss Element) [k], Global stiffness matrix [K] and its physical meaning, Properties of [K] matrix. Solution of unknowns. Simple problem of truss having 3 bars, Potential energy approach, One dimensional problem in stress analysis and heat transfer

TEXTBOOKS:

1. Ibrahim. Zeid, "CAD/CAM: Theory and Practice", TMH.
2. Ottosen & Petersson." Introduction to the Finite Element Method", Prentice Hall, New York

REFERENCE BOOKS:

1. Beasant C. B. and Lui C. W. K. "Computer Aided Design and Manufacturing", 3rd Edition, Affiliated East West Press Ltd., New Delhi.
2. Mortenson M. E., "Geometric Modeling", John Wiley, New York.

COURSE OUTCOMES (COs):

CO1	Will be able to understand the fundamental principles of hardware and software requirements in CAD/CAM and conduct geometric transformation.
CO2	Will be able to design and draft simple and complex machine parts using CAD through wireframe and surface modelling.
CO3	Will be able to develop solid models and carry out visualization of parts using solid modeling.
CO4	Will be able to understand the basic concepts of FEM and its various applications.
CO5	Will be able to analyze plane Truss and Heat transfer problem using FEM.

MEC-402	Production Engineering-I	PCC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

This course provides a comprehensive study of metal cutting principles, including tool geometry, cutting mechanics, and machining performance. It covers chip formation, strain analysis, shear angle determination, force equilibrium, and heat generation during machining. The influence of tool materials, tool wear, machinability of engineering alloys, and the application of cutting fluids are examined. Additionally, the course explores plastic deformation, yield criteria, and formability in manufacturing processes such as rolling, forging, extrusion, and sheet metal forming, including deep drawing, blanking, and punching, with a focus on process mechanics, defects, and their mitigation.

COURSE OBJECTIVES:

- To demonstrate the fundamentals of machining processes and machine tools.
- To develop knowledge and importance of metal cutting parameters.
- To develop fundamental knowledge on tool materials, cutting fluids and tool wear mechanisms.
- To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes.
- To develop fundamental knowledge on metal forming processes.

PREREQUISITES:

- Material Science
- Manufacturing Processes
- Workshop Practice-I & II

CONTENT:

Unit I	Mechanics of metal cutting, Process of chip formation, Merchant circle, Strain forces and velocities during metal cutting, Machining Power, Effect of heat and forces on the machining performance, Tolerances.
Unit II	Temperature in metal cutting: Heat generation in metal cutting during machining, Temperature distribution in metal cutting, measurement of cutting temperature and forces, Tool life and Tool wear.
Unit III	Plastic deformation: Role of shear, behaviour of material during plastic deformation, Yield criteria. Effect of heat and Temperature rise during plastic deformation, Role of Shear during metal deformation and Theories of failures, cold, warm and hot deformation.
Unit IV	Theory of metal forming, Bauschinger effect, Analysis of forging. Technology of Rolling, types of rolling stands, defects during rolling and their alleviation. Forging, types of forging. Calculation of forging force.
Unit V	Extrusion and drawing, Deep Drawing, Draw die and extrusion die, Types of Extrusion, Tube drawing, manufacturing of seamless tube, Drawing process analysis. Sheet Metal forming, Punching and Blanking.

TEXTBOOKS:

1. Manufacturing Science, by Malik A and Ghosh, Affiliated East- West Press Pvt., Ltd.

REFERENCE BOOKS:

1. Fundamentals of Metal Machining and Machine Tools, by Geoffrey Boothroyd, McGraw-Hill International Book Co.
2. Fundamentals of Tools Design by Wilson, Prentice Hall.
3. Manufacturing Technology by John R. Lindbergh Molly W. Williams and Robert M. Wygant.
4. Technician Manufacturing Technology by M. Hazlehurst (English Language Book Society).
5. Introduction to the theory of Plasticity for Engineers by Hoffman and George Sachs McGraw-Hill.

Other details regarding this course:

- This course is predominantly important for manufacturing Industry visit will help.

COURSE OUTCOMES (COs):

CO1	Will be able to apply fundamental concepts of machining, cutting tools, and quality parameters for machining parts.
CO2	Will be able to investigate and determine the machining parameter and estimate the tool life and wear for practical machining applications.
CO3	Will be able to apply the fundamental concepts of yielding and deformation during various metal forming processes.
CO4	Will be able to apply the fundamental concepts of metal forming in forging and rolling operations.
CO5	Will be able to apply the fundamental concepts of extrusion, drawing and deep drawing.

MEC-403	Heat and Mass Transfer	PCC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

This course explores the core principles of heat and mass transfer. Topics include Steady and Unsteady heat conduction, governing equations and Heat flow through walls. Both free and forced modes convection will be thoroughly examined, along with its impact on heat transfer. Boiling heat transfer, heat exchangers classification and methods for calculating overall heat transfer coefficients using LMTD and NTU approaches will also be addressed. This course provides a comprehensive understanding of radiation, covering emissive power, absorptivity, and view factors. Additionally, mass transfer will be explored, drawing parallels with heat transfer principles and examining diffusion through different media.

COURSE OBJECTIVES:

1.	Students will understand the basic concepts of conduction, convection and radiation heat transfer.
2.	Students will understand how to formulate and be able to solve one and two-dimensional conduction heat transfer problems. Solution techniques will include both closed form and numerical methods. Convection effects will be included as boundary conditions.
3.	Students will understand the fundamentals of the relationship between fluid flow, convection heat transfer and mass transfer.
4	Students will apply empirical correlations for both forced and free convection to determine values for the convection heat transfer coefficient. They will then calculate heat transfer rates using the coefficients.
5	Students will understand the basic concepts of radiation heat transfer to include both black body radiation and gray body radiation.

PREREQUISITES:

- Fundamental of Engineering Physics
- Engineering Mathematics

CONTENT:

Unit I **Modes of Heat Transfer**: Transfer of 1-D, Heat Conduction, Resistance Concept, Electrical Analogy. Energy carriers and continuum approximation. Fourier's Law of Conduction, Thermal Conductivity of Solids, Liquids and Gases, General Conduction Equation in Cartesian Coordinates and Cylindrical Coordinates, 1-D steady heat flow through plane wall cylinders and spheres, Heat flow through composite wall, cylinder and sphere, critical thickness of insulation. Different type of fins. Heat transfer from fin of uniform cross-section, 2-D conduction through plane walls.

Unit II **Transient Heat Conduction**: Introduction, Lumped Heat Analysis, Systems with negligible Surface Resistance, Heat flow in Semi-Infinite Body, System with Finite Surface and Internal Resistance, Chart Solutions, Graphical Analysis, Heat Balance Integral. Finite Difference Methods for discretization of heat equation.

Unit III	**Convection**: Free and forced convection, hydrodynamics and thermal boundary layers, similarity conditions of Heat Transfer Process. Equation of Momentum and Energy, Application of dimensional analysis, Empirical equation of convection Heat Transfer, condensation heat transfer, Drop-wise and film wise condensation, Laminar film on a vertical surface. Heat transfer in external and internal laminar and turbulent flows, and use of correlations.
Unit IV	Boiling Heat Transfer, Pool and flow boiling regimes, Heat Exchangers, Classification of Heat Exchange Overall Heat Transfer Coefficient, LMTD method for parallel flow & counter flow, The NTU method. Radiation: Black body radiation, Definitions, Emissive Power, Emissivity. Absorptive, Reflectivity and Transmissivity, Black, Gray, White & real Surfaces, Planck's Distribution law, Kirchoff's law, Rayleigh-Jeans, Wien's Displacement Law, Stefan Boltzman Law, Radiation Shape factor. View factor, Gas radiation.
Unit V	**Mass Transfer**: Analogy between Mass Transfer and Heat Transfer, The conservation of Chemical Species, diffusion Mass Flux, Fick's Law, diffusion Molar Concentration and Flux, diffusion through a stationary medium, steady stateandtransientdiffusion through a plane membrane. Reference Mass Coefficient, Convective Mass Transfer, Boundary Layer Concentration, Governing equations.

TEXTBOOKS:

1. Fundamentals of Heat and Mass Transfer, Incropera and Dewitt, Sixth Edition, John Wiley.
2. Heat Transfer, Y Cengel, Mcgraw-Hill.

REFERENCE BOOKS:

1. Fundamentals of Momentum, Heat and Mass Transfer, by James R. Welly, Chark E. Wicks and Robert E. Wilson, & Sons.
2. Principles of Heat Transfer, by, Frank P. Kreith and Mark S. Bhonharpar& Row Publisher.
3. Basic Heat and Mass Transfer, by A.F. Mills, Prentice Hall of India.
4. Heat and Mass Transfer, A P. Singh, Macmillan India Ltd.
5. Fundamental of Heat and Mass Transfer, C.P. Kothandaraman, New Age international Publisher.
6. Heat transfer principles & application, B.K. Dutta

Computer Usage / Software required:

Students can be introduced to basic simulation and modelling software. Also,student can be introduced with numerical heat transfer and CFD.

COURSE OUTCOMES (COs):

CO1	Students will understand the basic concepts of conduction, convection and radiation heat transfer. Students will understand how to formulate and be able to solve one and two-dimensional conduction heat transfer problems. Solution techniques will include both closed form and numerical methods. Convection effects will be included as boundary conditions.
CO2	Students will understand the fundamentals of the relationship between fluid flow, convection heat transfer and mass transfer.

CO3	Students will apply empirical correlations for both forced and free convection to determine values for the convection heat transfer coefficient. They will then calculate heat transfer rates using the coefficients.
CO4	Students will understand the basic concepts of radiation heat transfer to include both black body radiation and gray body radiation. Students will be able to evaluate radiation view factors using tables and the view factor relationships.
CO5	Students will be able to understand mass transfer using analogy with heat transfer

AST-401	Operations Research	HSMC (OEC I)	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

This foundational course introduces you to the powerful tools and techniques used to make optimal decisions in a variety of complex, real-world situations. It will facilitate to understand core concepts like modelling, optimization, and uncertainty in making impactful decisions.

COURSE OBJECTIVES:

1. Introduction to operational research and its general methodology. Problem formulation and solution with graphical methods, the simplex algorithm and its application
2. Problem formulation and solution with Integer programming, Transportation and assignment models
3. Problem formulation and solution with Goal programming, Understanding the queuing system and concepts with basic numerical.
4. Introduction to simulation and its applications Decision making under uncertainty
5. Learning the basic knowledge of network development and project management with Project time management using CPM & PERT

PREREQUISITES:

- Strong foundation in mathematics: Calculus, Linear Algebra, Probability and Statistics.
- Familiarity with computer programming

CONTENT:

Unit I Nature and development of operations research, OR general methodology, applications of OR to industrial problems. Formulation of linear programming; deterministic models Linear Optimization Models: Graphical solutions. Simplex algorithm, computational procedure in simplex, duality and its concept, elementary sensitivity analysis, Application of Linear Programming. Application of LINDO, LINGO and related software for solving optimisation problems.

Unit II Integer Programming: Relationship to linear programming (LP), Formulating IP models, Solving IP Problems: Branch-and-Bound, Cutting Plane Method.

Transportation problems; methods for obtaining the solution, degeneracy in transportation problems. Stepping stone method. Trans-shipment problems. Assignment problems.

Unit III Goal Programming (GP): Definition and purpose of GP, Comparison with other optimization techniques (LP, IP), Formulation and Solution Techniques of Goal Programming Models

Queuing Problems: Queuing systems and concepts; classification of queuing situations; Kendall's notation, solution of queuing problems, single channel, single stage, finite and infinite queues with Poisson arrival and exponential service time; applications to industrial problems.

Unit IV Simulation: Introduction, reasons for using simulation, limitations of simulation. Steps in simulation process. Application of simulation. Computer simulation. Monte Carlo simulation.
Sequencing, n jobs two stations, two jobs n stations and graphical method.
Decision theory.

Unit V Network development, Gantt chart. Project Critical path scheduling, construction of a CPM network, the critical path. Float calculations. Project Evaluation and Review Technique and its calculations, Network applications in operations management. Project crashing and resource allocation. Newer Network methods.
Mathematics I, II and III

TEXTBOOKS:

1. Operations Research – Introduction, Taha, H.A., Pearson Education, India.

REFERENCE BOOKS:

1. Quantitative Techniques for Decision Making, Gupta M P, Prentice Hall of India.
2. Introduction to Operations Research by Hillier and Lieberman, Tata McGraw Hill, India.

COURSE OUTCOMES (COs):

CO1	Will be able to identify and develop operational research models from the verbal description of the real system.
CO2	Will be able to understand the mathematical tools that are needed to solve Linear programming problem, transportation problem, and assignment problems.
CO3	Will be able to understand the basic concepts of goal programming and queuing theory for different applications.
CO4	Will be able to use mathematical tools/software to solve the simulation models.
CO5	Will be able to understand network development and project management technique.

AST-402	Economics	HSMC (OEC II)	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

The course introduces concepts and economic analysis procedures to assist with decision making in engineering analysis. Concepts include demand and supply, time value of money and cash flow diagrams; simple, compound, nominal, and effective interest rate; single and series payments. Methods to compare project alternatives include present, future, and annual worth, and rate of return analysis. Methods to forecast demand include extrapolative, explanatory and judgemental methods. It also provides an introduction to different depreciation methods.

COURSE OBJECTIVES:

1. To learn the basics of economics and cost analysis relevant to engineering so as to take economically sound decisions.
2. To provide engineering students with an appreciation and understanding of the time value of money and its importance in making engineering decisions.
3. To understand the various methods used for making economy studies.
4. To develop skills for applying tools and techniques needed to perform economy studies in order to select the best alternative.
5. To understand meaning and methods of forecasting and forecasting errors and also methods for calculating depreciation costs.

PREREQUISITES:

- Basic Mathematics

CONTENT:

Unit I Introduction to engineering economy: Definition, the economic environment, methodology and application, Principles of engineering economy, Steps in engineering economic analysis, Cost concepts and its application to break-even analysis, Basics of demand, supply and equilibrium, Price elasticity of demand, Income elasticity of demand, Cross elasticity of demand, Market structure: Perfect competition, Monopoly, Monopolistic competition and Oligopoly.

Unit II Interest and money-time relationship: Simple and compound interest, notation and cash flow diagram, the concept of equivalence. Interests formulas for discrete compounding and discrete cash flows relating present and future worth of single cash flows and uniform time series (annuity), deferred annuities, annuities with beginning of period cash flows, equivalent present worth, future worth and annual worth, Interest formulas relating an arithmetic gradient series to its present and annual worth, Nominal and effective interest rates, interest problems with uniform cash flows occurring less often and more often than compounding periods, Increasing and decreasing gradients.

Unit III Basic methods of making economic studies: Present worth (P.W. method, annual worth (A.W.) method, future worth (F.W.) method, internal rate of return (I.R.R.) method, external rate of return (E.R.R.) method, explicit reinvestment rate of return (E.R.R.R.) method

Unit IV	Selection among alternatives: alternatives having identical (or not known) revenues and lives, Alternatives having identical revenues and different lives, Selection among independent alternatives.
Unit V	Demand estimation and forecasting: Basic categories of forecasting method, Extrapolative methods, simple average, moving average and exponential smoothing, Errors involved in forecast. Explanatory methods, regression analysis for linear forecaster, coefficient of determination and correlation. Qualitative method, Delphi approach, Market survey, Depreciation and depletion: Definition and purpose, types of depreciation, and depreciation methods

TEXTBOOKS:

1. Principles of Engineering Economics with Applications, Zahid A. Khan, Arshad Noor Siddiquee, Brajesh Kumar, Mustufa H. Abidi. Cambridge University Press, New Delhi, India.

REFERENCE BOOKS:

1. Engineering Economy, Degarmo E. Paul, Sullivan William G. And Bontadelli James A. Macmillan Co. of Singapore.
2. Engineering Economy, Leyland Blank T. and Tarquin Anthony J. (1989), McGraw Hill Publishing Company Ltd., India.
3. Engineering Economy, Panneerselvam R. Prentice Hall of India.
4. Modern Production/Operations Management, Elwood S. Buffa and Rakesh K. Sarin, Wiley India Pvt. Ltd.

COURSE OUTCOMES (COs):

CO1	Will be able to interpret the significance of engineering economy, demand and supply, and market structure.
CO2	Will be able to apply the basic principles of the time value of money and its application to draw the cash-flow diagrams (CFD) and to compute equivalent values for time-based cash flows of varying complexities.
CO3	Will be able to select and apply different standard methods for economy studies.
CO4	Will be able to evaluate different alternatives using the economy study methods to design the best one for considered application.
CO5	Will be able to suggest, customize and implement the most suitable forecasting, depreciation, depletion and depreciation methods.

IV Semester- Laboratory

S. No.	COURSE NUMBER	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
i	MEL-401	CAD, FEM and Computer aided Machine Drawing Laboratory	Lab	PCC	1	0	0	2	2
ii	MEL-402	Production Engineering Laboratory	Lab	PCC	1	0	0	2	2
iii	MEL-403	Heat & Mass Transfer Laboratory	Lab	PCC	1	0	0	2	2
iv	ASL-401	Numeric and Scientific Computing Lab.	Lab	ESC	2	0	0	4	4

MEL-401	CAD, FEM and Computer aided Machine Drawing Laboratory	PCC	L	T	P	C
		2Hrs	0	0	2	1

COURSE OBJECTIVES:

1.	To impart practical knowledge of CAD tools for geometric modeling, part design, and assembly of machine components.
2.	To develop skills in performing finite element analysis (FEA) for evaluating the structural behavior of machine components under load conditions.
3.	To enable students to prepare accurate and detailed machine drawings, including sectional and assembly views, with appropriate dimensions, tolerances, and annotations.

LIST OF EXPERIMENTS:

1.	To study the elements of CAD workstation.
2.	To study in detail the geometric modelling method.
3.	To draw the part models of the given machine components using Pro/E or CATIA or Solid Works.
4.	To draw the assembly for the given parts of a machine components using Pro/E or CATIA or Solid Works.
5.	To perform the load analysis of a given machine component using CATIA or ANSYS.
6.	Draw a detailed assembly drawing of a Cotter Joint with front views of the socket, spigot, and cotter with proper dimensions.
7.	Create a detailed assembly drawing of a Knuckle Joint featuring front views of the eye, fork, collar, and pin with proper dimensions.
8.	Prepare assembly and detailed drawings of a Universal Coupling, incorporating all parts with proper dimensions, tolerances, annotations, and half sectioning where necessary.
9.	Develop assembly and detailed drawings of Cross Heads, including all components with accurate dimensions.
10.	Generate detailed half section view drawings of the Stuffing Box, illustrating all relevant parts with clear internal features.

REFERENCE BOOKS:

1. Machine Drawing, N.D. Bhatt, V. M. Panchal, Charotar Publication, 51st edition.
2. Ibrahim Zeid, *Mastering CAD/CAM*, McGraw Hill Education.

COURSE OUTCOMES (COs):

CO1	Will be able to identify and ascertain the hardware and software required for a CAD system.
CO2	Will be able to use the geometric modelling method.
CO3	Will be able to do part modelling and assembly.
CO4	Will be able to create the assembly drawing of different machine components.
CO5	Will be able to create sectional views of different machine components.

MEL-402	Production Engineering Laboratory	PCC	L	T	P	C
		2Hrs	0	0	2	1

COURSE OBJECTIVES:

1.	Perform alignment tests on lathe machines using suitable instruments.
2.	Analyze the effect of cutting conditions on chip morphology, surface roughness, and MRR.
3.	Study the parts and working of CNC machine and perform milling operation on CNC milling machine.
4.	Find cutting ratios and shear angles in lathe and shaper machines.

LIST OF EXPERIMENTS:

1.	To perform the alignment test on a lathe Machine.
2.	To study chips morphology with respect to various cutting conditions (such as speed feed depth of cuts etc.
3.	To investigate the effect of cutting parameter (such as speed, feed, and depth of cut on the surface roughness & MRR
4.	To study the CNC VMC machine and perform a pocket milling of 25X25X5mm on a given work material
5.	To determine the cutting ratio and shear angle for orthogonal machining operations on a lathe machine.
6.	To determine the cutting ratio and shear angle for machining operations on a shaper machine
7.	To study slides, derives and power sources of a CNC machine tool.

REFERENCE BOOKS:

1. Manufacturing Engineering and Technology, Serope Kalpakjian, Pearson Education; Seventh edition (2018).
2. Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Mikell P. Groover, John Wiley & Sons; 4th Edition (2010).

COURSE OUTCOMES (COs):

CO1	Will be able to carry out the alignment test on a machine tools.
CO2	Will be able to investigate the effect of cutting parameters on surface roughness & MRR and will be able to understand the morphology of chips generated.
CO3	Will be able to perform a pocket milling using CNC VMC machine.
CO4	Will be able to determine the cutting ratio and shear angle for machining operations.
CO5	Will be able to study slides, derives and power sources of a CNC machine tool

MEL-403	Heat & Mass Transfer Laboratory	PCC	L	T	P	C
		2Hrs	0	0	2	1

COURSE OBJECTIVES:

1.	To develop a foundational understanding of thermal conductivity and resistance in various materials, such as metals and insulating powders.
2.	To investigate and evaluate heat transfer coefficients in natural and forced convection regimes, as well as radiative heat transfer properties, including emissivity and Boltzmann's constant.
3.	To explore heat transfer processes in practical applications such as parallel and counterflow heat exchangers and study the performance and effectiveness of extended surfaces.

LIST OF EXPERIMENTS:

1.	To determine the thermal conductivity of the highly conducting metal rod.
2.	To determine the thermal resistance of composite wall and plot the temperature gradient across the different materials
3.	To determine the thermal conductivity of the insulating powder.
4.	To determine the thermal conductivity of the insulating pads/glasswool
5.	To evaluate heat transfer coefficient in natural convection regime
6.	To evaluate heat transfer coefficient in forced convection heat transfer regime.
7.	To determine the emissivity of the Graysurface.
8.	To determine Boltzmann’s Constant of radiation heat transfer.
9.	Parallel and counter flow heat exchanger.
10.	Heat transfer in pin-fin.

REFERENCE BOOKS:

1. Heat and Mass Transfer by P.K. Nag (McGraw Hill Education).
2. Fundamentals of Heat and Mass Transfer” by Frank P. Incropera, David P. DeWitt, Theodore L. Bergman, and Adrienne S. Lavine (Wiley).

COURSE OUTCOMES (COs):

CO1	Students will be able to determine the thermal conductivity of highly conductive metal rods, demonstrating proficiency in assessing materials for their efficiency in conducting heat.
CO2	By evaluating thermal resistance in composite walls and plotting temperature gradients across different materials, students will acquire the skill to analyse and optimize heat flow in complex, multi-layered structures.
CO3	Through the determination of thermal conductivity in insulating powders, students will develop the ability to assess and select materials for their effectiveness in minimizing heat transfer
CO4	Student will be proficient in evaluating Heat Transfer Coefficient in natural and forced convection regime
CO5	Students will gain the expertise to determine the emissivity of grey surfaces and Boltzmann’s Constant for radiation heat transfer.

ASL-401	Numeric and Scientific Computing Lab.	ESC	L	T	P	C
		4Hrs	0	0	4	2

COURSE OBJECTIVES:

The course is intended to help students learn programming codes for solving various numerical problems.

LIST OF EXPERIMENTS:

1.	**To develop a program for** Bisection Method and also implement it to solve numerical problems.
2.	**To develop a program for** Regula-false Method and also implement it to solve numerical problems.
3.	**To develop a program for** Newton Raphson Method and also implement it to solve numerical problems.
4.	**To develop a program for** Gauss Elimination Method and also implement it to solve numerical problems.
5.	**To develop a program for** Gauss-Jordan Method and also implement it to solve numerical problems.
6.	**To develop a program for** Newton's Forward Interpolation formula and also implement it to solve numerical problems.
7.	**To develop a program for** Newton's Backward Interpolation formula, Simpson's three-eight rule and also implement it to solve numerical problems.
8.	**To develop a program for** Simpson's three-eight rule and also implement it to solve numerical problems.
9.	**To develop a program for** Trapezoidal Rule and also implement it to solve numerical problems.
10.	**To develop a program for** Runge Kutta Method and also implement it to solve numerical problems.

REFERENCE BOOKS:

1. Numerical Methods for Engineers Steven C. Chapra & Raymond P. Canale, Tata McGraw Hill Book Co.
2. Computer Oriented Numerical Methods, Rajaraman; V, Prentice Hall of India Pvt. Ltd.

COURSE OUTCOMES (COs):

CO1	Will be able to apply numerical methods to obtain approximate solutions to mathematical problems.
CO2	Will be able to derive numerical methods for various mathematical operations such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
CO3	Will be able to analyse and evaluate the accuracy of common numerical methods.
CO4	Will be able to implement numerical methods in computer programming C/C++.
CO5	Will be able to write efficient, well-documented C/C++ code and present numerical results in an informative way.

Course Syllabi

B.Tech.(Mechanical Engineering)

FIFTH Semester

V Semester- Course Details

S. No.	COURSE NUMBER	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	MEC-501	Advanced Fluid Mechanics & Control Engineering	Theory	PCC	3	3	0	0	3
2	MEC-502	Applied Thermodynamics	Theory	PCC	3	3	0	0	3
3	MEC-503	Theory of Mechanisms and Machines	Theory	PCC	3	3	0	0	3
4	MEC-504	Design of Mechanical Components	Theory	PCC	3	3	0	0	3
5	MEC-505	Production Engineering-II	Theory	PCC	3	3	0	0	3
6	MEE-501	Mechatronics	Theory	PEC	3	3	0	0	3
I	MEL-501	Instrumentation, Measurement & Control Laboratory	Lab	PCC	1	0	0	2	2
Ii	MEL-502	Theory of Mechanisms and Machines Laboratory	Lab	PCC	1	0	0	2	2
Iii	MEL-503	Design of Mechanical Components Practice Laboratory	Lab	PCC	1	0	0	2	2
Iv	MEL-504	Mechatronics Laboratory	Lab	PCC	1	0	0	2	2
				Total	**22**	**18**	**0**	**8**	**26**

V Semester- Theory

S. No.	COURSE NUMBER	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	MEC-501	Advanced Fluid Mechanics & Control Engineering	Theory	PCC	3	3	0	0	3
2	MEC-502	Applied Thermodynamics	Theory	PCC	3	3	0	0	3
3	MEC-503	Theory of Mechanisms and Machines	Theory	PCC	3	3	0	0	3
4	MEC-504	Design of Mechanical Components	Theory	PCC	3	3	0	0	3
5	MEC-505	Production Engineering-II	Theory	PCC	3	3	0	0	3
6	MEE-501	Mechatronics	Theory	PEC	3	3	0	0	3

MEC-501	Advanced Fluid Mechanics & Control Engineering	PCC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

This course provides advanced knowledge of fluid mechanics and control engineering, focusing on laminar, turbulent, and compressible flows, along with boundary-layer concepts and flow control. It covers analytical and numerical methods for solving Navier–Stokes equations, boundary layer theory, turbulent modelling, and compressible flow behavior including shock waves and nozzle flow. The course also introduces control principles for fluid systems with emphasis on flow, pressure, velocity, and level measurement techniques essential for industrial and research applications.

COURSE OBJECTIVES:

1.	Analyze laminar, turbulent, and compressible flow phenomena using fundamental governing equations and flow models.
2.	Apply boundary layer theory, turbulence concepts, and flow measurement principles to real-world engineering problems.
3.	Develop knowledge of hydraulic control systems and modern instrumentation for effective monitoring and regulation of fluid systems

PREREQUISITES:

- Fluid Mechanics
- Thermodynamics / Engineering Thermodynamics

CONTENT:

Unit I	**Laminar flow of Viscous Incompressible Fluids:** Introduction to Fluid Mechanics, Reynolds transport theorem, Basic equations; continuity equation, momentum equation (N-S equations), Exact solution of N-S equations; Couette flow, Hagen-Poiseuille flow, Flow between two coaxial cylinders, Flow between two concentric rotating cylinders, Low Reynolds number flows (Creeping flows).
Unit II	**Boundary layer theory and external flows:** Boundary-layer concept, Boundary layer along a flat plate; boundary layer thickness, displacement thickness, momentum thickness, Boundary layer equations, Blasius solution, Momentum integral boundary layer equation, Boundary layer control. Lift and drag, Comparison of laminar and turbulent velocity profiles, Streamlining and implications.
Unit III	**Turbulent flow:** Characteristics of turbulent flow, Laminar-turbulent transition, Mean motion and fluctuations, Governing equations for turbulent flow, Reynolds stresses, Shear stress models, Universal velocity distribution law, Turbulent flow in pipes, turbulent boundary layer.
Unit IV	**Compressible flow:** Review of thermodynamics, thermodynamic relations of perfect gases, Propagation of sound waves; speed of sound, types of flow, the Mach cone, Adiabatic and isentropic flow; stagnation properties, Isentropic flow through a variable area, Isentropic flow through a convergent-divergent nozzle; critical properties, shock waves, Flow through constant area duct with friction (Fanno flow), Flow through constant area duct with heat transfer (Rayleigh flow).
Unit V	**Control and Measurement:** Function of hydraulic flow control valves, types, design

considerations and their characteristics, Flow measurement and control, Primary, secondary and special methods of flow measurement, Measurement of liquid level, Pressure measurement and control (high pressure, moderate and vacuum), Velocity measurement.

TEXTBOOKS:

1. Introduction to Fluid Mechanics by Fox & McDonald, John Wiley & Sons, Inc.
2. Foundations of Fluid Mechanics by S. W. Yuan, Prentice-Hall of India Pvt. Ltd.

REFERENCE BOOKS:

3. Introduction to Fluid Mechanics by Fox & McDonald, John Wiley & Sons, Inc.
4. Fluid Mechanics by Yunus A. Cengel& John M. Cimbala, McGraw-Hill Education Pvt. Ltd.
5. Fluid Mechanics by Frank M White, Tata McGraw-Hill Pub. Company Ltd.
6. Foundations of Fluid Mechanics by S. W. Yuan, Prentice-Hall of India Pvt. Ltd.

COURSE OUTCOMES (COs):

CO1	Will be able to understand basic concepts of laminar follow of viscous incompressible fluids.
CO2	Will be able to understand and apply boundary layer theory and determine lift and drag.
CO3	Will be able to understand turbulent follow in pipes etc.
CO4	Will be able to understand the basic concepts of different compressible flows like Fanno and Rayleigh flow.
CO5	Will be able to implement various control and measurements techniques for different fluid flow.

MEC-502	Applied Thermodynamics	PCC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

This course focuses on the practical application of thermodynamic principles to analyze, design, and optimize thermal engineering systems. It covers advanced concepts of the first and second laws of thermodynamics, availability and irreversibility, and thermodynamic property relations. The course includes detailed study of vapor and gas power cycles, steam turbines, condensers, compressors, nozzles, and internal combustion engines. Emphasis is placed on evaluating cycle performance, efficiency improvements, and component behavior in real systems. Students are also introduced to computational tools for thermodynamic analysis, providing a foundation for advanced studies in thermal engineering and energy systems.

COURSE OBJECTIVES:

This course is designed to teach mechanical engineering students the application of thermodynamic principles to the design and optimization of Thermal Engineering Systems. Specifically, students will be taught how to apply the laws of thermodynamics to vapor power and refrigeration systems, gas power systems, applications concerning humidification, dehumidification, evaporative cooling, and thermodynamics of combustion systems such as furnaces, flow reactors etc.

PREREQUISITES:

- Basic Thermodynamics

CONTENT:

Unit I	First and Second law Thermodynamics; Its analysis for Open and Closed system; Availability and irreversibility, Gibb's function, Helmholtz function, Clausius and Clapeyron equation.
Unit II	Thermodynamic cycles, Cannot Cycle, joule cycle, Air standard cycle, Otto cycle, Diesel cycle, Dual cycle, Rankine cycle, Modified Rankine cycle, Thermal refinements in Rankine cycle, Working of steam power plant, Binary vapor cycle.
Unit III	Steam turbine, Types and application, Impulse and reaction turbine, compounding of impulse turbine, pressure and velocity diagrams, reaction turbines, Work output, Losses and efficiencies, Reaction turbine, velocity diagram, degree of reaction; Work output.
Unit IV	Condensers, types of condensers, jet and surface condensers, Compressors, Types, reciprocation, centrifugal, axial flow, single and multistage compressors, effect of inter-cooling surging, choking and stalling.
Unit V	Nozzles, isometric flow through nozzles, critical pressure, pressure ratio, maximum discharge, stagnation condition; I.C. Engines, types, Air fuel mixture requirement; Requirement and suitability of fuels in I.C. Engines.

TEXTBOOKS:

1. Applies Thermodynamics: P. K. Nag, Tata McGraw Hill Publications.

REFERENCE BOOKS:

1. Applied Thermodynamics Engineering technology by T. D. Eastop & McConkey, Pearson Education.
2. Applies Thermodynamic Sciences. Principle Applications. S. K. Agrawal, Viva Book.
3. Turbine Compressors and Fans, S.M. Yahya, Mc-Graw Hill.
4. Thermal Engineering by R. K. Rajput, Laxmi Publication, Delhi.

Computer Usage/Software required:

- Students can be introduced to basic simulation software such as FLUENT.

Other details regarding this course:

- This is a basic course necessary for further studies in Thermal Engineering and Sciences

COURSE OUTCOMES (COs):

CO1	Able to understand the laws and limitation of thermodynamics and will be able to sort out realistic and unrealistic thermodynamic claims.
CO2	Able to analyze a vapor power cycle given a set of operational parameters and constraints, determine cycle efficiency, its power output, and required heat input.
CO3	Able to understand cycle efficiency for the steam power cycle.
CO4	Able to analyze the performance characteristics of condenser and compressor.
CO5	Able to analyze and determine cycle efficiency, work output and required heat input for a Petrol/Diesel Engine with a given set of operating parameters.

MEC-503	Theory of Mechanisms and Machines	PCC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

This course provides a comprehensive study of the fundamental principles governing mechanisms and machines, with emphasis on kinematic synthesis, analysis, and dynamic behavior of mechanical systems. It covers planar mechanisms, velocity and acceleration analysis, inertia force analysis, and the role of governors in speed control. Students will gain an understanding of cam design, gear geometry, and gear train mechanisms essential for motion and power transmission. The course integrates analytical and graphical methods to develop problem-solving skills, laying a strong foundation for applications in machine design, robotics, automotive, and industrial automation.

COURSE OBJECTIVES:

1.	To introduce fundamental principles of kinematics and dynamics of machines.
2.	To impart knowledge of synthesis and analysis of mechanisms, cams, gears, and governors.
3.	To develop the ability to apply analytical and graphical methods for machine design problems.

PREREQUISITES:

- Engineering Mechanics (statics and dynamics).
- Basic knowledge of Mathematics (differentiation, integration, vector algebra).

CONTENT:

Unit I	Kinematic Synthesis of Plane Mechanism: Types of Kinematic Synthesis, Type, dimensional, number synthesis, function generation, path generation & motion generation. Analytical Method of Dimensional Synthesis, four bar, slider crank function generator with three accuracy points, method for complex variables, four bar linkage for specified instantaneous condition using Freudenstein's Equation. Bloch's synthesis, Graphical Methods.
Unit II	Velocity and Acceleration Analysis in Mechanisms: Analytical method for velocity and acceleration of a mechanism. Relative velocity and instantaneous centre method for determination of velocities of links of a mechanism. Velocity and acceleration diagrams for different mechanisms. Klein's construction for a reciprocating engine. Coriolis component of acceleration.
Unit III	Inertia Force Analysis: Simple and compound pendulums. Inertia force and inertia couple. Dynamically equivalent systems. Equilibrium of a link in a mechanism. Inertia force in reciprocating engines. Inertia forces in a four-bar linkage. Turning moment diagrams. Fluctuation of speed and energy. Flywheel. Governors: Function of a governor, governor's types, working of Watt Porter, Proell and Hartnell governor with and without the effect of friction at the sleeves. Qualities of a governor- sensitiveness, stability, isochronism and hunting. Effort and power. Controlling force of a governor.
Unit IV	Cam Design: Types of cams and followers. Displacement, velocity, and acceleration diagrams for usual motion of followers. Cam profiles for knife-edge, roller and flat-

	faced followers. Cam size determination. Determination of motion of the follower for specified cam profiles.
Unit V	Gears: Motion transmitted by two-curved surface in contact. Gear nomenclature. Types of teeth. Interference and undercutting. Minimum number of teeth on gear wheel/pinion to avoid interference. Arc and path of contact in the case of straight tooth spur gears. Helical and bevel gears. Gear Trains: Types of gear trains. Epicyclic and compound gear trains for change in speed. Torques and tooth loads in epicyclic gear trains.

TEXTBOOKS/REFERENCE BOOKS:

1. Theory of Mechanisms and Machines by Dr. Jagdish Lal, Metropolitan Book, Co. Pvt. Ltd.,
2. The Theory of machines by Thomas Bevan, CBS Publishers and distributors
3. Theory of Machines and Mechanisms by J. E. Shigley and J. J. Vicker, McGraw Hill Book co.
4. Mechanisms and Machine theory by J.S. Rao and R.Y. Dukkipati, Wiley Eastern Ltd.
5. Design of Machinery by Robert L Norton, McGraw-Hill Publishing Co.

COURSE OUTCOMES (COs):

CO1	Will be able to carry out synthesis of planar mechanisms.
CO2	Will be able to conduct displacement, velocity and acceleration analysis of different mechanisms.
CO3	Will be able to conduct inertia force analysis of mechanisms and analyze the performance of different type of governors.
CO4	Will be able to design cam and follower mechanism for a given application.
CO5	Will be able to understand the mechanism of gear pair and gear train.

MEC-504	Design of Mechanical Components	PCC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:
This course is to serve as an introduction to mechanics of deformable solid bodies.

COURSE OBJECTIVES:

- The primary course objective is to prepare a student of mechanical engineering to apply theory and practice of Design of Mechanical Elements. It is an introductory course laying foundation on design fundamentals, application of strength of material principles, selection of components and selection of materials for a given application.
- To teach students how to apply the concepts of stress analysis, theories of failure and material science to analyse, design and/or select commonly used machine components.
- Impart design principles involved in evaluating the critical design parameters of machine elements to satisfy functional and strength requirements
- Formulation of solutions to problems of design of mechanical elements.
- The objective also includes working with CATIA, Solid works and other design software.

PREREQUISITES:

- Engineering Mechanics
- Mechanics of Solids
- Material Science
- Machine Drawing

CONTENT:

Unit I	**Introduction**: Introduction to Design Process & Phases of design. Design factors. Margin of safety. Working stresses. Properties of the materials, Manufacturing Consideration in design, BIS Codes for Steels, Theories of Failure. Types of joints. Types of riveted joints. Design of riveted joints. Design of welded joints. Eccentrically loaded riveted and welded joint. Cotter and Knuckle joint design.
Unit II	**Design against Fatigue**: Fatigue strength. Factors affecting fatigue behavior. Influence of superimposed static stress. Stress concentration. Notch sensitivity. Factor of safety. Cumulative damage in fatigue, Soderberg and Goodman lines, Gerber's Parabola, Modification of Goodman's Line. Practical measures to combat fatigue.
Unit III	**Screws**: Design of screw joints under tension and shear, initial loading, consideration of stiffness. Eccentrically loaded screws joints. Standard threads. Power Transmission by screws. Friction and efficiency. Examples of application: screw jack, C-Clamp, lead screw, broach actuator etc. Design of nut-screw pair for axial load and torque. Impact load on bolts.
Unit IV	**Clutches and Brakes**: Function of Clutches, Friction and limiting torque. Theories of uniform pressure and wear. Classification-single & multiple plate clutches. Cone clutch. Centrifugal Clutch. Energy loss during clutching. Consideration of heat dissipation in brakes and clutches. Description of power-controlled clutches.

	Brakes-function, types, lining material, Band, Shoe, Band and Shoe. Actuating mechanism. Maximum and average pressure. Leading and trailing shoe brakes. Disc Brakes.
Unit V	**Springs**: Types of close and open coil Helical springs. Tension & compression spring. Design of helical spring. Combination in series and parallel. Leaf springs and design of leaf spring. Load on the clip bolts. Flat spiral springs. Material for springs. Method of improvement of life and strength. **Thin & Thick Cylinders**: Thin Cylinders: Assumptions, Stresses, Strains, Strengthening, Applications. Thick Cylinders: Analysis using Lame's Theory, Stresses due to internal and external Pressures. Compound cylinders, Spherical Vessels. Pressure Vessel Design Using ASME Codes.

TEXTBOOKS:

1. Design of Machine Elements by Bhandari V B McGraw HI Book Co. 5th Ed
2. Mechanical Engineering. Design by J.E. Shigley, C.R. Mischke, McGraw HI Book Co.

REFERENCE BOOKS:

1. Fundamentals of Machine Component Design by R.C.
2. Juvinall, John Wiley & Sons
3. Design of Machine Elements by Spots, Prentice Hall of India.
4. Fundamentals of Mechanical Component Design by Edwards and McKee, McGraw-Hill.
5. Machine Design by Robert L. Norton, Prentice Hall, USA

Computer Usage / Software required:

- Language- C, C++, Fusion 360, SolidWorks, Pro/E, CATIA, ANSYS

Other details regarding this course:

- Mini projects as assignments for improving the practice of design of mechanical components should be done.

COURSE OUTCOMES (COs):

CO1	Will be able to design riveted, welded and other types of joints under different loading conditions.
CO2	Will be able to design machine parts under variable loading.
CO3	Will be able t design bolted joints and power screws.
CO4	Will be able to analyze and design brakes and clutches for give loading conditions.
CO5	Will be able to design springs and pressure vessels.

MEC-505	Production Engineering-II	PCC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

This course provides an in-depth study of advanced concepts in production engineering with emphasis on metrology, tooling, finishing, and non-conventional manufacturing processes. It covers precision measurement techniques for linear, angular, surface, gear, and thread inspection, along with the application of coordinate measuring systems. The design principles and applications of jigs and fixtures are discussed to enhance productivity and accuracy in machining operations. Students are introduced to grinding and super-finishing processes, as well as advanced manufacturing technologies such as EDM, ECM, laser machining, ultrasonic machining, and high-energy-rate forming methods. The course also explores the structure, properties, and processing methods of plastics, preparing students to select appropriate materials and manufacturing processes for industrial applications.

COURSE OBJECTIVES:

- To demonstrate the fundamentals of metrology and inspection.
- To develop knowledge and importance of jigs and fixtures.
- To develop fundamental knowledge on grinding of materials.
- To develop knowledge and importance of non-conventional manufacturing processes.
- To demonstrate the fundamentals of properties and processing of plastics.

PREREQUISITES:

- Material Science
- Production Engineering-I
- Manufacturing Processes
- Workshop Practice-I & II.

CONTENT:

Unit I	Linear and angular measurements- Precision gauge block, ISO system of Limits, fits and tolerance. Interferometry, - e.g. optical flats. Measurement of gears and threads. Coordinate measurement system, Surface measurements e.g. surface roughness.
Unit II	Usefulness of Jigs and Fixtures. Principles of jigs and fixtures design. Principles and types of locating and clamping devices. Elements of a drilling jig and types of jigs. Elements of a milling fixtures and types of milling fixtures. Jig and fixture economic analysis.
Unit III	Finishing and Super-finishing processes. Grinding Process, Grinding wheels- materials and designation, balancing and dressing. Reaming, Honing, Lapping, Broaching and Trepanning.
Unit IV	Need of Unconventional manufacturing methods, Electro discharge machining, water jet machining, electro-chemical machining, abrasive jet machining, ultrasonic machining. Electron beam machining, Laser beam machining. Plasma Arc Machining. High velocity forming of metals- Explosive forming. Electro-hydraulic forming.
Unit V	Structure, properties of Plastics and factors affecting properties, Plastic Processing-

Casting of Plastics, Compression Moulding, Injection Moulding, Roto moulding, Blow Moulding, Reinforced Plastic Moulding, Pultrusion, Filament Winding, Machining of Plastics.

TEXTBOOKS:

1. Manufacturing Science, by Mallik A and Ghosh, Affiliated East- West Press Pvt., Ltd.

REFERENCE BOOKS:

1. Fundamentals of Metal Machining and Machine Tools, by Geoffrey Boothroyd, McGraw-Hill International Book Co.
2. Fundamentals of Tools Design by Wilson, Prentice Hall.
3. Processes and Materials of Manufacture, by Roy A. Lindberg, PHI Learning.
4. Manufacturing Technology by John R. Lindbeck Molly W. Williams and Robert M. Wygant.
5. Technician Manufacturing Technology by M. Hazlehurst (English Language Book Society.
6. Introduction to the theory of Plasticity for Engineers by Hoffman and George Sachs McGraw-Hill.

Other details regarding this course:

The course is of predominantly important in industry and requires industry interaction

COURSE OUTCOMES (COs):

CO1	Will be able to conduct measurement and inspection of gears, threads, etc. using metrological instrument including coordinate measuring machine.
CO2	Will be able to design jigs and fixtures for industrial applications.
CO3	Will be well versed with and identify the finishing and superfinishing processes for given application.
CO4	Will be able to decide the non-conventional and modern manufacturing processes for developing a product.
CO5	Will be able to identify the properties of different plastics and prescribes processing methods for different product.

MEE-501	Mechatronics	PEC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

Mechatronics (ME-507) is a graduate level basic course in robotics. This course is open to all engineering graduate students. Mechatronics engineering is a field which consists of a combination of computer, electrical, electronic and mechanical engineering that serves the purpose of controlling advanced hybrid systems. Mechatronics Engineers maintain, manage, design and develop engineering systems. Mechatronics Engineering has applications in numerous industries such as Automation, Oceanography, Robotics, Transport, Nanotechnology, Aircraft Engineering, Oil and Gas, Biomedical Systems, and Computer-aided design.

COURSE OBJECTIVES:

The Objective of this course is to impart the skills and knowledge that are not confined to a single subject area, but a range of engineering disciplines. Students completing a course will be capable of working in a number of interesting areas i.e. process engineering, product design, manufacturing, automation, quality and business process, green engineering and research and development.

PREREQUISITES:

- Basic Electrical & Electronics Engineering
- Basic Elements of Mechanical Engineering
- Basic Manufacturing Engineering

CONTENT:

Unit I	**Introduction to Mechatronics**: Origin &evolution of Mecha tronics. Objectives, Advantages, And Disadvantages of Mechatronics, Instrumentation and Control Systems. **Actuators and Mechanisms:** Actuator Types and application Areas, Electromechanical Actuators, DC Motors, AC Motors, Piezoelectric Actuators, Magneto strictive Actuators, Memory-metal Actuator, Ion-Exchange Polymer-metal Composites, Chemical Actuator, **Mechanisms:** Bearings, Belt, Chain, Pulleys, Gears, Rack and Pinion, Ratchet, Pawl and Crank, Slider and Crank, Cams and Follower, Chain and Sprocket, Geneva Wheel, Four-bar Linkages.
Unit II	**Sensors andTransducers**: static & Dynamic characteristic of transducer, Sensors for measurement of displacement, position, force, torque & temperature etc. Optical Encoder, Opto-Electrical Sensors & Smart Sensors. **Basic Elements of Microprocessor:** Architecture, Terminology, instruction Types, Addressing Models, Intel 8085A Microprocessor, Microprocessor-based Digital Control, Introduction to Microcontrollers and its families, Microcontroller, Architecture, Programmable Logic Controller
Unit III	**Pneumatics & Electro Pneumatics**: Introduction to Pneumatics, Air Compression, Distribution and Treatment. Directional Control valves. Electro Pneumatic Components. Circuit Design. Pneumatic Actuation System, Practical Exercises **Hydraulic & Electro Hydraulics:** Cylinders – Types and construction, Application,

	Hydraulic cushioning – Rotary Actuators-Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Accessories: Reservoirs, Pressure Switches – Filters –types and selection-Practical Exercises
Unit IV	**Modelling:** Systems Modelling, Mechanical System, Electrical Systems, Fluid Systems, Thermal Systems, Engineering System, Translational Mechanical System with spring, Damper and Mass. Rotational Mechanical Systems with Spring, Damper and Mass, Modelling Electric Motor, Modelling Chamber Filled with Fluid, Modelling Pneumatic Actuator. **Signal Conditioning:** Signal Nomenclature, Signal Processing, filtering digital signal, multiplexers, Data acquisition, Digital Logic digital signal processing. Pulse modulation Timer, counters & Relays
Unit V	**Intelligent Systems and Their Applications:** Advance Actuators, Consumer Mechatronics Products, Hydraulic Fingers, Surgical Equipment, Industrial Robot, Autonomous Guided Vehicle (AGV), Drilling Machine, Conveyor-based Material Handling Systems. **Mechatronics in Manufacturing:** Production Unit, Input/output and Challenges in Mechatronics Production Units, Knowledge Required For Mechatronics in Manufacturing, Main Features of Mechatronics in Manufacturing, Computer Integrated Manufacturing, just- in-Time Production Systems, Mechatronics and Allied Systems.

TEXTBOOKS:

1. W. Bolton, 'Mechatronics', Pearson Education New Delhi.
2. N P Mahalik, 'Mechatronics Principle, concept & Application, ' Tata McGraw-Hill, New Delhi.

REFERENCE BOOKS:

1. Robert H. Bishop, 'Mechatronics Hand Book', CRC Press, New York
2. J.R Groot, ‘Introduction to Pneumatics’, Fluid Power Education Foundation, Milwaukee.

Computer Usage / Software required:

- MATLAB, AutoSIM

COURSE OUTCOMES (COs):

CO1	Will be able to understand the basic concepts of Mechatronics and actuation mechanisms.
CO2	Will be able to understand the working principle of different types of sensors and microcontrollers.
CO3	Will be able to understand the basic concept of pneumatic and electro-pneumatic, hydraulic and electro-hydraulics.
CO4	Will be able to conduct system modeling and signal conditions.
CO5	Will be able to understand the modern machinery and intelligent systems used in industries, like AGVs, etc.

V Semester- Laboratory

S. No.	COURSE NUMBER	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
i	MEL-501	Instrumentation, Measurement & Control Laboratory	Lab	PCC	1	0	0	2	2
ii	MEL-502	Kinematics of Machines Laboratory	Lab	PCC	1	0	0	2	2
iii	MEL-503	Design of Mechanical Components Practice Laboratory	Lab	PCC	1	0	0	2	2
iv	MEL-504	Mechatronics Laboratory	Lab	PCC	1	0	0	2	2

MEL-501	Instrumentation, Measurement & Control Laboratory	PCC	L	T	P	C
		2Hrs	0	0	2	1

COURSE OBJECTIVES:

1.	Gain the knowledge and skills to accurately measure physical parameters such as diameter, thickness, displacement, torque, speed, and pressure using advanced instruments like vernier calipers, screw gauges, LVDTs, strain gauge-based transducers, and pressure transducers.
2.	Develop the ability to analyze experimental data, plot performance characteristics, and evaluate errors through experiments involving devices like dial gauge indicators, photoelectric pick-ups, LDRs, and potentiometers, ensuring precise calibration and error estimation.
3.	Understand the feedback and control systems by studying configurations like feedback light intensity control systems and angular position error detectors, enabling students to evaluate performance characteristics and apply these concepts to real-world engineering problems.

LIST OF EXPERIMENTS:

1.	To calculate the internal estimate of error in the measurement of the diameter of given object like rod, ball & gear/slab using vernier calipers and screw gauge.
2.	To determine the thickness of one paper using dial gauge indicator mounted on a pillar stand.
3.	To study linear variable differentiable transformer (LVDT) and draw the graph between displacement v/s digital panel meter (DPM) reading.
4.	To study the light detecting resistor (LDR) and draw the graph between displacement and DPM reading.
5.	To calculate the measurement of torque using strain gauge based torque transducer.
6.	To calculate the speed measurement using magnetic pick-up and photo-electric pick-up and draw the graph between photoelectric pick-up reading and error between them.
7.	To make the pressure measurement using pressure transducer.
8.	To study the characteristics of strain gauge transducer.
9.	To study the performance characteristics of an angular position error detector using two potentiometers.
10.	To study the configuration and evaluate the performance characteristics of a feedback light intensity control system.

REFERENCE BOOKS:

1. Instrumentation Measurement and Analysis, 4th Edn by B. C. Nakra, K. K. Chaudhary, ISBN No 978-9385880629, McGraw Hill Education India Private Limited, 2016
2. Instrumentation for Engineering Measurements by James W. Dally, William F. Riley, Kenneth G. McConnell, ISBN No 978-047155192, John Wiley & Sons, 1993.

COURSE OUTCOMES (COs):

CO1	Will be able to acquire knowledge pertaining to measurement, error and calculate length, diameter and thickness using various measuring instruments.
CO2	Will be able to study about the LVDT and LDR and analyse the displacement and DPM reading.

CO3	Will be able to measure torque and speed using various measuring instruments and also will be able to calculate errors.
CO4	Will perform study about the pressure measurement using pressure transducer and also study various characteristics of strain gauge transducer.
CO5	Will be able to assess performance characteristics of an angular position error detector and evaluate the performance characteristics of a feedback light intensity control system.

MEL-502	Theory of Mechanisms and Machines Laboratory	PCC	L	T	P	C
		2Hrs	0	0	2	1

COURSE OBJECTIVES:

1.	Study mobility characteristics, inversion and kinematic analysis of different planar mechanisms
2.	Learn kinematic design software to perform kinematic analysis of planar mechanism
3.	Study gear tooth profiles

LIST OF EXPERIMENTS:

1.	Study of the different types of kinematic pairs
2.	Study of the application of Grashof's criterion to different kinematic chains
3.	Study of the inversions of the four-bar kinematic chain
4.	Study of the inversions of the four-bar single slider kinematic chain
5.	Study of the inversions of the four-bar double slider kinematic chain
6.	Study of the motion kinematics of different planar mechanisms using GIM software
7.	Study of the straight-line motion mechanisms
8.	Study of velocity diagram of four bar kinematic chain and slider crank mechanism
9.	Study of the gear tooth profiles
10.	Study of the different gear trains

REFERENCE BOOKS:

1. Theory of Machines and Mechanisms by J. E. Shigley and J. J. Vicker, McGraw Hill Book co.
2. Mechanisms and Machine theory by J.S. Rao and R.Y. Dukkipati, Wiley Eastern Ltd.
3. Machines and Mechanisms, Applied Kinematic Analysis by David H. Myzka, Pearson.

COURSE OUTCOMES (COs):

CO1	Will be able to Identify different types of kinematic links, pairs and chains, and analyze their motion kinematics.
CO2	Will be able Design and analyze the mechanisms for the specified application in a machine.
CO3	Will be able to apply inversions of different four bar kinematic chains in applications.
CO4	Will be able to use software for the kinematics analysis of different planar mechanisms with revolute and sliding pairs.
CO5	Will be able to understand different gear profiles and gear trains.

MEL-503	Design of Mechanical Components Practice Laboratory	PCC	L	T	P	C
		2Hrs	0	0	2	1

COURSE OBJECTIVES:

1.	To apply theories of failure in designing machine components.
2.	To design and analyze welded, riveted, knuckle, and cotter joints using Fusion 360.
3.	To study fatigue behavior and solve design problems related to screw joints and power screws.
4.	To design and simulate clutches, brakes, helical and leaf springs using simulation software.
5.	To study and design thin and thick cylinders based on ASME codes.

LIST OF EXPERIMENTS:

1.	To study the applications of various Theories of Failures.
2.	Design of Welded & Riveted Joints, Eccentrically loaded joints.
3.	To design Knuckle and Cotter Joint using Fusion 360.
4.	To study problems on Fatigue Behavior of machine components and solve them.
5.	To study problems on Design of screw joints under tension and shear, initial loading, consideration of stiffness. Eccentrically loaded screws joints. Standard threads.
6.	Design of nut-screw pair for axial load and torque. Impact load on bolts.
7.	To design a and analyse the working of the following power screws: screw jack, C-Clamp, lead screw, broach actuator etc.
8.	To solve problems on design of different types of Clutches and Brakes using simulation software.
9.	To design and analyze problems on Helical and Leaf springs using simulation.
10.	To study the design of thin & Thick Cylinders Using ASME Codes.

REFERENCE BOOKS:

1. Mechanical Engineering. Design by J.E. Shigley, C.R. Mischke, McGraw HI Book Co.
2. Design of Machine Elements by Bhandari V B McGraw HI Book Co. 5th Ed

COURSE OUTCOMES (COs):

CO1	Will be able to determine the forces in welds and riveted joints and formulate design solution for size of weld and size of rivet.
CO2	Will be able to design against fatigue for mechanical systems.
CO3	Will be able to design screw and bolted joints and power screws for various applications.
CO4	Will be able to design of different types of brakes and clutches.
CO5	Will be able to different types of springs and thin and thick cylinders.

MEL-504	Mechatronics Laboratory	PCC	L	T	P	C
		2Hrs	0	0	2	1

COURSE OBJECTIVES:

1.	To calibrate and verify the accuracy of various sensors, including temperature, pressure, and light sensors.
2.	To analyze the performance characteristics of actuators such as DC motors, servo motors, and solenoid valves.
3.	To configure data acquisition systems and interface sensors and actuators using software tools.
4.	To develop microcontroller programs for basic automation tasks.
5.	To study and identify key components of industrial mechatronics, including robotic manipulators and conveyor systems.
6.	To design and implement hydraulic and pneumatic control circuits for motion control applications.

LIST OF EXPERIMENTS:

1.	To calibrate different types of sensors (e.g., temperature, pressure, light) using calibration standards and verify their accuracy.
2.	To measure the performance characteristics of actuators (e.g., DC motors, servo motors, solenoid valves) including speed, torque, and response time.
3.	To configure a data acquisition system to interface with sensors and actuators and collect data using software tools such as LabVIEW or MATLAB.
4.	To develop the Program different Micro controllers for simple applications.
5.	To study & operate the Production line conveyor &Identify the different components of mechatronics.
6.	To study the Robotic Manipulator& Identify the different components of mechatronics.
7.	To study the operation of directional control valves (e.g., spool valves, poppet valves) by controlling the direction of fluid flow and actuating hydraulic cylinders in different directions.
8.	To design and implement hydraulic circuits for various applications such as actuating cylinders, controlling pneumatic grippers, and sequencing operations using control valves.
9.	To study the operation of directional control valves (e.g., spool valves, poppet valves) by controlling the direction of air flow and actuating hydraulic cylinders in different directions.
10.	To design and implement pneumatic circuits for various applications such as actuating cylinders, controlling pneumatic grippers, and sequencing operations using control valves.

REFERENCE BOOKS:

1. W. Bolton, 'Mechatronics', Pearson Education New Delhi.
2. N P Mahalik, 'Mechatronics Principle, concept & Application, ' Tata McGraw-Hill, New Delhi.

COURSE OUTCOMES (COs):

CO1	Will be able to understand the working of different sensors.
CO2	Will be able to develop Program of different Microcontrollers.
CO3	Will be able to understand the application of PLC & develop ladder Program.
CO4	Will be able to develop the pneumatic circuits for different applications.

CO5	Will be able to develop the Hydraulic circuits for different applications.

Course Syllabi

B.Tech.(Mechanical Engineering)

SIXTH Semester

VI Semester- Course Details

S. No.	COURSE NUMBER	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	MEC-601	Fluid Machines	Theory	PCC	3	3	0	0	3
2	MEC-602	Refrigeration and Air conditioning	Theory	PCC	3	3	0	0	3
3	MEC-603	Design of Mechanical System	Theory	PCC	3	3	0	0	3
4	MEC-604	Computer Aided Manufacturing	Theory	PCC	3	3	0	0	3
5	MEE-601	Electro-Mechanical Energy Conversion	Theory	PEC	3	3	0	0	3
i	MEL-601	Fluid Machines Laboratory	Lab	PCC	1	0	0	2	2
ii	MEL-602	Refrigeration and Air Conditioning Lab	Lab	PCC	1	0	0	2	2
iii	MEL-603	Design of Mechanical Systems Practice Laboratory	Lab	PCC	1	0	0	2	2
iv	MEL-604	Computer Aided Manufacturing Lab	Lab	PCC	1	0	0	2	2
v	MEP-601	Seminar (Literature Review)		PROJ	1	0	0	2	2
				Total	**20**	**15**	**0**	**10**	**25**

VI Semester- Theory

S. No.	COURSE NUMBER	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	MEC-601	Fluid Machines	Theory	PCC	3	3	0	0	3
2	MEC-602	Refrigeration and Air Conditioning	Theory	PCC	3	3	0	0	3
3	MEC-603	Design of Mechanical System	Theory	PCC	3	3	0	0	3
4	MEC-604	Computer Aided Manufacturing	Theory	PCC	3	3	0	0	3
5	MEE-601	Electro-Mechanical Energy Conversion	Theory	PEC	3	3	0	0	3

MEC-601	Fluid Machines	PCC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

This course covers the principles and analysis of turbomachinery, including hydraulic turbines, pumps, compressors, fans, blowers, and gas turbines. It explores velocity triangles, efficiency, performance characteristics, losses, cavitation, and propulsion systems. The course also introduces unconventional turbomachines like wind and solar turbines.

COURSE OBJECTIVES:

To provide basic understanding of working and associated principles of Turbo Machines. This includes turbines, compressors, pumps, blowers, fans and other associated devices.

PREREQUISITES:

- Fluid Mechanics –I and II,
- Applied Thermodynamics

CONTENT:

Unit I **Introduction**: Fluid machines; classification, positive-displacement machines, turbomachines, basic laws and equations, Euler's equation for a turbomachine, steady flow energy equation, degree of reaction, aerodynamics of turbomachinery blading, propellers and windmills.
Dimensional Analysis and Model Testing: Buckingham's π theorem, significant dimensionless groups in fluid machinery, flow similarity and model studies, specific speed, unit quantities, thermodynamics of fluid flow; stagnation and static properties.

Unit II **Hydraulic Turbines:** Introduction, schematic layout of a hydro-electric power plant, Euler's equation for hydro-turbines, efficiencies of hydraulic turbine, classification of hydraulic turbines; impulse and reaction turbines, working and design aspects of **Pelton, Francis, Kaplan and Propeller turbines,** draft tube, specific speed, cavitation in turbines, performance characteristics of turbines, governing of turbines, comparison of turbines, selection of hydraulic turbines.

Unit III **Hydraulic Pumps:** Introduction, classification: **Positive-displacement pumps;** reciprocating type, rotary type, **Rotodynamic pumps;** centrifugal pump; priming, head developed, losses and efficiencies, theoretical head vs. discharge curve, velocity triangles, slip, effect of blade outlet angle on head vs. discharge characteristics, specific speed, performance characteristics, net positive suction head (NPSH) and cavitation, pumps in series and parallel, problems, **axial flow pumps;** working principle, performance characteristics, centrifugal vs. axial flow pumps, pump design.

Unit IV **Compressors, Fans and Blowers:** Introduction, classification, **centrifugal compressor;** working principle, velocity triangles, slip factor, power input factor, specific work and pressure rise, losses and efficiencies, T-s diagram, non-dimensional quantities, performance characteristics, surging, choking and rotating stall, **axial flow compressor;** description and principle of operation, stage velocity triangles, losses and efficiencies, T-s/h-s diagram, pressure ratio per stage, work done factor, flow coefficient, degree of reaction, performance characteristics, centrifugal vs. axial flow compressors, design of compressors, **Fans and Blowers;** terminology, difference between a fan, blower and a compressor, classification, velocity triangles, losses, performance

characteristics, fan laws and design parameters.

Unit V **Gas Turbines:** Introduction, Joule-Brayton cycle, classification; axial and radial flow gas turbines, velocity triangles and T-s diagram, performance characteristics.

Propulsive devices; turbojet, turboprop, bypass turbojet engines, thrust augmentation.

TEXTBOOKS:

1. Shepherd, D. G., Principles of Turbomachinery, Macmillan.

REFERENCE BOOKS:

1. Dakshina Murty, V. "Turbomachinery; Concepts, Applications, and Design", CRC Press, Taylor & Francis Group.
15. Douglas, Gasiorek, Swaffield and Jack, "Fluid Mechanics", Pearson Education.
16. S K Som & G Biswas, "Introduction to Fluid Mechanics and Fluid Machines" Tata McGraw-Hill Pub.
17. Saravanamuttoo, HIH., Cohen, H., Rogers, GFC., "Gas Turbine Theory", Pearson Education, Ltd.
18. Venkanna, B. K., "Fundamentals of Turbomachinery", PHI Learning Private Ltd.
19. S. L. Dixon and C. Hall, "Fluid Mechanics and Thermodynamics of Turbomachine

COURSE OUTCOMES (COs):

CO1	Will be able to carry out dimensional analysis and model testing for different fluid machine.
CO2	Will be able to analysis the performance of various hydraulic machines and will be able to carry out selection of hydraulic turbines for specific applications.
CO3	Will be able to analyze the performance characteristics of hydraulic pumps.
CO4	Will be able to analyze the performance characteristics of compressors, fans and blowers.
CO5	Will be able to conduct performance analysis of gas turbine and other propulsive devices.

MEC-602	Refrigeration and Air Conditioning	PCC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

This course covers refrigeration and air-conditioning principles, including the second law interpretation, vapor compression cycles, and compound compression systems. It explores refrigerants, absorption refrigeration, and cascade systems. Key refrigeration equipment such as evaporators, condensers, compressors, and expansion devices are studied, along with cooling towers and water treatment. Air-conditioning topics include psychrometry, comfort conditions, cooling load calculations, system design, and ductwork.

COURSE OBJECTIVES:

- Clear all concepts of Refrigeration Cycles
- Clear all concepts of Heating, Ventilation and Air-conditioning systems and cycles
- Introduce to Green, Intelligent Buildings
- Train students to work as an HVAC Engineer

PREREQUISITES:

- Thermodynamics
- Heat Transfer
- Fluid Mechanics

CONTENT:

Unit I The second law interpretation, Vapour compression cycle. Actual vapor compression cycle. Effect of Super Heating, the suction vapour, super-heating with useful cooling and super-heating, Liquid-Suction heat exchanger, removal Flash gas, Inter-cooling, Compound Compression with water inter-cooling, Compound Compression with liquid flash cooler. Cascade systems.

Unit II Refrigerants: classification of refrigerants, Designation of refrigerants, Selection of refrigerant, required properties of an ideal refrigerant, Secondary refrigerants, Brine.

Absorption Refrigeration System: Simple vapour absorption system, Co-efficient of Performance of absorption systems. Lithium -Bromide- Absorption refrigeration system, Brief Study of Domestic Refrigerators, Solar Refrigeration, Reversed Brayton cycle. Cooling towers, and water treatment plant.

Unit III Refrigeration Equipment: Evaporators: flooded evaporators, liquid chiller, direct expansion coil, Heat transfer during boiling. Fluid side heat transfer, Overall performance.

Condenser: Air cooled condensers, water cooled condensers, heat transfer in condensers, Fouling Factor, water side co-efficient, superheating, Finned tubes air cooled and evaporative condenser.

Expansion Devices: Automatic or constant pressure expansion valve, thermostatic Expansion valves. Capillary tube and its sizing.

Types of Compressors, Selection of Compressors for Refrigeration systems.

Unit IV	Air-conditioning: Psychrometry, Definition of Psychometric properties, Psychrometric relations, Psychrometric chart, Psychrometric processes, Thermodynamic wet bulb temperature, Calculation of air properties, Summer air-conditioning system for hot and dry outdoor conditions and for hot and humid air conditions, winter air-conditioning system, Year round air-conditioning system.
Unit V	Requirement of comfort air Air-conditioning: Effective temperature economic consideration for selecting the comfort point, Cooling load calculation; sum load, Load from occupants, equipment load, Infiltration air load, fan load, fresh air Load. Design of air-conditioning systems, Cooling load and air quantities, Central air-conditioning system, and unitary air-conditioning system, Comfort indices, Control, Duct design. Building automation system.

TEXTBOOKS:

1. Refrigeration and Air-conditioning by C.P. Arora, McGraw-Hill.

REFERENCE BOOKS:

1. Fundamental of Refrigeration by Dossat – McGraw Hill
2. Refrigeration and Air-conditioning by P.L. Ballaney, Khanna. Publication

Computer Usage / Software required:

Students can be introduced to basic simulation software such as Fluent; HEVACOMP, Primavera, and other CFD modelling techniques.

Other details regarding this course (if any):

HVAC is a big industry & student has prospects of becoming Design Engineer; Site Engineer; Procurement Engineer; Project Engineer etc.

COURSE OUTCOMES (COs):

CO1	Will be able to understand the working of different refrigerating machine and multi pressure systems.
CO2	Will be able to select suitable refrigerant for different refrigerating systems.
CO3	Will be able to analyze various refrigeration equipment like condenser, compressor etc.
CO4	Will be able to carry out the determination of air properties for different seasonal requirements.
CO5	Will be able to determine the performance parameter for achieving comfort air conditioning.

MEC-603	Design of Mechanical System	PCC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

This course is to serve as an introduction to mechanics of deformable solid bodies. The primary course objective is to equip the students with the tools necessary to design Machine components.

- To teach students how to design transmission shafts, with couplings and bearings
- Impart design principles involved in designing and analysing the modes of failure in transmission systems such as belts and pulleys, gears, etc.
- Formulation of solutions to problems of design of mechanical systems.

COURSE OBJECTIVES:

- Reinforce the philosophy that real engineering design problems are open-ended.
- Broaden skills in team work, critical thinking, communication, planning and scheduling through design projects/ case studies,
- The objective also includes working with CATIA, Solid works and other design software.

PREREQUISITES:

- Design of Mechanical Components
- Theory of Machines

CONTENT:

Unit I Shafts: Stresses in shaft, kinds and causes of failure in shafts. Transmission Shafts: Design calculation for strength and deflection. ASME CODE, Design ofhollow Shafts, Design of Flexible shafts. Fatigue consideration. Types of couplings. Design of Rigid Couplings: muff and flange coupling. Design of Flexible Couplings. Materials for shafts.

Unit II Bearings: Rolling Contact Bearings: Types of Rolling-contact Bearings(Ball & Roller), Principle of Self-aligning Bearing, Selection of Bearing-type, Static & Dynamic Load Carrying Capacities. Stribeck's Equation, Equivalent Bearing Load , Load-Life Relationship, Selection of Bearing Life, Load Factor, Selection of Bearing from Manufacturer's Catalogue, Design for Cyclic Loads and Speeds, Bearing with Probability of Survival other than 90 Per Cent, Bearing Failure—Causes and Remedies.

Sliding Contact Bearings: Basic Modes of Lubrication, Petroff's Equation, McKee's Investigation Hydrostatic and Hydrodynamic Bearings, Energy Losses in Hydrostatic Bearing, Reynold's Equation, Raimondi and Boyd Method, Temperature Rise, Bearing Design—Selection of Parameters, Bearing Constructions. Bearing Materials, Lubricating Oils and Additives, Selection of Lubricants, Bearing Failure—Causes and Remedies.

Unit III Power Transmission Systems: Types of drives. Comparison. Mechanical drives and their characteristics. Belt drives and types. Design of belts for strength. Theory and design of belt drives. Velocity ratio. Flat belts. V-belts. Selection of belts and belt materials.

	Surface strength and against bending. Design o chain drives.
Unit IV	Gear: Types of gears. Modes of gear failures. Force analysis for gears. Design of spur gear based upon contact stress. Beam strength of gear teeth. Lewis form factor and other factors affecting design of gear. Dynamic and static tooth load considerations. Design of spur gears based upon wear. Gear materials.
Unit V	Design of Gear Drives: Introduction to Gear box, Structural Diagram, Sliding-Mesh Gearing. Design calculation for spur gear (Straight tooth and inclined tooth) reducers. Materials for gears standards for spur gears. Lubrication & efficiency of a gear drive. Anatomy of machines; Functional dissection of motorcycle, washing machine, sewing machine, etc. Case studies on automobile suspensions, automatic transmissions, material conveyor systems, construction machinery, etc.

TEXTBOOKS:

1. Design of Machine Elements by Bhandari V B McGraw HI Book Co. 5th Ed
2. Mechanical Engineering. Design by J.E. Shigley, C.R. Mischke, McGraw HI Book Co.

REFERENCE BOOKS:

1. Fundamentals of Machine Component Design by R.C. Juvinall, John Wiley & Sons
2. Design of Machine Elements by Spots, Prentice Hall of India.
3. Fundamentals of Mechanical Component Design by Edwards and McKee, McGraw-Hill.
4. Machine Design by Robert L. Norton, Prentice Hall, USA

Computer Usage / Software required:

Language- C, C++; Fusion 360, Solid works, Pro/E, CATIA, ANSYS

Other details regarding this course:

Mini projects as assignments for improving the practice of design of mechanical system should be done.

COURSE OUTCOMES (COs):

CO1	Will be able to design shafts and mechanical couplings.
CO2	Wil be able to select and design rolling contact bearings and sliding contact bearings.
CO3	Will be able to design power transmission systems like belt and chain drives.
CO4	Will be able to design spur gears for transmitting power.
CO5	Will be able to design gear trains using spur and helical gears.

MEC-604	Computer Aided Manufacturing	PCC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

Computer-Aided Manufacturing, often abbreviated as CAM, is a technology-driven process that uses computer software and machinery to facilitate and automate manufacturing processes. Employed in various industries, CAM enables the translation of computer-aided design (CAD) into manufacturing instructions for computer numerical control (CNC) machines. Computer-aided manufacturing (CAM) has become mainstay in today's industry. Therefore, they should be an important part in the current teaching plan of the graduate Mechanical engineers.

COURSE OBJECTIVES:

Computer aided manufacturing is an interdisciplinary subject area. This course tries to build fundamentals and working knowledge of the subject.

PREREQUISITES:

- Production Engineering
- Computer Aided Design
- Fundamental of Computers

CONTENT:

Unit I Type of production: continuous, mass, batch and job shop. Computer aided engineering: Product cycle, influence of CAD/CAM on product cycle. Manufacturing Automation: Automation in industry: types and automation strategies, devices, drives and control circuits in automation. Numerical Control: History of NC/CNC Machines. Coordinate system of NC machines Axis designation. NC motion control systems: point-to-point, straight-cut and continuous path control systems, Economics of NC systems, Applications of NC in metal-cutting and non-metal cutting areas.

Unit II Computer numerical control: devices, drives and control circuits, PLCs, Block diagrams of CNC operations. Nomenclature, types and features of CNC machine tools. Elements of CNC machines and systems. Machine control unit. Position control and its significance. Engineering analysis of NC positioning systems. Open loop and closed loop systems. Precision in NC positioning systems: control resolution, accuracy and repeatability. Actuators: DC servomotor, ac servomotor, stepper motor. Transducers and feedback elements: resolvers, inductosyns optical grating and encoders.

Unit III Introduction to Process planning and flow chart for part programming. Tooling systems, tool nomenclature and tool geometries of modern indexable carbide tools. Tool presetting& Modular Tooling. Selection of tools based on machining capacity, accuracy and surface finish. Elements of programming for turning and milling. NC code generation: Preparatory codes G, Miscellaneous functions M. Interpolation, Tool compensations, cycles for simplifying programming. Part programming for typical components on turning machines and machining centres, Computer aided programming.

Unit IV Modern CNC machines: CNC lathes. Turning centres. Machining centres. Automatic pallet changers. Automatic tool changers. Direct numerical control and applications. CNC machine design features. Supporting structures. Guide ways. Ball screw-and-nut

	mechanisms. Machine spindles. Concept of rigidity and relation with accuracy. Computer aided Inspection: Contact and non-contact sensing technologies, Introduction to machine vision and applications of optical inspection, Coordinate measuring machines and their applications.
Unit V	Manufacturing system: performances and analysis of manufacturing system, Group technology (G.T), Cellular manufacturing System, Reconfigurable manufacturing system, FMS and CIM, Computer Aided Process Planning (CAPP), Material requirement planning (M.R.P), Material handling system: conveyors – AGVs, Industrial robots.

TEXTBOOKS:

1. Automation Production System and Integrated Manufacturing, Grover M. P., Prentice Hall of India, New Delhi.
2. CAD/CAM Principle and Application, PN Rao, Tata McGraw Hill Publishing Co. Ltd, New Delhi.

REFERENCE BOOKS:

1. Computer Integrated Design and Manufacturing, David D. Bedworth, McGraw Hill Inc. Singapore.
2. CAD/CAM", Grover M.P, "Prentice Hall of India, New Delhi.

Computer Usage / Software required:
CNC MILLING and CNC TURNING, MASTER CAM Package

COURSE OUTCOMES (COs):

CO1	Will be able to understand and classify various production systems and suggest suitable system for different product.
CO2	Will be able to understand the systems for CNC and DNC.
CO3	Will be able to prepare a process plan for a given product and generate an NC code.
CO4	Will be able to recommend the CAI schemes using optical CMM for given application.
CO5	Will be able to perform CAPP, MRP and understand the working of different material handling systems.

MEE-601	Electro-Mechanical Energy Conversion	PEC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

This course covers the principles, construction, and performance characteristics of electrical machines, including three-phase induction motors, synchronous generators, and synchronous motors. It explores single-phase motors, stepper motors, switched reluctance motors, and PMMC motors, along with their characteristics and control methods. Standard voltage levels in generation and transmission, generating stations, substations, and their components are discussed. Additionally, the course introduces switchgear, relays, timers, PLCs, ADCs, and DACs. Fundamental power electronics concepts, including SCR characteristics, switching methods, rectifiers, inverters, choppers, AC voltage controllers, and motor speed control, are also covered.

COURSE OBJECTIVES:

To transfer the basic knowledge of electrical engineering to the students of Mechanical engineering, and also for allied Mechanical Engineering Jobs.

PREREQUISITES:

- Elements of Electrical and Electronics Engineering

CONTENT:

Unit I	Three Phase Induction Motor: Construction, Principle of operation, torque-slip characteristics, relation between slip and speed, losses, speed control.
Unit II	Synchronous Generator: Principle of operation, emf equation, voltage regulation by synchronous impedance method, efficiency. Synchronous Motor: Principle of operation, effect of excitation, V-curves.
Unit III	Single phase induction motor, Stepper motor, Switch reluctance motor, PMMC motor their characteristic and control. Standard voltages used in generation, transmission. Generating station, sub-station: equipment and layout.
Unit IV	Switchgear, relays, timers: their types, Introduction to PLC, ADC (Analog to digital converter), DAC (Digital to Analog converter).
Unit V	Power Electronics and application: Characteristics of SCR, Turn ON-Off methods, rectifier, inverter, chopper, AC voltage controller, speed control of ac and dc motor.

TEXTBOOKS:

1. Robert Boylested, Louis Nashelky, “Electronic Devices and Circuit Theory” Sixth Edition, Prentice Hall of India Pvt. Ltd. New Delhi, India.

REFERENCE BOOKS:

1. Electric Machinery Fundamentals, Stephen J. Chapman, McGraw Hill Book Co.
2. Digital Circuits and Logic Design, Morris Manno, Prentice Hall of India Pvt. Ltd., New Delhi.
3. Electrical Machines, NagrathI.J. and D.P. Kothari, Tata McGraw Hill, New Delhi.
4. Introduction to Power Electronics Rashid, M. H, Prentice Hall, India, New Delhi.

Computer Usage / Software required:

- MATLAB, etc.

COURSE OUTCOMES (COs):

CO1	Understanding the concepts principles and operation of three phase induction motor.
CO2	Learning the working, principle and characteristics of synchronous motor and generator.
CO3	Expanding the knowledge of various types of motors and their characteristics.
CO4	Principle and design of switchgear and their types.
CO5	Basics of power electronic and its application.

VI Semester- Laboratory

S. No.	COURSE NUMBER	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
i	MEL-601	Fluid Machines Laboratory	Lab	PCC	1	0	0	2	2
ii	MEL-602	Refrigeration and Air Conditioning Lab	Lab	PCC	1	0	0	2	2
iii	MEL-603	Design of Mechanical Systems Practice Laboratory	Lab	PCC	1	0	0	2	2
iv	MEL-604	Computer Aided Manufacturing Lab	Lab	PCC	1	0	0	2	2
v	MEP-601	Seminar (Literature Review)		PROJ	1	0	0	2	2

MEL-601	Fluid Machines Laboratory	PCC	L	T	P	C
		2Hrs	0	0	2	1

COURSE OBJECTIVES:

1.	To understand the application of basic fluid flows in various fluid machines.
2.	To apply the principle of instrumentation and measurement in various fluid machines.
3.	To conduct the performance measurement of fluid machines, e.g. turbines, pumps, compressor, etc.

LIST OF EXPERIMENTS:

1.	To study the mean flow characteristics of a free air jet and to study the application of the integral form of the continuity, momentum and energy equations.
2.	To determine the drag force on a circular cylinder placed in a uniform stream of air.
3.	To draw pressure distribution around a circular cylinder for laminar and turbulent flows and identify the point of flow separation and recirculation zone.
4.	To study the Pelton turbine and perform experiment to draw its operating characteristics curve.
5.	To study the Kaplan turbine and perform experiment to draw its operating characteristics curve.
6.	To study the Centrifugal pump and perform experiment to draw its operating characteristics curve.

REFERENCE BOOKS:

1. Shepherd, D. G., Principles of Turbomachinery, Macmillan.
2. REFERENCE BOOKS:
3. Cherkassky, V. M., Pumps, Fans and Compressors, Mir Publishers,
4. Yahya, S. M., Turbines, Fans and Compressors,
5. Douglas, J.F., Gasiorek, J.M., Swaffield, J.A., and Jack, L.B., Fluid Mechanics, Pearson Education, Ltd.

COURSE OUTCOMES (COs):

CO1	Will be able to determine the mean flow characteristics of a free air jet and will be able to interpret the integral form of the continuity, momentum and energy equations.
CO2	Will be able to determine the drag force on a circular cylinder placed in a uniform stream of air.
CO3	Will be able to draw pressure distribution around a circular cylinder for laminar and turbulent flows and identify the point of flow separation and recirculation zone.
CO4	Will be able to experimentally determine the operating characteristics of Pelton and Kaplan turbine.
CO5	Will be able to experimentally determine the operating characteristics Centrifugal pump.

MEL-602	Refrigeration and Air Conditioning Lab	PCC	L	T	P	C
		2Hrs	0	0	2	1

COURSE OBJECTIVES:

1.	To understand the working principles, components, and performance parameters of refrigeration and air-conditioning systems.
2.	To analyze the effects of load variation, energy balance, and efficiency in refrigeration and heat pump systems.
3.	To perform fundamental processes in refrigeration systems, including copper piping, flaring, soldering, bending, and pressure testing.
4.	To study different types of valves used in refrigeration and air-conditioning applications.
5.	To examine the operation and performance of cooling towers, air coolers, and dehumidifiers under varying conditions.
6.	To conduct psychrometric analysis of air-conditioning processes, including air mixing, heating, humidification, and energy recovery ventilation.
7.	To evaluate energy consumption, efficiency improvements, and sustainability aspects of refrigeration and air-conditioning systems.

LIST OF EXPERIMENTS:

1.	To understand the working of Vapor Compression unit, its components, find the effect of load variation on evaporator, condenser pressure, work of compression condenser water circulation rate and make Energy balance analysis.
2.	To conduct experiment for the analysis if Heat Pump and energy consumption
3.	To perform simple processes used in Copper piping like flaring, cutting, soldering, bending at different angles and pressure testing applied in refrigeration systems.
4.	To study various type of valve used in air-conditioning and refrigeration industries distinguish in it application
5.	To understand a Cooling Tower Set up, working and perform tests to analyze the effect of inlet water temperature air circulation and variation in its performance
6.	To Conduct experiment on Air Coolers and understand humidifying efficiency, Adiabatic Humidification process. Find the effect of water Circulation.
7.	To understand DBT, WBT, DPT and conduct experiment on mixing of air, Sensible heating, Humidification in air conditioning Tet rig and do its Psychrometric analysis.
8.	To work on the Energy Recovery Ventilation system (ERV) and understand the use of power saving in 100% Fresh Air- Circulation. Also Calculate the Pay Back Period for application where it is utilized
9.	To Study the components and understand the Ejector Refrigeration System
10.	To study a Dehumidifier and its use.

REFERENCE BOOKS:

1. Refrigeration and Air-conditioning by C.P. Arora, McGraw-Hill.
2. Fundamental of Refrigeration by Dossat – McGraw Hill
3. Refrigeration and Air-conditioning by P.L. Ballaney, Khanna. Publication

COURSE OUTCOMES (COs):

CO1	Will be able to analysis of Vapor Compression System and Heat Pump.
CO2	Will be able identify the application of various valves in Refrigeration systems.

CO3	Will be able to carry out the analysis of Air Cooler and Cooling Tower.
CO4	Perform and analyze Comfort Air-Conditioning, Energy saving in systems.
CO5	Will be able to understand the applications of new technologies like Ejector refrigeration and Dehumidifier.

MEL-603	Design of Mechanical Systems Practice Laboratory	PCC	L	T	P	C
		2Hrs	0	0	2	1

COURSE OBJECTIVES:

1.	To design shafts, couplings, and bearings based on strength criteria and industry standards.
2.	To analyze and select suitable belt, chain, and gear drives for mechanical power transmission.
3.	To apply AGMA standards and Buckingham's equation for spur gear design and evaluate performance.
4.	To develop and simulate gearboxes, mechanical systems, and machine components using software tools.
5.	To conduct case studies on real-world mechanical systems such as transmissions, conveyor systems, and suspensions using simulation techniques.

LIST OF EXPERIMENTS:

1.	Design of shaft using strength criteria and ASME CODE.
2.	Design of Rigid and Flexible Couples for Transmission Shaft
3.	Load and Life calculations for Ball and Roller Bearing, Selection of RCB
4.	Design of Sliding Contact Bearings
5.	Design Problems on: i) Flat Belt Drives ii) V Beld Drives iii) Chain Drives
6.	Design of Spur Gear using Bending strength and surface strength Criteria.AGMA design of Spur Gears
7.	Design of Spur gears using Buckingham equation.
8.	Design of Sliding Mesh Gear Box using simulation software
9.	Anatomy of Mechanical System using Simulation software, e.g. Fusion 360
10.	Group Case studies on Mechanical Systems, e.g., automobile suspensions, automatic transmissions, material conveyor systems, construction machinery, etc, using simulation.

REFERENCE BOOKS:

1. Mechanical Engineering. Design by J.E. Shigley, C.R. Mischke, McGraw HI Book Co.
2. Fundamentals of Machine Component Design by R.C. Juvinall, John Wiley & Sons.

COURSE OUTCOMES (COs):

CO1	Will be able to carry out the design of shaft and flexible couplings
CO2	Will be able to design Rolling and Sliding Contact bearings.
CO3	Will be able to design and belt and chain under different applications.
CO4	Will be able to design and analyse Spur gears
CO5	Will be able to Gear Drives and analyze the anatomy of machines and case studies of mechanical systems.

MEL-604	Computer Aided Manufacturing Lab	PCC	L	T	P	C
		2Hrs	0	0	2	1

COURSE OBJECTIVES:

1.	Understand the components, layout, and functions of CIM systems, CNC machines, and PLCs.
2.	Develop and simulate CNC programs for various machining operations.
3.	Explore industrial automation technologies including robots, AGVs, conveyors, and AS/RS.

LIST OF EXPERIMENTS:

1.	To study the layout and components of CIM.
2.	To study specifications, components and operations of a CNC Lathe machine.
3.	To study specifications, components and operations of a CNC Milling machine.
4.	To study specifications, components and operations of a CNC Wire-Cut EDM machine.
5.	To study specifications, components and operations of a PLC.
6.	To study Point-To-Point control system by drilling a set of holes in given metal plate using CNC Milling Machine.
7.	To study Straight cut control system by pocket milling in given workpiece using CNC Milling Machine.
8.	To study Contouring control system by cutting a slot of given contour in given metal plate using CNC Milling Machine.
9.	To make a component on a CNC Lathe machine.
10.	To make and simulate CNC program.
11.	To study specifications, configuration and operation of an Industrial Robots.
12.	To study various types of material handling equipment such as conveyors, AGV etc.
13.	To study Automated Storage and Retrieval System.

REFERENCE BOOKS:

1. Heat and Mass Transfer by P.K. Nag (McGraw Hill Education).
2. Fundamentals of Heat and Mass Transfer by Frank P. Incropera and David P. DeWitt (Wiley).

COURSE OUTCOMES (COs):

CO1	Will be able to apply computer-aided technologies such as CAD, CAM, CNC, PLC, Robots, AS/RS for efficient and accurate manufacturing processes.
CO2	Will be able to develop and simulate machining programs for various CNC.
CO3	Machines using CAM software package.
CO4	Will be able to execute machining programs for various CNC machines using software package and verify the accuracy and quality of the machined parts.
CO5	Will be able to verify the accuracy and quality of the machined parts made on various CNC machines.

Course Syllabi

B.Tech.(Mechanical Engineering)

SEVENTH Semester

VII Semester- Course Details

S. No.	COURSE NUMBER	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	MEE-701	Industrial Engineering	Theory	PEC	3	3	0	0	3
2	MEE-702	I. C. Engines	Theory	PEC	3	3	0	0	3
3	MEE-703	Machinery Dynamics & Vibration	Theory	PEC	3	3	0	0	3
4	MEO-701	Elective (THERMAL & FLUID)	Theory	OEC	3	3	0	0	3
i	MEL-701	Industrial Engineering Laboratory	Lab	PEC	3	3	0	0	3
ii	MEL-702	Heat Engines & Solar Energy Laboratory	Lab	PEC	2	0	0	2	2
iii	MEL-703	Machinery Dynamics & Vibration Laboratory	Lab	PEC	2	0	0	2	2
iv	MEP-701	Summer Internship	Project-II	PROJ	2	0	0	4	4
v	MEP-702	Project	Project-III	PROJ	3	0	0	6	6
				Total	**20**	**15**	**0**	**10**	**25**

VII Semester- Theory

S. No.	COURSE NUMBER	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	MEE-701	Industrial Engineering	Theory	PEC	3	3	0	0	3
2	MEE-702	I. C. Engines	Theory	PEC	3	3	0	0	3
3	MEE-703	Machinery Dynamics & Vibration	Theory	PEC	3	3	0	0	3
4	MEO-701	Elective (THERMAL & FLUID)	Theory	OEC	3	3	0	0	3

MEE-701	Industrial Engineering	PEC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:
This course is designed to provide a comprehensive understanding of industrial engineering concepts at the undergraduate level for mechanical engineering students. This contains a good blend of classroom teaching as well as practical applications.

COURSE OBJECTIVES:

This course provides an understanding of industrial engineering concepts at the undergraduate level for mechanical engineering students. This contains a good blend of classroom teaching as well as practical applications.

- This course would be covered in 3- lectures per week for at least 14 weeks. Tutorials shall be held after the lectures. Course materials and assignments shall be provided as and when required.
- Study material shall be provided as and when required. Students must explore Study material from open courseware like NPTEL, IGNOU, open courseware, etc.
- Assignment should be submitted on the next class to the class representative.
- Students can communicate any new developments in the subject online. Students will present their experiences through presentations during Laboratory classes.
- Please refer to jmi web site and other websites for open courseware.
- Student evaluation will be holistic and based on class performance in different tests, attitude of learning, innovative learning, assignments and overall discipline. Attendance will be one of the criteria to see the student's sincerity.

PREREQUISITES:
- Operation Research
- Engineering Economy and Management.

CONTENT:

Unit I
- Contribution of Industrial engineering in everyday life. Definition and scope of Industrial Engineering, some historical developments. Production and production systems.
- Systems approach in problem identification and solving, brief of some other methods
- Role of Innovation and disruptive innovations in development of Industrial Engineering
- The general problem-solving approach.
- Productivity, Manufacturing process technology and its relevance, Site location and factors affecting site location.
- Plant location and capacity planning, Facility design, and Assembly line balancing.
- Learning curve

Unit II
- Motion and Time Study, definition, importance, limitations & historical background. Process Analysis through charts: Process charts, activity charts, man & machine charts and operation process charts. Motion study: Motion analysis,

	camera study, micro-motion study, cyclograph and chronocyclograph. Fundamental hand motions. Principles of motion economy and the human body, workplace arrangement with respect to tools and equipment. Micro motion Study, SIMO Charts • Time Study: Stopwatch time study: Information recording, data recording by continuous, repetitive and cumulative timing, determining the number of observations, the rating factor, performance rating, allowances determination, normal and standard time. • Work sampling: theory, procedures, and applications. Synthetic time and introduction to predetermined times • Some real-life examples of the application and relevance of IE in Industry 4.0
Unit III	• Inventory: reasons for holding inventory, Inventory concepts, inventory costs, and Inventory models assuming certainty. Inventory management. Selective inventory control like VED (vital/Essential/Desirable), FSN (Fast/Slow and Non-moving inventory items) etc., • Inventory models with safety stock. • Material Requirement Planning (MRP). Introduction to Enterprise Resource Planning. • Just in Time Systems • Supply Chain Management and critical chain • Material Handling &Reliability
Unit IV	• Quality: evolution of Quality concepts in industry, historical perspective, definition. Importance to services and manufacturing. Basic quality-related concepts. Quality dimensions. Economics of Quality: quality is free. Acceptance sampling plans by attributes, Operating Characteristic Curve, producing and consuming risks. • Single, double and sequential sampling plans. Acceptance sampling by variables. Average outgoing quality. Limitations and importance of Sampling plans
Unit V	• Quality Management, Quality Circle. Quality Systems. Seven Quality control tools • Control charts for variables. Control chart for attributes. • Total Quality Management. Business Process Redesign and Breakthrough improvements

TEXTBOOKS:

1. Martinich, Joseph S, "Production and Operations Management", an Applied `Modern Approach", John Wiley, Re. Ed
2. Stevenson, Operations Management, McGraw Hill

REFERENCE BOOKS:

20. Unit 1 Industrial Engineering NPTEL material, in-house study material to be provided
21. Unit 2 Motion and Time Study Design and Measurement of Work", Ralph M. Barnes, John Wiley & Sons. New York. NPTEL, TED/TEDx
22. Unit 4 & 5 Introduction to Statistical Quality Control, Douglas C. Montgomery, John Wiley & Sons. New York
23. Total Quality Management by Besterfield, Pearson Education; NPTEL, TED/TEDx.

Computer Usage / Software required:

MS EXCEL and other Industrial Engineering Software.

Other details regarding this course

This course is predominantly important in industry and needs lots of industrial visits and awareness of what best practices are being followed.

COURSE OUTCOMES (COs):

CO1	Will be able to understand the significance of industrial engineering in industrial applications and solve problem of industrial organizations.
CO2	Will be able to conduct motion and time study for an industrial process.
CO3	Will be able to conduct MRP, ERP, JIT, etc., for an industrial organization.
CO4	Will be able to carry out quality evolution of the product using different methods.
CO5	Will be able to understand the basic concepts of quality management.

MEE-702	I. C. Engines	PEC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

This course introduces the fundamentals of internal combustion engines, including their classification, working principles, and performance analysis. Topics cover S.I. and C.I. engine operation, combustion processes, abnormal combustion, scavenging, supercharging, and turbocharging. Students will study fuel systems, emission characteristics and control, as well as conventional and alternative fuels such as biodiesel, ethanol, and hydrogen. The course provides a balanced understanding of engine design, fuel behavior, and emission challenges for sustainable automotive applications.

COURSE OBJECTIVES:

- To impart knowledge and understanding of basic concept and working of different types of Engines.
- To make the student capable enough to be employed by Engine Manufacturers.

PREREQUISITES:

- Applied Thermodynamics
- Fluid Mechanics
- Heat and Mass Transfer

CONTENT:

Unit I I.C. Engines: Introduction and Engine classification, Air Standard Cycles, Fuel Air Cycles and Actual Cycle, Analysis of air standard cycles, working principle of S.I. and C.I. Engines operation. Merits and demerits of 2-Stroke and 4-Stroke Engines. Scavenging of Two Stroke Engines; dual fuel and multi fuel engines, Introduction of Supercharging & Turbo charging.

Unit II S.I. Engines: Introduction- Theories of combustion and Stages of Combustion in S.I Engines.Abnormal Combustion, Effect of Engine Variables on Knock; Fuel metering, Carburetion and Fuel injection systems. Multi Point Fuel injection

Unit III C.I. Engines: Introduction-Theories of combustion, Stages of Combustion in C. I. Engines, abnormal combustion Significance of Delay Period on Knocking phenomena, Influence of Various Factors on Delay Period, Comparison of Knock in SI and CI Engines, Variable Compression Ratio Engines.

Unit IV Air Pollution and emersions: Exhaust Emissions from S.I& C I Engines & its Control.

Unit V Fuels: Fuels used in S.I., C.I. Engines, Alternative Fuels, Bio Diesel, Bio Ethanol, Bio Hydrogen, Fuel characteristics and their rating. Advanced fuels.

TEXTBOOKS:

1. Internal Combustion Engine by V. Ganesan; Tata McGraw Hill Publication

REFERENCE BOOKS:

1. Internal Combustion Engines Fundamentals by John B. Heywood; McGraw Hill

2. Internal Combustion Engines and Air Pollution, by Edward F. Obert Harper & Row Publishers
3. Internal Combustion Engine by Sharma &Mathur; Dhanpat Rai & Sons

COURSE OUTCOMES (COs):

CO1	Will be able to analyze different thermodynamic cycles employed in operation of SI and CI engines.
CO2	Will be able to analyze the conditions leading to abnormal combustion and carry out the analysis of fuel metering of an SI engine.
CO3	Will be able to analyze the conditions leading to knocking in CI engine.
CO4	Will be able to conduct the measurement and analysis of exhaust gas emissions for SI and CI engines.
CO5	Will be able to formulate and select suitable fuel for operations of IC engines.

MEE-703	Machinery Dynamics & Vibration	PEC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

This course covers the fundamentals of vibrations in mechanical systems, including free and forced vibrations of single, two, and multi-degree-of-freedom systems. It explores damping effects, response under harmonic forces, vibration absorbers, and modal analysis. The course also introduces approximate methods for natural frequency determination and studies vibrations in continuous systems, including beams, shafts, and strings.

COURSE OBJECTIVES:

1.	Understand undamped SDOF systems and its relation to a vibrating system
2.	Understand Damped SDOF systems-viscous (underdamped, critically damped and overdamped) and coulomb friction, their differences and relation to real world
3.	Understand Forced Motion due to harmonic loading and rotating unbalance
4.	Understand the concept of lumped parameter analysis to represent a system as a set of masses, springs and dampers to evaluate the vibration characteristics of the system.

PREREQUISITES:

- Theory of Machines
- Machine Dynamics
- Engineering Mathematics

CONTENT:

Unit I Balancing: Introduction to static and dynamic balancing. Balancing of a single and a number of rotating weights by another weight rotating in the same plane. Balancing of a number of weights rotating in different planes. Balancing of reciprocating parts of an engine. Partial balancing of primary forces. Balancing of two and four cylinder in a line engine. Balancing of V /radial engines. Direct and reverse crank method. Balancing machines.

Unit II Free, undamped and damped vibrations of single degree of freedom systems: Importance of the study of vibration, basic concepts of vibration, classification of vibration, vibration analysis procedure, free vibrations of undamped and damped, translational & torsional, single degree of freedom systems, derivation and solution of equations of motion using different methods. Free vibration with viscous damping, coulomb damping and hysteretic damping.

Unit III Forced vibrations of single degree of freedom systems: response of an undamped system under harmonic force, response of a damped system under harmonic force, response of a system under the harmonic motion of the base, response of a damped system under rotating unbalance, transfer-function approach, solutions using Laplace Transforms.

Unit IV Free and forced vibrations of multi degree of freedom systems: Two Degree of freedom Systems, Coordinate Coupling and Principal Coordinates, Semi-definite Systems, vibration absorbers. Modelling of continuous systems as multi-degree of freedom systems, derivation of equations of motion using influence coefficients, Lagrange's equations, generalized coordinates and generalized forces, Eigenvalue problem, solution of the eigenvalue problem, free vibration of undamped systems, forced vibration of undamped systems using modal analysis.

Unit V	Vibration Measurement and Control: Introduction, Transducers, Vibration Pickups, Frequency-Measuring Instruments, Vibration Exciters, Signal Analysis, Dynamic Testing of Machines and Structures, Experimental Modal Analysis, Machine-Condition Monitoring and Diagnosis. Vibration Nomograph and Vibration Criteria, Reduction of Vibration at the Source, Whirling of Rotating Shafts, Control of Vibration, Control of Natural Frequencies, Vibration Isolation, Vibration Absorbers.

TEXTBOOKS/REFERENCE BOOKS:

1. Theory of Mechanism and Machines by Ghosh &Malick, Affiliated East-West Publications.
2. Theory of Machines by Thomas Bevan CBS Publishers and Distributor, N. Delhi.
3. Theory of Machines and mechanisms, Shigley, MGH
4. Mechanism and Machine Theory by J.S. Rao and R. V Dukkipati,· Wiley Eastern
5. Mechanical Vibrations (Sixth Edition in SI Units) by Singiresu S. Rao, Pearson Education, 2018
6. Mechanical Vibrations by G.K. Grover, Nem Chand Bros. Roorkee.
7. An Introductory course on Theory & Practice of Mechanical Vibrations by J.S. Rao & K. Gupta, Wiley Eastern Ltd

COURSE OUTCOMES (COs):

CO1	Will be able to dynamically balance a given rotary and reciprocating system.
CO2	Will be able to formulate and solve equation of motion for free vibration of single degree of freedom system.
CO3	Will be able to formulate and solve equation of motion for forced vibration of single degree of freedom system.
CO4	Will be able to formulate and solve equation of motion for two degree of freedom, multi-degree of freedom and continuous systems.
CO5	Will be able to conduct measurement and control of vibration of a system.

MEO-701	Non- Conventional Sources of Energy, Elective (THERMAL & FLUID)	OEC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

This course introduces the principles, technologies, and applications of renewable and non-conventional energy sources as sustainable alternatives to fossil fuels. It covers the fundamentals of energy demand, consumption trends, and the need for diversifying energy resources in the context of environmental and economic challenges.

COURSE OBJECTIVES:

1.	To introduce the need and importance of renewable and non-conventional energy sources in the global energy scenario.
2.	To study the working principles, design, and applications of solar, biomass, wind, tidal, geothermal, ocean, and waste-to-energy systems.
3.	To analyze the performance, potential, and limitations of different non-conventional energy technologies.
4.	To develop the ability to evaluate and apply sustainable energy solutions for real-world applications.

PREREQUISITES:

- Fluid Mechanics I & II
- Applied Thermodynamics
- A. T. H. T

CONTENT:

Unit I : Introduction: Sources of conventional and renewable energy, Trends of energy consumption, Fossil fuel availability and limitations, need to develop new energy sources, Energy Economy.

Unit II : Solar Energy: Solar radiation, Characteristics and estimation, Solar Collectors, Flat Plate and concentrating types: Their comparative study, design, Heating of air and water for the building and other uses. Thermal storages, Solar Ponds, Solar pumps, Solar Power, Solar Cookers etc. Direct Conversion of Solar Energy to electricity.

Unit III : Biomass system: Biomass conversion – Combustion, gasification, aerobic digestion, pyrolysis, digesters and their design; Performance analysis & testing - Thermal applications & power generation.

Unit IV : Wind energy: Wind turbines and their characteristics; Types of rotors, horizontal axis and vertical axis system, system design, site selection and Performance analysis. Tidal energy: Sites, potentiality and possibility of harnessing from site, limitations.

Unit V : Geo-thermal Energy: Sites, potentiality and limitation, study of the different conversion systems.

Ocean Energy: Principle of utilization and its limitations, description of various systems. Energy from the waste and other sources.

TEXTBOOKS:

1. G.N. Tiwari & Suneja – *Solar Thermal Energy Systems*, Narosa Publishing House.

REFERENCE BOOKS:

1. S.P. Sukhatme & J.K. Nayak – *Solar Energy: Principles of Thermal Collection and Storage*, Tata McGraw Hill.
2. H.P. Garg (Ed.) – *Advances in Solar Energy Technology*, D. Reidel Publishing.
3. A.N. Mathur – *Biogas Production, Management and Utilization*, Himansu Publication.
4. K.C. Khandelwal & S.S. Mahdi – *Practical Handbook on Biogas Technology*, Tata McGraw Hill.

COURSE OUTCOMES (COs):

CO1	Explain the role and necessity of renewable and non-conventional energy in the current and future energy mix.
CO2	Demonstrate understanding of solar energy systems and their applications in power and thermal sectors.
CO3	Analyze biomass, wind, tidal, geothermal, ocean, and waste-to-energy technologies for sustainable energy generation.
CO4	Evaluate the performance, design considerations, and limitations of various non-conventional energy systems.
CO5	Propose appropriate renewable energy solutions for practical and industrial applications.

VII Semester- Laboratory

S. No.	COURSE NUMBER	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
i	MEL-701	Industrial Engineering Laboratory	Lab		1	0	0	2	2
ii	MEL-702	Heat Engines & Solar Energy Laboratory	Lab		1	0	0	2	2
iii	MEL-703	Machinery Dynamics & Vibration Laboratory	Lab		1	0	0	2	2
Iv	MEP-701	Summer Internship	Project-II	PROJ	2	0	0	4	4
v	MEP-702	Project	Project-III	PROJ	3	0	0	6	6

MEL-701	Industrial Engineering Laboratory	PCC	L	T	P	C
		2Hrs	0	0	2	1

COURSE OBJECTIVES:

1.	To study Layout of Factory/ Office/ workshop
2.	To perform motion and time study
3.	To draw a Control chart for variables, Control chart for defects and Determine the Process Capability of a machine tool
4.	To undertake ABC analysis of given inventory datasets
5.	To undertake an exercise on discrete event simulation

LIST OF EXPERIMENTS:

1.	Draw Layout of Factory/ Office/ workshop /etc. and suggest possible improvements. (Using REL chart method / some relevant plant layout software to experiment). Give focus on your simulations and improvement. Provide all reasonable assumptions, methodology figures and appropriate analysis.
2.	Draw a Flow Process Chart for a process of your choice. Also, draw its improved version. Give figures, assumptions and suggested improvements.
3.	Draw a Left hand and Right-hand chart of any process of your choice. Suggest possible improvements. (Use standard formats to provide all possible assumptions, figures and appropriate improvements).
4.	Draw a SIMO chart for the process of your own choice. Give figures, relevance and assumptions and suggest possible improvements.
5.	Draw a Control chart for variables for a given sample of rivets coming from a continuous stream of lots. Draw Mean and Range charts with appropriate data. Give assumptions and limitations also. Use software to support your results.
6.	Determine the Process Capability of a machine tool, manufacturing rivets and specify the tolerances for this job based on the process capability study.
7.	Time study the process of your choice with the help of your stopwatch. Provide relevant materials. List all assumptions. Suggest limitations and improvements.
8.	Draw a Control chart for defects with the help of proper software to plot this Chart and suggest improvements. Alternatively, draw a Control chart for per cent defective with the help of proper software and suggest improvements.
9.	Undertake ABC analysis of given inventory datasets. Use Ms excel to analyse. Further classification can also be made.
10.	To undertake an exercise on discrete event simulation with the help of a selected data set/problem of your choice and software of choice.

REFERENCE BOOKS:

1. Motion and Time Study: Design and Measurement of Work by Ralph M. Barnes, Wiley; 7th edition (1 October 1980), ISBN-13 : 978-0471059059.
2. Statistical Quality Control by Douglas C. Montgomery, John Wiley & Sons; 7th Edition (21 June 2012), ISBN-13: 978-1118146811.

COURSE OUTCOMES (COs):

CO1	Will be able to draw layout of production facility & precribe possible improvements.

CO2	Will be able to prepare draw flow process chart for an industrial process & prescribe possible improvements.
CO3	Will be able to prepare control chart for different variables for a given sample of products & draw mean and standard deviation charts.
CO4	Will be able to determine the process capability of a machine tool manufacturing.
CO5	Will be able to conduct time study of the different processes

MEL-702	Heat Engines & Solar Energy Laboratory	PCC	L	T	P	C
		2Hrs	0	0	2	1

COURSE OBJECTIVES:

1.	To provide hands-on understanding of the construction, working, and performance characteristics of internal combustion (IC) engines and their auxiliary systems.
2.	To develop the ability to conduct performance tests on diesel and petrol engines, compressors, and analyze parameters such as efficiency, fuel consumption, and energy balance.
3.	To familiarize students with fuel supply systems (carburetor, fuel pump, and injector) and their role in engine operation and performance.
4.	To introduce experimental techniques for evaluating the performance of solar photovoltaic (PV) cells under varying conditions of tilt angle, radiation, and technology type.
5.	To strengthen practical skills in experimental data collection, analysis, and interpretation related to heat engines and solar energy systems.

LIST OF EXPERIMENTS:

1.	To study the various components of an I.C. Engine and to draw the valve timing diagram for 2- stroke engines.
2.	To study the fuel pump and injector of a Diesel Engines.
3.	To study the carburetor of an SI Engine.
4.	To determine the mechanical efficiency of a Ruston Diesel engine by drawing Williams line and to plot the various curves
5.	To determine the mechanical efficiency of a four stroke, 4- cylinder petrol engines by performance
6.	Performance test on a kirlosker diesel engine
7.	To draw the energy balance sheet for kirlosker diesel engine
8.	Performance test on two stage reciprocating air compressor
9.	To study the effect of the tilt angle and radiation on the power output of solar cell
10.	To compare poly crystalline and thin film solar cells

REFERENCE BOOKS:

1. Internal Combustion Engines – V. Ganesan, Tata McGraw Hill
2. Thermal Engineering – P.L. Ballaney, Khanna Publishers
3. Solar Photovoltaics: Fundamentals, Technologies and Applications – Chetan Singh Solanki, PHI Learning
4. Solar Engineering of Thermal Processes and Photovoltaics – Duffie & Beckman, Wiley

COURSE OUTCOMES (COs):

CO1	Will be able to identify the various components of an I.C. Engine and will be able to draw the valve timing diagram for 2- stroke engines.
CO2	Will be able to understand the fuel injection in diesel and petrol engines.
CO3	Will be able to determine the performance characteristics and energy balance of diesel and petrol engines and air compressors.
CO4	Will be able to understand the effect of the tilt angle and radiation on the power output of

	solar cell.
CO5	Will be able to experimentally compare poly crystalline and thin film solar cells.

MEL-703	Machinery Dynamics & Vibration Laboratory	PCC	L	T	P	C
		2Hrs	0	0	2	1

COURSE OBJECTIVES:

1.	To provide practical understanding of the working principles of governors, cams, and balancing mechanisms used in machinery.
2.	To analyze and determine the response of single- and multi-degree-of-freedom vibration systems under various conditions.
3.	To experimentally determine damping characteristics, critical speeds, and torsional/longitudinal vibration behaviors of mechanical systems.
4.	To develop skills in modal analysis of beams and rotating machinery components for dynamic behavior prediction and fault diagnosis.

LIST OF EXPERIMENTS:

1.	Study of different types of governors, including Watt, Porter, Hartnell.
2.	Study of different types of cams& follower mechanisms.
3.	Study of static and dynamics balancing of machines.
4.	Determine the damping constant of a given viscous damper.
5.	Study of single DoF systems, longitudinal vibrations.
6.	Study of torsional vibrations of single disc-shaft system.
7.	Study of 2 DoF systems, longitudinal vibrations, both damped and undamped.
8.	Study of 2 DoF systems, torsional vibrations, both damped and undamped.
9.	Study of critical speeds of shafts under different types of supports.
10.	Modal analysis of cantilever and free-free beams.

REFERENCE BOOKS:

1. Theory of Machines – S.S. Rattan
2. Mechanical Vibrations – S.S. Rao
3. Mechanical Vibrations – V.P. Singh
4. Mechanical Vibrations – G.K. Grover
5. Fundamentals of Mechanical Vibrations – S. Graham Kelly

COURSE OUTCOMES (COs):

CO1	Will be able to analyze the dynamics of different types of governors and cams & follower mechanisms.
CO2	Will be able to experimentally determine the undamped and damped natural frequency of single and two DoF systems under longitudinal, lateral/transverse and torsional vibrations.
CO3	Will be able to experimentally determine the critical speeds of shafts under different types of supports.
CO4	Will be able to experimentally determine the linear and torsional viscous damping of a dashpot system.
CO5	Will be able to use accelerometers, impact hammers and other instrumentation to measure vibration signals.

Course Syllabi

B.Tech.(Mechanical Engineering)

EIGTH Semester

VIII Semester- Course Details

S. No.	COURSE NUMBER	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	MEO-801	Elective (MACHINE DESIGN) *	Theory	OEC	3	3	0	0	3
2	MEO-801	Elective (PRODUCTION& INDUSTRIAL) *	Theory	OEC	3	3	0	0	3
i	MEP-801	Project	Project-IV	PROJ	6	0	0	12	12
				Total	**12**	**6**	**0**	**12**	**18**

*In case of semester long project work done in industry or internship, the OECs in VIII semester may be offered in online mode/NPTEL on SWAYAM.

VIII Semester- Theory

S. No.	COURSE NUMBER	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	MEO-801	Elective (MACHINE DESIGN) *	Theory	OEC	3	3	0	0	3
2	MEO-801	Elective (PRODUCTION& INDUSTRIAL) *	Theory	OEC	3	3	0	0	3

MEO-801	ROBOTICS Elective (PRODUCTION& INDUSTRIAL) *	OEC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

Robotics (ME-801) is a graduate level basic course in robotics. This course is open to all engineering graduate students. It is intended here to cover the topics of introductory robotics. The first unit of the course deals with the theoretical portion & the second unit for modeling, analysis (kinematics and dynamics). Different components of robots are discussed in unit-III & IV. In last unit-V Programming & application part is described. A more detailed description of the course is available here.

COURSE OBJECTIVES:

Objective of this course is to provide an introduction to Robotics including robot classification, design and selection, analysis, sensing and control, and applications in industry.

PREREQUISITES:

- Basic Electrical & Electronics Engineering
- Basic Kinematics
- Control Engineering
- Engineering Mathematics

CONTENT:

Unit I **Fundamentals of Robotics:**

Introduction, Automation and Robotics, A Brief History of Robotics, Human system & Robotics, Laws & Definition of Robot, Industrial Robot Anatomy, Classification & Structure, Work Volume, Specifications of Robot, Precision of Movement. The Robotics Market, Social Issues and the Future Prospects.

Unit II **Robot Arm Kinematics:**

Introduction to Robot Arm Kinematics, Homogeneous Coordinate transformations, Composite Homogeneous transformation matrix. Link, joint and parameters. Denavit Harten Berg Notation, D-H Matrix, Kinematic equations. Direct & Inverse Kinematics, Exercises on Direct & Inverse Kinematics up to six degree of freedom Robots.

Unit III **Robot Grippers:**

Classification of End Effectors, Mechanical Grippers, Magnetic gripper, Vacuum gripper, Adhesive gripper, Multifingered gripper - Utah, Okada, Stanford, DGIT Hands. Considerations in Gripper Selection - Force Analysis and Design.

Unit IV **Robot Drives, Sensors, Actuators and Control:**

Robot drive systems-Hydraulic, Pneumatic & Electric. Robot Sensors - Contact & non-contact type sensors, Force & torque Sensor. Robotic vision system. Basic Control Systems Concepts and Models, Controllers, Control System Analysis.

Unit V **Robot Programming-Languages & Applications in Manufacturing:**

Methods of Robot Programming, Lead through Programming Methods. Robot Languages & classification. Programming Exercise on ACL/ATS for Robots Eshed Robots.

Robot Application areas- Material Transfer and Machine Loading/ Unloading, Processing Operations, Assembly and Inspection, Future Manufacturing Applications

Robots.

TEXTBOOKS:

1. Introduction to Robotics by S. K. Saha, Tata McGraw-Hill Pvt. Ltd.
2. Industrial Robotics" by M.P Groover, McGraw-Hill International Editions

REFERENCE BOOKS:

1. Introduction to Robotics by J.J Craig., Addison Wesley N Delhi.
2. Robotics: Control, sensing & Vision by K. S. Fu., McGraw-Hill International Editions.

Computer Usage / Software required:

MATLAB, ACL & ATS

COURSE OUTCOMES (COs):

CO1	Will be able to understand the fundamentals of robotics and automation.
CO2	Will be able to conduct robot arm kinematics of a given robot.
CO3	Will be able to recommend gripper for different industrial applications.
CO4	Will be able to understand the application robotic sensors, actuators, and control mechanisms.
CO5	Will be able to program a given robot for a particular process/ activity using different programming language.

MEO-801	PRODUCT DESIGN WITH ADDITIVE MANUFACTURING Elective (PRODUCTION& INDUSTRIAL) *	OEC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

This multidisciplinary course covers the significance of product design, various tools used for product design, identification of customer needs, concept generation, concept selection, concept testing, product architecture, design of modular systems, and computer-aided design. Further imparts knowledge of Additive Manufacturing technologies that are being gainfully deployed, practised, and researched.

COURSE OBJECTIVES:

Introduce an interdisciplinary subject with lots of research and development potential and applications. This course builds fundamentals and working knowledge of product design and additive manufacturing technologies so that the students can gainfully use the same.

PREREQUISITES:

- Industrial Engineering
- Production Engineering
- Computer-Aided Design
- Basics of Machine Design

CONTENT:

Unit I

- Significance of product design, product design and development process, sequential engineering design method, and product development challenges. Product life cycle
- Innovation & Creativity; Idea Generation and its Methods, Creative Thinking; Techniques of Creative Problem-Solving.
- Identifying Customer needs: Gather raw data from customers, interpret raw data in terms of customer needs, organise the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process.
- Product Specifications: Establishing target specifications and setting the final specifications.

Unit II

- Concept Generation: The activity of concept generation, problem clarification, searching externally, searching internally, exploring systematically, and reflecting on the results and the process.
- Concept Selection: Overview of methodology, concept screening, and concept scoring.
- Concept Testing: Define the purpose of the concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, and reflect on the results and the process.

Unit III	• Product Architecture: What is product architecture, implications of the architecture, architecture establishment, variety and supply chain considerations, platform planning, and related system-level design issues? • Design of Modular System – abstract design, the process of conception and its documentation • Computer-aided Design (CAD), need for CAD, components of CAD systems, advantages. Steps used to create a 3D model. • Introduction to Design for "X
Unit IV	• Introduction to Additive Manufacturing (AM). Differentiating Additive Manufacturing from Subtractive Manufacturing. • Different technologies used in 3D Printing like Stereolithography (SLA), Selective laser sintering (SLS), Fused deposit modelling (FDM), Selective Laser Melting (SLM), Laminated Object Manufacturing (LOM), Direct Metal Laser Sintering (DMLS), Inkjet Printing (IJP), Polyjet 3D printing, Binding Jet 3D printing, Built mechanism of each technology, applications. Overview of Colour-Jet 3D Printing (CJP), working principle, the material used, and post-processing in CJP. • 3D Scanner: its types with scanning principle, applications, Overview of Steinbichler blue light 3D scanner, different components function and working principle. • 3D Bioprinting brief understanding • Brief to 3D Scanner software, and brief to 3D Printing Software like Rhinoceros 3D
Unit V	• Briefs on some commonly used design tools in product development, product development process stages, QFD, Concurrent Engineering, Value Engineering in Product development and design, and Model-based technology for generating innovative ideas. • Theory of inventive problem solving (TRIZ): Fundamentals, problem Solution, methods and techniques, General Theory of Innovation and TRIZ. • Developing new products, some studies with AM with the help of case studies/ experimentations/ new product development.

TEXTBOOKS:

1. Product Design and Development, Karl. T. Ulrich, Steven D Eppinger, Irwin Mc Graw Hill

REFERENCE BOOKS:

1. Product Design, Pearson Engineering of creativity: an introduction to TRIZ Methodology of Inventive Problem Solving, By Semyon D. Savransky, CRC Press.
2. Inventive thinking through TRIZ: A practical guide; By Michael A. Orloff, Springer.
3. Systematic innovation: An introduction to TRIZ (theory of inventive Problem.
4. Product Design for Manufacture and Assembly, Geoffrey Boothroyd, Peter Dewhurst and Winston Knight, "

5. Product Design: Fundamentals and Methods, Roozenburg and Eekels, Publisher: McGraw-Hill
6. Design Secrets: Products: 50 Real-Life Projects Uncovered - Industrial Designers, Goodrich, Kristina; Society of America, Publisher: Rockport Publishers
7. Creating Breakthrough Products: Innovation from Product Planning to Program Approval, Cagan, Jonathan; Vogel, Craig M, Publisher: Financial Times Prentice Hall.

Computer Usage / Software required:

- Basic awareness of relevant 3D Scanning, 3D Printing, Bioprinting, Inspection, and Reverse Engineering software.

Other details regarding this course:

- Product design is being taught through the foundation of theory, and students are also engaging in loosely supervised practice and industry exposure when additive manufacturing technologies are being adopted.

COURSE OUTCOMES (COs):

CO1	Will be able to understand the significance of product design and its life cycle, identify the customer needs and determine the product specification.
CO2	Will be able to carry out the concept generation, concept selection, and testing for developing a product.
CO3	Will be able to understand and propose product architecture to incorporate design process.
CO4	Will be able to understand the basic technology of additive manufacturing and its applications.
CO5	Will be able to develop QFD for a given product and apply TRIZ principle in developing the products.

MEO-801	ERGONOMICS Elective (PRODUCTION& INDUSTRIAL) *	OEC	L	T	P	C
		3Hrs	3	0	0	3

COURSE DESCRIPTION:

This course provides a comprehensive introduction to occupational ergonomics with a focus on the interaction between humans, machines, and work environments. It emphasizes ergonomic principles in system and workstation design, tool design, and human–machine interfaces. Students will learn methods to assess physical workload, musculoskeletal disorders, vibration, noise, and illumination, and will gain insights into applying ergonomic considerations for improving productivity, safety, comfort, and overall system performance.

COURSE OBJECTIVES:

- Provide students with the basis of occupational ergonomics.
- Ergonomic considerations in design, ergonomic consideration in re-design and research basis of ergonomics.

PREREQUISITES:

- Industrial Engineering

CONTENT:

Unit I Introduction to ergonomics, scope of ergonomics, cost of ignoring ergonomics, result of application of ergonomics, Ergonomics and its areas of application in the work-system, Description of Human-Machine system. Standard format for describing human-machine system.

Unit II Muscular Work: Physiological Principles, Sources of Energy, Nervous control of movements and structure of nervous system: Types of nervous system, Neurons, Action potential, Sodium potassium pump, innervations of muscles, Reflex-arc. Dynamics and static muscular work. Field method for assessing physical overload.

Unit III Introduction to Anthropometry, Its application in design of system, Design aspect in ergonomics: Manufacturing work-station design; Determining work-station design parameters, Systematic approach for determining work-station design, determining work-station dimension. Tool evaluation and design: Principles of tool design (General principles, Anatomical concern, and Single handle); Attributes of common industrial hand tools, Attributes of common industrial power tools, Tool evaluation check list. Displays and controls.

Unit IV Cumulative Trauma Disorder: Work-related Musculoskeletal Disorder: Definition of work-related Musculoskeletal Disorder, Types of WMSDs, Factors affecting WMSDs. Occupational Human Vibration: Characteristics of vibration, Whole-body and hand-arm vibration, Effect of vibration on comfort, health and performance.

Unit V Sound and related studies: Definition, evaluation of noise, combining decibels. Levels and Spectra: Sound power level, sound intensity level, numerical problems on sound its measurement, Illumination and its measurement.

TEXTBOOKS:

1. Introduction to Ergonomics-R.S. Bridger, McGraw-Hill International Edition.

REFERENCE BOOKS:

1. Industrial Noise Control-Lewis H-Bell and Douglas H-Bell, Marcel Dekker, INC.
2. Fitting Tasks to Human, Kroemer, K.H.E. and Grandjean, E. (1997). Philadelphia: Taylor and Francis
3. The Ergonomic Edge-MacLeod, D. (1995). New-York: Van Nostrand Reinhold.

Computer Usage / Software required:

- Adobe Acrobat Reader, Power Point or PP viewer, Video Player.

Other details regarding this course:

- Product design is being taught through the foundation of theory, and students are also engaging in loosely supervised practice and industry exposure when additive manufacturing technologies are being adopted.

COURSE OUTCOMES (COs):

CO1	Will be able to understand the Human Machine system and importance of ergonomics.
CO2	Will be able to assess the physical workload on human operators.
CO3	Will be able to understand the principle of anthropometry and its applications in work station design.
CO4	Will be able to understand the cumulative trauma disorder in machine operators and carry out the whole body and hand arm vibration estimation.
CO5	Will be able to evaluate workplace environmental factors by conducting sound level measurements, noise mapping, and illumination studies for ergonomic assessment.