AC – 20/5/2025
Item No. – 6.57 (N) 5

As Per NEP 2020

University of Mumbai

Syllabus for MDM offered by Mechanical Engg. Vertical – 2 (Not to offer for Mechanical Engg., Automobile Engg., Mechanical Engg. Automobile and Mechanical & Automation Students)		
Faulty of Engineering		
Board of Studies in Mechanical Engineering		
Second Year Programme in Minor (Mechanical Engineering)		
Semester	IV	
Title of Paper (Theory)	Sem.	Total Credits 4
Mechanical Engineering Systems	IV	3
Title of Paper (Lab)		Credits
Mechanical Engineering Systems Lab Course -1	IV	1
From the Academic Year	2025-26	

Program Structure for MDM offered by Mechanical Engineering
UNIVERSITY OF MUMBAI (With Effect from 2025-26)

SEMESTER IV to SEMESTER VII

Course Code	Course Description	Teaching Scheme (Contact Hours)			Credit Assigned			
		Theory	Practical	Tutorial	Theory	Tutorial	Practical	Total Credits
2404211	**Mechanical Engineering Systems**	3	–	--	3	–	–	3
2404212	**Mechanical Engineering Systems Lab Course-1**	–	2	–	–	–	1	1
2405211	**Computer Aided Design**	3			3			3
2405212	**Computer Aided Design Lab**	-	2	-	-	-	1	1
2406211	**Innovation & Product Development**	3	–	--	3	–	–	3
2406212	**Innovation & Product Development Lab**	-	2	-	-	-	1	1
2407211	**3D Printing**	-	2*+2	--	--	--	2	2
Total		**9**	**10**	--	**9**	**--**	**5**	**14**

* Two hours of practical class to be conducted for full class as demo/discussion
#Institute shall offer a course for MDM from other Engineering Boards.

Course Code	CourseDescription	Examination Scheme							
		Internal Assessment Test (IAT)			End Sem. Exam Marks	End Sem. Exam Duration (Hrs)	Term Work (Tw)	Oral & Pract.	Total
		IAT-I	IAT-II	Total (IAT-I) + IAT-II)					
2404211	**Mechanical Engineering Systems**	20	20	40	60	2	--	--	100
2404212	**Mechanical Engineering Systems Lab Course-1**	--	--	--	--	--	25	--	25
2405211	**Computer Aided Design**	20	20	40	60	2	--	--	100
2405212	**Computer Aided Design Lab**	--	--	--	--	--	25	25	50
2406211	**Innovation & Product Development**	20	20	40	60	2	--	--	100
2406212	**Innovation & Product Development Lab**	--	--	--	--	--	25	25	50
2407211	**3D Printing**	--	--	--	--	--	50	25	75
Total		**60**	**60**	**120**	**180**	**6**	**125**	**75**	**400**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2404211	Mechanical Engineering Systems	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2404211	Mechanical Engineering Systems	20	20	40	60	2	--	--	100

Rationale :

Most of the engineering branches are being off-spring of…….

Course Objectives: Six Course Objectives

1. To introduce metrology and material science – Understanding measurement standards, fits, tolerances, and material properties to ensure precision in engineering applications.

2. To provide fundamental knowledge of thermal engineering – Covering thermodynamics, heat transfer mechanisms, and internal combustion engines to develop an understanding of energy systems.

3. To impart knowledge of conventional and digital manufacturing – Exploring casting, forming, machining, and advanced fabrication techniques like CNC and additive manufacturing.

4. To introduce vehicle systems and transmission mechanisms – Understanding kinematic linkages, power transmission, and electric/hybrid vehicle systems.

5. To study energy sources and their conversion – Covering renewable and non-renewable energy, efficiency calculations, and energy conversion devices like turbines and compressors.

6. To explore engineering mechanisms and their applications – Analyzing the working principles and applications of mechanical systems like compressors, pumps, gears, and electric motors.

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

1. Analyze metrology principles and material science fundamentals to select appropriate measurement techniques and materials for engineering applications.
2. Apply principles of thermodynamics and heat transfer to evaluate thermal systems and understand engine performance.
3. Demonstrate proficiency in conventional and digital fabrication methods including machining, welding, CNC, and 3D printing.
4. Understand the functioning of vehicle systems and analyze the performance of power transmission components in conventional and electric vehicles.
5. Evaluate various energy sources and conversion devices by performing efficiency and power calculations for thermal, hydro, wind, and solar systems.
6. Apply knowledge of mechanical systems and mechanisms to real-world applications such as pumps, compressors, motors, and energy-efficient devices.

Prerequisite:

Students should have basic knowledge of physics and mathematics, including mechanics, heat, and energy concepts. Familiarity with engineering graphics, material properties, and simple machine elements will help in understanding mechanisms, manufacturing processes, energy systems, and IC engines covered in the course.

DETAILED SYLLABUS: total six module for each subject (13 Weeks)

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic Engineering Physics – Mechanics, thermodynamics, heat transfer. Basic Engineering Mathematics – Algebra, trigonometry, unit conversions, basic Introduction to Engineering Drawing and Graphics – Orthographic projection, simple part representation. Basic Electrical and Electronics Concepts – Voltage, current, basic sensors and actuators. Fundamentals of Mechanical Systems – Levers, gears, pulleys, and basic machines.	**02**	
I	Introduction to Metrology and Material Science	**1.1 Introduction to Metrology** Standards of measurement, Limits, fits and tolerances, Hole based and shaft-based systems, Taylor's principle, measurement of displacement, pressure and temperature. **1.2 Introduction to Material Science** Engineering materials (Metals, Non-metals, Ceramics, polymers), advanced materials and smart materials.	06	CO1
II	Introduction to Thermodynamics and IC Engine	**2.1 Introduction to Thermodynamics** Basic concepts and properties, Laws of thermodynamics, Modes of heat transfer (conduction, convection and radiation). **2.2 Introduction to I.C Engines** Engine Nomenclature, two stroke and Four stroke engines, Types of Sensors, Euro and Bharat Stage Norms, and Engine Emission Control	07	CO2
III	**Conventional and Additive Manufacturing**	**Conventional and Additive Manufacturing:** Primary Manufacturing Processes: Casting and Metal forming. Secondary Manufacturing Processes: Forging, Sheet metal working, Welding, Turning, Milling and Drilling. Additive manufacturing and 3D Printing, Basic CNC programming: Concept of Computer Numerical Controlled machines	07	CO3
IV	**Introduction to Vehicle system**	**Introduction to Vehicle system** Introduction, Mechanism and machine, Classification of kinematic pairs, Linkage, Mechanisms, Degrees of freedom, Introduction of chassis layouts, steering system, suspension system, braking system, cooling system and fuel injection system and fuel supply system. Study of Electric and Hybrid Vehicle systems. Study of power transmission system, clutch, gear box (Simple Numerical), propeller shaft, universal joint, differential gearbox and axles & Basics of Electric vehicles	07	CO4
V	**Introduction of energy sources & its conversion**	**Introduction of energy sources & its conversion** **5.1 Energy sources:** Thermal energy, Hydropower energy, Nuclear energy, Solar energy, Geothermal energy, Wind energy, Hydrogen energy, Biomass energy and Tidal energy. Grades of Energy. (Numerical on efficiency calculation of thermal power plant) **5.2 Energy conversion devices:** Introduction of pump, compressor, turbines, wind mills etc (Simple numerical on power and efficiency calculations)	06	CO5
VI	**Engineering Mechanisms and their applications**	**Engineering Mechanisms and their applications** Introduction to Basic mechanisms and equipment: Pumps, blowers, compressors, springs, gears, Belt-Pulley, Chain-Sprocket, valves, levers, etc. Introduction to terms: Specifications, Input, output, efficiency, etc. Applications of: Compressors - Refrigerator, Water cooler, Split AC unit; Pumps - Water pump for overhead tanks, Water filter/Purifier units;	07	CO6

		Blower - Vacuum cleaner, Kitchen Chimney; Motor - Fans, Exhaust fans, Washing machines; Springs - Door closure, door locks, etc.; Gears - Wall clocks, watches, Printers, etc.; Application of Belt-Pulley/Chain-Sprocket - Photocopier, bicycle, etc.; Valves - Water tap, etc.; Application of levers - Door latch, Brake pedals, etc.; Electric/Solar energy - Geyser, Water heater, Electric iron, etc. (simple numerical on efficiency calculation)		

Text Books:

1. Nag, P. K., "Engineering Thermodynamics," Tata McGraw-Hill Publisher Co. Ltd.
2. Chaudhari and Hajra, "Elements of Workshop Technology", Volume I and II, Media Promoters and Publishers, Mumbai
3. Agrawal,Basant and Agrawal, C. M., (2008), "Basics of Mechanical Engineering", John Wiley and Sons, USA
4. Rajput, R.K., (2007), "Basic Mechanical Engineering", Laxmi Publications Pvt. Ltd.
5. Pravin Kumar, (2018), " Basic Mechanical Engineering, 2nd Ed.", Pearson (India) Ltd.
6. Moran, M. J., Shapiro, H. N., Boettner, D. D., and Bailey, M. "Fundamentals of Engineering Thermodynamics", Wiley
7. Surinder Kumar, (2011), "Basic of Mechanical Engineering", Ane Books Pvt. Ltd. New Delhi

References:

1. Khan, B. H., "Non Conventional Energy Sources, Tata McGraw-Hill Publisher Co. Ltd.
2. Boyle, Godfrey, "Renewable Energy",2nd Ed., Oxford University Press
3. Khurmi, R.S. ,and Gupta, J. K.,"A Textbook of Thermal Engineering", S. Chand & Sons
4. Incropera, F. P. and Dewitt, D.P., (2007), "Fundamentals of Heat and Mass Transfer, 6th Ed., John Wiley and Sons, USA
5. Groover,Mikell P., (1996), "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", Prentice Hall, USA
6. Norton, Robert L., (2009), "Kinematics and Dynamics of Machinery", Tata McGrawHill
7. Cleghorn, W. L., (2005), "Mechanisms of Machines", Oxford University Press
8. Juvinal, R. C., (1994), "Fundamentals of Machine Component Design", John Wiley and Sons, USA
9. Ganeshan, V., (2018), "Internal Combustion Engines", McGraw Hill
10. Anderson, Curtis Darrel and Anderson,Judy, (2010), "Electric and Hybrid Cars: A History", 2nd Ed., McFarland

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc24_me104/preview
2.	https://onlinecourses.nptel.ac.in/noc25_me09/preview

Assessment:

Internal Assessment (IA) for 20 marks:

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

Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marksQ.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **Three questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2404212	Mechanical Engineering Systems Lab Course-1	2	-	-	2	-	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test	Test 2	Avg. of 2 Tests				
2404212	Mechanical Engineering Systems Lab Course-1	--	--	--	--	25	25	50

Lab Objectives:

1. To study and perform displacement measurement using sensors such as LVDT and potentiometers, and to determine the hardenability of steel using the Jominy End Quench Test.
2. To measure thermal conductivity of different materials and understand the working principles and components of internal combustion engines and their subsystems.
3. To demonstrate and understand the working of additive manufacturing processes through 3D printing technology.
4. To analyze and report the construction, working, and types of automotive brake systems including hydraulic, pneumatic, drum, disc, and ABS.
5. To explore renewable energy applications through the demonstration of solar thermal collectors used for air or water heating.
6. To study the working principles and wiring of common mechanical systems such as domestic refrigerators, centrifugal pumps, and gear pumps.

Lab Outcomes:

By the end of the lab course, students will be able to:

1. Measure displacement using electromechanical sensors and assess steel hardenability through standardized testing procedures.
2. Evaluate the thermal conductivity of various materials and explain the operational details of IC engines and fuel systems.
3. Demonstrate the process of 3D printing and understand its role in modern manufacturing techniques.
4. Identify, compare, and explain the functioning of different automotive brake systems through hands-on study.
5. Describe the principles and performance of solar thermal systems used for heating applications.
6. Understand and describe the design and functionality of everyday engineering mechanisms such as refrigerators and pumps.

Prerequisite: Students should have basic knowledge of physics and mathematics, including mechanics, heat, and energy concepts. Familiarity with engineering graphics, material properties, and simple machine elements will help in understanding mechanisms, manufacturing processes, energy systems, and IC engines covered in the course.

DETAILED SYLLABUS

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	**Prerequisite**	Basic Engineering Physics – Mechanics, thermodynamics, heat transfer. Basic Engineering Mathematics – Algebra, trigonometry, unit conversions, basic Introduction to Engineering Drawing and Graphics – Orthographic projection, simple part representation. Basic Electrical and Electronics Concepts – Voltage, current, basic sensors and actuators. Fundamentals of Mechanical Systems – Levers, gears, pulleys, and basic machines.	**02**	**-**
I	**Introduction to Metrology and Material Science**	**1.1 Introduction to Metrology** Standards of measurement, Limits, fits and tolerances, Hole based and shaft-based systems, Taylor's principle, measurement of displacement, pressure and temperature. **1.2 Introduction to Material Science** Engineering materials (Metals, Non-metals, Ceramics, polymers), advanced materials and smart materials.	**06**	**LO1**
II	**Introduction to Thermodynamics and IC Engine**	**2.1 Introduction to Thermodynamics** Basic concepts and properties, Laws of thermodynamics, Modes of heat transfer (conduction, convection and radiation). **2.2 Introduction to I.C Engines** Engine Nomenclature, two stroke and Four stroke engines, Types of Sensors, Euro and Bharat Stage Norms, and Engine Emission Control	**07**	**LO2**
III	**Conventional and Additive Manufacturing**	**Conventional and Additive Manufacturing:** Primary Manufacturing Processes: Casting and Metal forming. Secondary Manufacturing Processes: Forging, Sheet metal working, Welding, Turning, Milling and Drilling. Additive manufacturing and 3D Printing, Basic CNC programming: Concept of Computer Numerical Controlled machines	**07**	**LO3**
IV	**Introduction to Vehicle system**	**Introduction to Vehicle system** Introduction, Mechanism and machine, Classification of kinematic pairs, Linkage, Mechanisms, Degrees of freedom, Introduction of chassis layouts, steering system, suspension system, braking system, cooling system and fuel injection system and fuel supply system. Study of Electric and Hybrid Vehicle systems. Study of power transmission system, clutch, gear box (Simple Numerical), propeller shaft, universal joint, differential gearbox and axles & Basics of Electric vehicles	**07**	**LO4**
V	**Introduction of energy sources & its conversion**	**Introduction of energy sources & its conversion** **5.1 Energy sources:** Thermal energy, Hydropower energy, Nuclear energy, Solar energy, Geothermal energy, Wind energy, Hydrogen energy, Biomass energy and Tidal energy. Grades of Energy. (Numerical on efficiency calculation of thermal power plant) **5.2 Energy conversion devices:** Introduction of pump, compressor, turbines, wind mills etc (Simple numerical on power and efficiency calculations)	**06**	**LO5**
VI	**Engineering Mechanisms and their applications**	**Engineering Mechanisms and their applications** Introduction to Basic mechanisms and equipment: Pumps, blowers, compressors, springs, gears, Belt-Pulley, Chain-Sprocket, valves, levers, etc. Introduction to terms: Specifications, Input, output, efficiency, etc. Applications of: Compressors - Refrigerator, Water cooler, Split AC unit; Pumps - Water pump for overhead tanks,	**07**	**LO6**

		Water filter/Purifier units; Blower - Vacuum cleaner, Kitchen Chimney; Motor - Fans, Exhaust fans, Washing machines; Springs - Door closure, door locks, etc.; Gears - Wall clocks, watches, Printers, etc.; Application of Belt-Pulley/Chain-Sprocket - Photocopier, bicycle, etc.; Valves - Water tap, etc.; Application of levers - Door latch, Brake pedals, etc.; Electric/Solar energy - Geyser, Water heater, Electric iron, etc. (simple numerical on efficiency calculation)		

Text Books:

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7. Cleghorn, W. L., (2005), "Mechanisms of Machines", Oxford University Press
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9. Ganeshan, V., (2018), "Internal Combustion Engines", McGraw Hill
10. Anderson, Curtis Darrel and Anderson,Judy, (2010), "Electric and Hybrid Cars: A History", 2nd Ed., McFarland

Online Resources:

Sr. No.	Website Name
3.	https://onlinecourses.nptel.ac.in/noc24_me104/preview
4.	https://onlinecourses.nptel.ac.in/noc25_me09/preview

List of Experiments.

Sr No	List of Experiments	Hrs
01	Experiments on measurement of displacement by sensors like LVDT, Potentiometers etc.	03
02	Determination of hardenability of steel using Jominy end Quench Test (Using different hardness testers to measure the Hardness)	03
03	Measurement of thermal conductivity of metal rod/ liquids/insulating powder.	02
04	Study of physical systems in terms of constructional details and functions a] 2 Stroke and 4 Stroke Engines b] Carburetor. c] Ignition system. d] Fuel injection system.	03
05	Demonstration on 3D printing	03
06	To study and prepare report on the constructional details, working principles and operation of the following automotive brake systems: a. Hydraulic & pneumatic brake system b. Drum brake system c. Disk brake system b. Antilock brake system	03

07	Demonstration of solar collector for air/water heating	02
08	Study of domestic refrigerator along with wiring diagram	03
09	Study of Centrifugal and Gear of Pumps	02

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment 1: Metrology Fundamentals and Material Classification • Explain various standards of measurement and Taylor's principle. • Differentiate between hole-based and shaft-based systems. • Classify engineering materials and describe the properties of smart materials.	02
02	Assignment 2: Limits, Fits, and Tolerances • Solve numerical problems on types of fits and tolerances. • Provide real-life examples where different types of fits are applied in mechanical design.	02
03	Assignment 3: Laws of Thermodynamics and Heat Transfer • Write detailed notes on the First and Second Laws of Thermodynamics with examples. • Solve simple numerical problems on conduction, convection, and radiation.	02
04	Assignment 4: Internal Combustion Engines and Emission Norms • Compare two-stroke and four-stroke engines with neat sketches. • Explain Euro and Bharat Stage emission norms and engine emission control systems.	02
05	Assignment 5: Conventional and Additive Manufacturing Processes • Compare primary and secondary manufacturing processes. • Describe the working of 3D printing and write basic G-code/CNC programming examples.	02
06	Assignment 6: Vehicle Systems and Power Transmission • Illustrate the layout of a vehicle chassis and explain various vehicle systems. • Solve numerical problems on gear ratios, torque transmission, and efficiency of gearboxes.	02
07	Assignment 7: Energy Sources and Conversion Devices • Explain different conventional and non-conventional energy sources. • Solve simple numerical problems related to thermal power plant efficiency and pump power.	02
08	Assignment 8: Applications of Basic Engineering Mechanisms • Identify and explain the real-life applications of compressors, blowers, gears, springs, valves, and pulleys. • Solve efficiency-based numerical problems related to household and industrial equipment.	02

Assessment :

Term Work: Term Work shall consist of at least 8 practicals' based on the above list. Also, Term work Journal must include at least 6 assignments.

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

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