



# GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Mechanical (I.C.Engine & Automobile Engineering)

Course / Subject Code : ME01080011

Course / Subject Name : Modern Vehicle Design

w. e. f. Academic Year:	2024-25
Semester:	1 <sup>st</sup> Semester
Category of the Course:	PEC

<b>Prerequisite:</b>	<ul style="list-style-type: none"> <li>• Mechanics of Deformable Bodies</li> <li>• Design of Machine Elements</li> <li>• Basics of Computer Programming Language</li> </ul>
<b>Rationale:</b>	<p>This course is designed to equip students with advanced knowledge and state-of-the-art technology necessary for the automotive engineering and design industry. The course will cover various aspects of modern vehicle design, including engine components, material selection, CAD, and finite element analysis, preparing students for the challenges of tomorrow's vehicle engineering design.</p>

## Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level	Marks % weightage
1	Calculate the basic design aspects of different engine components.	1,3	15
2	Select, evaluate, and analyze forces acting on different engine parts.	2,4	25
3	Perform force analysis and design suspension system components effectively.	1,3	19
4	Evaluate and calculate the performance of I.C. engine brakes, including recent developments.	5	21
5	Demonstrate knowledge of CAD automation and perform finite element analysis on automobile components.	4,5,6	20

## Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150



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## Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	<b>Unit I: Engine Components and Design</b> <ul style="list-style-type: none"><li>Material, construction, and design aspects of engine components</li><li>Determination of engine power</li><li>Engine selection: swept volume, stroke, bore, and number of cylinders</li><li>Arrangement of cylinders, stroke-to-bore ratio</li></ul>	09	19
2.	<b>Unit II: Design Procedures for Engine Components</b> <ul style="list-style-type: none"><li>Design procedure and considerations</li><li>Material selection and actual design of components</li><li>Design of cylinder block, piston, piston assembly, cylinder liner, cylinder head, combustion chamber, connecting rod, crankshaft, flywheel, valves, valve actuating mechanism, cams, camshaft drives, vibration damper</li><li>Gearbox design: constant-mesh gearboxes, synchro-mesh gearboxes, heavy vehicle gearboxes</li></ul>	10	24
3.	<b>Unit III: Design of Vehicle Systems</b> <ul style="list-style-type: none"><li>Design of couplings, fluid couplings, torque converter, differential axle</li><li>Suspension system design: tandem axle suspension, adaptive suspension system, shock dampers</li><li>Steering system design: power-assisted steering, four-wheel steering system</li></ul>	08	19
4.	<b>Unit IV: Braking and Aerodynamics</b> <ul style="list-style-type: none"><li>Design of brakes: hydraulic brakes, air brakes, endurance brakes, anti-lock brakes</li><li>Vehicle structure and chassis frames</li><li>Principle of vehicle aerodynamics, aerodynamic design of the vehicle, latest developments</li></ul>	09	19



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Unit V: Introduction to CAD and FEA			
5.	<ul style="list-style-type: none"><li>• Introduction to CAD, the product cycle, and automation</li><li>• Finite Element Analysis (FEA)</li><li>• Stress analysis on automobile components</li></ul>	09	19
<b>Total</b>		<b>45</b>	<b>100</b>

## Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	25	19	18	18	05

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

## References/Suggested Learning Resources:

### (a) Books:

1. The Automotive Chassis – Engineering Principle – Reimpell J.
2. Automotive Chassis – Design & Calculation – P. Lukin, G. Gasparyarts, V. Rodionov, MIR Publishing, Moscow
3. Automotive Chassis – P. M. Heldt, Chilton Co. NK
4. Mechanics for Road Vehicles – W. Steed, Illiffe Books Ltd., London
5. Design of Automotive Engines – Kolchin and Demodov
6. Automotive Design – Jiles J.G.
7. Machine Design – Pandya and Shah
8. □ Machine Design – Khurmi and Gupta

### (b) Open-source software and website:

#### Open-Source Software:

1. FreeCAD
2. BRL-CAD
3. OpenModelica
4. Salome
5. GMSH



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## Websites:

1. MATLAB Online (Free Version)
2. SimScale
3. Fusion 360 for Education
4. Onshape
5. OpenStreetMap

## Suggested Course Practical List: If any

1. Study engine components, materials, and design aspects.
2. Detailed design of couplings, steering, and shock absorbers.
3. Constructional details, working principles, and operation of automotive brake systems.
4. Practice software for the design of various components.
5. Analysis of engine power and performance based on different engine configurations.
6. Design and test different gearbox mechanisms, including constant-mesh and synchro-mesh gearboxes.
7. Evaluate and design suspension systems, including tandem and adaptive suspension systems.
8. Study and analyze vehicle aerodynamics and its effect on performance.
9. Stress and strain analysis of critical vehicle components using Finite Element Analysis (FEA).
10. Design and simulation of various automotive drive train components, such as differentials and torque converters.

## List of Laboratory/Learning Resources Required:

1. Engine Test Bed:
2. CAD Software:
3. FEA Software:
4. Engine Component Kits:
5. Gearbox Models:
6. Suspension System Kits:
7. Brake System Models:
8. Aerodynamics Testing Equipment:
9. Vehicle Chassis and Frame Models:
10. Hydraulic and Pneumatic Test Equipment:
11. Data Acquisition Systems:
12. Simulation and Modeling Tools:
13. Workshop Tools and Machinery:
14. Technical Reference Materials:
15. Computers with High Processing Power:



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## Suggested Project List:

1. Design and Analysis of a High-Performance Engine:
2. Development of an Adaptive Suspension System:
3. Optimization of Vehicle Aerodynamics:
4. Design and Simulation of a Hybrid Power train:
5. Design and Analysis of a New Gearbox Mechanism:
6. Development of a Vehicle Stability Control System:
7. Study and Improvement of Brake System Performance:
8. Design of a Lightweight Chassis:
9. Finite Element Analysis of Critical Vehicle Components:
10. Implementation of Vehicle Telematics System:
11. Automotive HVAC System Design and Analysis:
12. Development of an Eco-Friendly Refrigerant System:
13. Design and Testing of an Innovative Steering Mechanism:
14. Simulation of Vehicle Crash Testing:
15. Design and Fabrication of an Electric Vehicle Prototype:

## Suggested Activities for Students: If any

1. Case Study Analysis:
2. CAD Workshops:
3. Industry Visits:
4. Design Competitions:
5. Guest Lectures:
6. Project Presentations:
7. Software Tutorials:
8. Hands-on Workshops:
9. Research Papers:
10. Collaborative Projects:
11. Simulation Exercises:
12. Field Experiments:
13. Technical Seminars:
14. Innovation Challenges:
15. Technical Documentation:

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