

2022-23

# MECHANICAL ENGINEERING

AUTOMOBILE ENGINEERING



PREPARED BY  
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# **Techno India NJR Institute of Technology**



## **Course File**

### **Automobile Engineering (5ME4- 12)**

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# RAJASTHAN TECHNICAL UNIVERSITY, KOTA

## Syllabus

3<sup>rd</sup> Year - V Semester: B.Tech. : Mechanical Engineering

### SME4-12: AUTOMOBILE ENGINEERING

Credit: 3  
3L+0T+0P

Max. Marks: 150(IA:30, ETE:120)  
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Frame & Body: Layout of chassis, types of chassis frames and bodies, their constructional features and materials.	3
	Clutches: single plate, multi-plate, cone clutch, semi centrifugal, electromagnetic, vacuum and hydraulic clutches. Fluid coupling. Brakes: Classification and function; Mechanical, hydraulic, vacuum air and self engineering brakes; Brake shoes and lining materials.	5
3	Gear Boxes: Sliding mesh, constant mesh, synchromesh and epicyclic gear boxes, Automatic transmission system; Hydraulic torque converter;	4
	Drives: Overdrive, Propeller shaft, Universal joints, Differential; Rear axle drives. Hotchkiss and torque tube drives; Rear axle types; Front wheel and All wheel drive.	4
4	Wheels and Tyres: Tyre types, Tyre construction; Tyre inflation pressure, Tyre wear and their causes; Re-treading of the tyre,	2
	Steering system: steering gear boxes, Steering linkages, Steering mechanism, Under and Over steering. Steering Geometry, Effect of camber, caster, king pin inclination, toe in and toe out; Power steering; Integral and linkage types.	3
	Suspension system: objective and requirements, Suspension spring, front and rear suspension systems, Independent suspension system Shock absorbers.	3
5	Automotive Electrical System: Battery construction, Charging and testing, battery types, Starting and Battery Charging System: Starter motor construction, types of drive, Alternator construction, regulation and rectification.	4
	Ignition System: Magneto and coil ignition systems, System components and requirements, Automotive lighting: Wiring systems Electrical instruments; head lamp, electric horn, fuel level indicator.	4
6	Automotive Air Conditioning: Introduction, Loads, Air conditioning system Components, Refrigerants, Fault Diagnosis.	4
	Automotive Safety: Safety requirements, Safety Devices, Air bags, belts, radio ranging, NVS (Night Vision System) GPS (Global Positioning System)	4
	<b>TOTAL</b>	<b>41</b>

### **Course Overview:**

Students will learn the basics of automobile engineering from this 41 hours course. Automobile Engineering is the branch of engineering which deals with designing, manufacturing, mechanical mechanisms as well operations of automobiles. It is also an introduction to vehicle engineering which includes cars, motorcycles, trucks and buses etc. Today an *Automotive Engineer* works in every area of the industry, from the look and mechanism of cars to the security and safety of new forms of transport.

*Automobile Engineer's* major task is to design, develop, manufacture & testing of vehicles from the concept stage to the production stage.

### **Course Outcomes:**

<b>CO. NO.</b>	<b>Cognitive Level</b>	<b>Course Outcome</b>
1	Synthesis	Student will be able to understand the basic lay-out of an automobile.
2	Synthesis	Student will be able to understand the operation of engine cooling, lubrication, ignition, electrical and air conditioning systems.
3	Synthesis	Students will be able to understand the principles of transmission, suspension, steering and braking systems.
4	Synthesis	Students will be able to understand automotive electronics.
5	Synthesis	Students will be able to understand latest developments in automobiles.

## Course Outcome Mapping with Program Outcome:

Automobile Engineering Year of study: 2020-21												
Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	2	1	0	0	0	1	0	1
CO2	3	2	3	3	2	0	0	0	0	0	0	1
CO3	3	2	2	3	1	1	0	0	0	1	0	1
CO4	2	1	2	3	1	1	0	0	0	1	0	1
CO5	2	2	1	2	1	1	0	0	0	0	0	1
<b>Average</b>	2.40	1.80	2.20	2.80	1.40	0.80	0.00	0.00	0.00	0.60	0.00	1.00

## Course coverage module wise:

Lecture No.	Unit	Topic
1	1	<b>INTRODUCTION:</b> Student should be able to understand objective, scope and outcome of the course
2	2	<b>FRAME &amp; BODY:</b> Student should be able to understand Layout of chassis
3	2	Student should be able to understand types of chassis frames and bodies
4	2	Student should be able to understand their constructional features and materials.
5	2	<b>CLUTCHES:</b> Student should be able to understand single plate, multi-plate and cone clutch,
6	2	Student should be able to understand Semi centrifugal, electromagnetic and vacuum Clutches
7	2	Student should be able to understand Hydraulic clutches, Fluid coupling and <b>BRAKES:</b> Student should be able to understand Classification and function
8	2	Student should be able to understand Mechanical, hydraulic and vacuum air brakes
9	2	Student should be able to understand Self-engineering brakes, Brake shoes and lining materials.

10	3	<b>GEAR BOXES:</b> Student should be able to understand sliding mesh and constant mesh gear box
11	3	Student should be able to understand synchromesh and epicyclic gear boxes,
12	3	Student should be able to understand automatic transmission system
13	3	Student should be able to understand hydraulic torque converter.
14	3	<b>DRIVES:</b> Student should be able to understand Overdrive, Propeller shaft, Universal joints,
15	3	Student should be able to understand Differential, Rear axle drives.
16	3	Student should be able to understand Hotchkiss and torque tube drives;
17	3	Student should be able to understand Rear axle types; Front wheel and All wheel drive.
18	4	<b>WHEELS AND TYRES:</b> Student should be able to understand Tyre types, Tyre construction;
19	4	Student should be able to understand Tyre inflation pressure, Tyre wear and their causes; Re-treading of the tyre,
20	4	<b>STEERING SYSTEM:</b> Student should be able to understand Steering gear boxes, Steering linkages, Steering mechanism,
21	4	Student should be able to understand Under and Over steering. Steering Geometry, Effect of camber, caster, king pin inclination, toe in and toe out;
22	4	<b>POWER STEERING:</b> Student should be able to understand Integral and linkage types
23	4	<b>SUSPENSION SYSTEM:</b> Student should be able to understand objective and requirements, Suspension spring,
24	4	Student should be able to understand front and rear suspension systems
25	4	Student should be able to understand Independent suspension system Shock absorbers.

26	5	<b>AUTOMOTIVE ELECTRICAL SYSTEM:</b> Student should be able to understand Battery construction, Charging and testing, battery types
27	5	Student should be able to understand Battery construction, Charging and testing, battery types,
28	5	<b>STARTING AND BATTERY CHARGING SYSTEM:</b> Student should be able to understand Starter motor construction, types of drive,
29	5	Alternator construction, regulation and rectification.
30	5	<b>IGNITION SYSTEM:</b> Student should be able to understand Magneto and coil ignition systems,
31	5	Student should be able to understand System components and requirements,
32	5	<b>AUTOMOTIVE LIGHTING:</b> Student should be able to understand Wiring systems Electrical instruments; head lamp,
33	5	Student should be able to understand Electric horn, fuel level indicator.
34	6	<b>AUTOMOTIVE AIR CONDITIONING:</b> Student should be able to understand Introduction, Loads,
35	6	Student should be able to understand Air conditioning system Components
36	6	Student should be able to understand Air conditioning system Components
37	6	Student should be able to understand Refrigerants, Fault Diagnosis.
38	6	<b>AUTOMOTIVE SAFETY:</b> Student should be able to understand Safety requirements, Safety Devices
39	6	Student should be able to understand Safety devices
40	6	Student should be able to understand Air bags, belts, radio ranging,
41	6	Student should be able to understand NVS (Night Vision System), GPS (Global Positioning System)

### **TEXT/REFERENCE BOOKS**

- KIRPAL SINGH,AUTOMOBILE ENGINEERING, STANDARD
- P S GILL,A TEXT BOOK OF AUTOMOBILE ENGINEERING,KATSON BOOKS VOL 1&2

**Course Level Problems (Test Items):**

CO.NO.	Problem description
1	<p>A. Describe briefly the basic layout of chassis and explain the different types of chassis frames.</p> <p>B. Describe the constructional features and working of hydraulic clutch. List the advantages of hydraulic clutch.</p> <p>C. With the help of neat sketch explain the working of fluid coupling.</p> <p>D. What is the difference between a centrifugal and semi centrifugal clutches.</p> <p>E. Describe with a neat sketch, the hydraulic brake system of a car.</p>
2	<p>A. What is synchromesh device, describe the working of synchromesh gear box with the help of neat sketch.</p> <p>B. What do you understand by overdrive with the help of a neat diagram describe the construction and working of an overdrive.</p> <p>C. Write short notes on propeller shaft, universal joint and rear axle drives.</p> <p>D. What are the different types of gear boxes with the help of neat diagram explain the working of sliding mesh gear box.</p>
3	<p>A. Discuss in detail the Ackermann steering mechanism.</p> <p>B. Explain the different types of power steering with the help of neat sketches.</p> <p>C. What is free wheel also describe the construction and working of a free wheel unit.</p> <p>D. Explain the various types of tyre and also explain the construction of tyre.</p>



4	<p>A. Describe briefly the construction and working of lead acid battery with the help of neat sketch.</p> <p>B. Describe briefly, the working principle of alternator and explain how alternator voltage and current output are controlled.</p> <p>C. Explain the working of the ignition system for a four cylinder passenger car engine with the aid of a schematic diagram.</p> <p>D. Discuss various method of battery testing in detail.</p>
5	<p>A. Describe the working of an automotive air conditioning system along with function of each component.</p> <p>B. Discuss briefly about the various safety devices used in an automobile.</p> <p>C. Discuss the requirement of automobile body also write short notes on NVS (Night Vision system).</p> <p>D. Write short notes on Global Positioning System (GPS).</p>

### **Assessment Methodology:**

1. Practical exam in lab where they have to write readings of automobile lab.
2. Assignments one from each unit.
3. Midterm subjective paper where they have to write numericals.
4. Final paper at the end of the semester subjective.

### **Teaching and Learning resources unit-wise:**

#### **Unit-1**

A. Introduction, objective, scope of the automobile engineering

Video Tutorials: <https://youtu.be/ilh8bnzvm8Q>

Theory concepts: <https://www.slideshare.net/sukeshops/introduction-automobile-engineering>

Sample Quiz: <http://www.geekmcq.com/mechanical-engineering/AutoEng/>

#### **Unit-2**

A. Frame and Body

Video Tutorials: <https://youtu.be/M6cAT3Lhd6E>

Theory concepts: <https://bie.tg.nic.in/Pdf/automobilechasis.pdf>

Sample Quiz: <https://www.objectivebooks.com/p/mechanical-engineering-mcq.html>

## B. Clutches

Video Tutorials: <https://youtu.be/GGRk5Wi9nx0>

Theory concepts:

<https://mechanical-engg.com/notes/automobile-engineering/types-of-clutches-r21/>

Sample Quiz:

<https://www.wisdomjobs.com/e-university/automobile-engineering-interview-questions.html>

## Unit-3

### A. Gear Boxes

Video Tutorials: <https://youtu.be/BTI45JdNc0w>

Theory concepts: <https://www.mechanicalbooster.com/2017/11/types-of-gearbox.html>

Sample Quiz:

<https://learnmech.com/automobile-engineering-mcq-objective-question-and-answers-part-2/>

### B. Drives

Video Tutorials: <https://youtu.be/WoWzUPIR8i0>

Theory concepts: <https://learnmech.com/mechanical-drives-belt-chain-gear/>

Sample Quiz: <https://www.examveda.com/mcq-question-on-mechanical-engineering/>

## Unit-4

### A. Wheels and tyres

Video Tutorials: <https://youtu.be/I08QRQYr-k8>

Theory concepts:

<https://www.mechanical-knowledge.com/2021/02/automobile-wheels-and-tyres.html>

Sample Quiz: <https://www.objectivebooks.com/p/mechanical-engineering-mcq.html>

## B. Steering system

Video Tutorials: <https://youtu.be/5ucmHxLpW6Q>

Theory concepts: <https://www.slideshare.net/farhanafzal896/steering-system-in-automobile>

Sample Quiz:

<https://learnmech.com/automobile-engineering-mcq-objective-question-and-answers-part-6/>

## Unit-5

### A. Automotive electrical system

Video Tutorials: <https://youtu.be/5ucmHxLpW6Q>

Theory concepts: [https://en.wikipedia.org/wiki/Automotive\\_electronics](https://en.wikipedia.org/wiki/Automotive_electronics)

Sample Quiz: <https://www.careerride.com/automobile-engineering-interview-questions.aspx>

### B. Automotive air conditioning

Video Tutorials: <https://youtu.be/hnrWl8lOwSQ>

Theory concepts: <https://www.irjet.net/archives/V5/i6/IRJET-V5I6398.pdf>

Sample Quiz: <https://www.examveda.com/mcq-question-on-mechanical-engineering/>

Previous Year Question Papers:

<b>5E6207</b>	Roll No. _____	Total No of Pages: <b>3</b>
	<b>5E6207</b> <b>B. Tech V Sem. (Main/Back) Exam. Nov-Dec. 2015</b> <b>Mechanical Engineering</b> <b>SME6.2A Automobile Engineering</b>	

**Time: 3 Hours** **Maximum Marks: 80**

**Min. Passing Marks Main: 26**

**Min. Passing Marks Back: 24**

*Instructions to Candidates:*

*Attempt any five questions, selecting one question from each unit. All questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.*

*Units of quantities used/calculated must be stated clearly.*

*Use of following supporting material is permitted during examination.*

1. NIL 2. NIL

**UNIT-I**

Q.1 (a) What are the loads coming on a chassis frame? With the help of line diagram, explain the frame construction, briefly. Enumerate the different types of chassis frames. [8]

(b) Describe briefly the constructional features and working of fluid coupling. [8]

**OR**

Q.1 (a) Describe the constructional features and working of a semi-centrifugal clutch with the help of neat sketch. [6+3=9]

(b) With the help of suitable sketches, explain the principle and working of hydraulic brakes. Mention the advantages of hydraulic brakes over mechanical brakes. [7]

## UNIT-II

- Q.2 (a) Draw a simple diagram to show the layout 5 forward 1 reverse speed gear box. Explain its working in detail. [9]
- (b) What is the necessity of differential in an automobile? Discuss in detail, the construction and operation of differential. [2+5=7]

### OR

- Q.2 (a) Write short note on (any two) - [4+4=8]
- (i) Overdrive
  - (ii) Front wheel drive
  - (iii) Hotchkiss and Torque tube drive
- (b) Explain the synchronizer action in manual transmissions with the help of a neat sketch. Explain the purpose of inter-lock device used in manual transmission. [8]

## UNIT-III

- Q.3 (a) What are the functions of wheel in an automobile? Describe the types and constructional features of tyre, briefly. [3+4=7]
- (b) Explain the following terms - [9]
- (i) Over steering and under steering
  - (ii) Power steering
  - (iii) Caster and Camber

### OR

- Q.3 (a) What is the difference between sprung and unsprung weight. Describe the independent rear suspension system with neat sketch and explain how it affects ride quality? [7]
- (b) Explain the constructional features and working of telescopic absorber. [9]

#### UNIT-IV

- Q.4 (a) Describe briefly the constructional features of battery used in automobile, with the help of neat sketch. How a battery is tested and charged? [5+3=8]
- (b) Describe briefly, the constructional features and working principle of starter motor in an automobile. [4+4=8]

**OR**

- Q.4 (a) Explain the Battery Ignition system with the help of neat sketch. Compare its advantages and disadvantages with that of Magneto Ignition system. [6+4=10]
- (b) With the help of neat sketch, explain the working of the electric horn. [6]

#### UNIT-V

- Q.5 (a) List the common faults related to automotive air conditioning system. How these faults are diagnosed and rectified? [5+3=8]
- (b) Explain the significance and features of Night Vision system and Global Positioning system. [3+5=8]

**OR**

- Q.5 (a) Enumerate the different loads on automotive air conditioning system. Explain the working of various components of automotive air conditioning system. [8]
- (b) List the various safety requirements of an automobile. Explain the functions of various safety devices incorporated in automobiles now days. [3+5=8]

**5E6207**

[Total No. of Pages : 3]

**5E6207**

B.Tech. V Semester (Main/Back) Examination, Nov./Dec. - 2017  
Mechanical Engineering  
5ME6.2A Automobile Engg.

Time : 3 Hours

Maximum Marks : 80

Min. Passing Marks : 26

**Instructions to Candidates:**

Attempt any five questions, selecting one question from each unit. All Questions carry equal marks. (Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly). Units of quantities used/calculated must be stated clearly.

**Unit - I**

1. a) How is a frame different from a chassis? Discuss the design aspects and salient features of frame? (2+4)
- b) With the help of neat sketch. Explain Hydraulic and Vacuum air braking system. (5+5)

**OR**

1. a) Explain working of fluid coupling with the help of neat sketch. (6)
- b) How the size of a clutch plate. Determined? How does the uniform pressure criteria differ from the uniform wear consideration? How does the mean effective radius influence the torque transmitting ability in both the design criteria? (2+4+4)

**Unit - II**

2. a) Which component in the transmission system makes a difference between the two wheel drive and the four wheel drive. Discuss the working of the same with neat sketch. (6)
- b) Explain the construction and working of constant mesh and synchromesh gear box? (5+5)

2. a) Write short notes on the following (any two) :- (4+4)
- i) Over drive
  - ii) Universal Joint
  - iii) Propeller Shaft
  - iv) Torque Tube drive
- b) Explain Construction and working of hydraulic torque converter with the help of neat sketch. (8)

**Unit - III**

3. a) What do you mean by tyre retreading? Name various tyre retarding process and explain them. How will you ascertain whether a tyre needs retreading or not? (2+4+2)
- b) State the Principle and derive equation for correct steering of a vehicle. Hence draw "Ackermann's Steering Mechanism" and Explain wheel lock and steering lock angles? (3+3+2)

**OR**

3. a) Sketch the construction of a double acting telescopic. Type Hydraulic shock absorber and explain it's working. Why it is known as "double acting" and "telescopic type"? (6+2)
- b) What do you mean by power steering? Different between a conventional and a power steering system. Explain the principles of power steering and draw its construction layout. (2+2+4)

**Unit - IV**

4. a) Describe in detail the method of battery charging. Also explain in detail how would perform specific gravity tests. (4+4)
- b) Describe the construction and working of starter motor for automobiles. (8)

**OR**

4. a) Write short notes on the following (any two) : (8)
- i) Electric horn
  - ii) Fuel level indicator
  - iii) Head Lamp



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paper

- b) With help of neat sketch explain working and construction of Magneto ignition system. (8)

**Unit - V**

5. a) What is refrigerant? Explain different types of refrigerants? (2+6)  
b) Describe the working of an automotive air conditioning system along with fraction of each components. (8)

**OR**

5. a) Explain the following : (4+4)  
i) Night Vision System (NVS)  
ii) Global Positioning system  
b) What are safety requirement in automobile. Explain the safety devices used in automobiles? (3+5)