GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering
Level: Diploma
Branch: Automobile Engineering
Subject Code: DI05002041
Subject Name: Automotive Mechanics

w. e. f. Academic Year:	2026-27
Semester:	5th
Category of the Course:	PEC-03

Prerequisite:	-------
Rationale:	Mechanics is a branch of Physics, which incorporates science concerned with the motion of bodies under the action of forces, including the special case in which a body remains at rest. Study of automotive mechanics includes the underlying study of various forces, motion analysis of mechanisms, braking performance, engine performance, vibration analysis, direction control, etc. This course is mainly concerned with the movements of a vehicle on a road surface. The movements of interest are acceleration, braking, ride and turning. Course is designed to acquaint students with effects of various forces on the vehicle, sources of vibration and its isolation, steering geometry for true rolling and engine performance measurement. Calculation on wheel reaction, braking force impact, traction available at wheel, maximum possible acceleration for given situation, heat balance sheet etc. are also covered in the course with a view to develop problem solving capacity of student in the field of automotive mechanics.

Course Outcome:

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

No	Course Outcomes	RBT Level
01	Apply fundamental principles of mechanics, kinematics, and automotive force systems to interpret vehicle motion and behavior.	R & A
02	Explain steering geometry, Ackermann steering mechanism, true rolling condition, turning radius, and four-wheel steering.	N & U
03	Apply the concepts of vehicle vibration, sources of vibration, and vibration isolation techniques to improve ride comfort and ergonomics.	R & N
04	Evaluate vehicle performance by determining resistances, tractive effort, stability, braking efficiency, and overall dynamic behavior under different operating conditions.	A & E
05	Evaluate engine performance using performance indicators, dynamometers, Morse test, heat balance sheet, and methods of improving engine performance.	A & E

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (In Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA(M)	PA(I)	ESE (V)	
3	1	0	4	70	30	00	00	100

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Fundamentals of Automotive Mechanics and Vehicle Dynamics** 1.1 Introduction to Mechanics • Mechanics • Statics • Dynamics • Kinematics • Kinetics 1.2 Important terminology in Mechanics • Kinematic Link • Kinematic Pair • Kinematic Chain • Mechanisms • Structure • Machine • Degree of freedom for planar mechanism. 1.3 Basic mechanisms used in Automobile Systems • Four bar chain Mechanism. • Single and Double Slider Crank Mechanisms. • Cam and Follower Mechanism (with their types) 1.4 Introduction to Automotive Mechanics and related Important terms • Aerodynamic Forces (Drag & Lift) • Side force • SAE Vehicle Axis System • Rolling, Pitching & Yawing moments 1.5 SAE Tire axis system	9	20%
2.	**Vehicle Steering Geometry** 2.1 Steering Gear Mechanism 2.2 Ackermann steering mechanism	05	12%

	2.3 True rolling condition 2.4 Turning radius and steering geometry (along with calculations) 2.5 Four-wheel steering		
3.	**Vehicle Vibrations** 3.1 Types of vibrations 3.2 Sources of vibration in vehicles 3.3 Vibration terminology 3.4 Vibration isolation techniques 3.5 Effect on human comfort and vehicle ergonomics	05	12%
4.	**Vehicle Performance** 4.1. Power for propulsion • Various resistances to vehicles • Traction and tractive effort 4.2. Relation between engine speed and vehicle speed (along with numerical) 4.3. Road Performance Curves on the basis of available power • Acceleration • Drawbar Pull • Gradability 4.4. Weight Distribution and reaction at wheel in • Three wheeled vehicles • Four wheeled vehicles 4.5. Stability of a vehicle on slope 4.6. Calculation of maximum acceleration, maximum tractive effort and relation for different drives 4.7. Factors affecting braking efficiency 4.8. Calculation of stopping distance. (When brakes are applied to…) • Only front wheel, • Only rear wheels All four wheels	14	30%
5.	**Engine Performance** 5.1. Performance Indicators of I.C engine • Indicated power • Brake power • Friction power • Indicated thermal efficiency • Brake thermal efficiency • Mechanical efficiency • Volumetric efficiency	12	26%

	• Relative efficiencies 5.2. Dynamometers used for measuring power of engine • Rope brake dynamometer • Prony brake dynamometer • Hydraulic dynamometer 5.3. Morse test – procedure – problems 5.4. Heat balance sheet - problems. 5.5 Variables affecting performance and methods to improve engine performance.		
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15	**25**	**30**	**20**	**10**	**-**

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:

S. No.	**Title of Book**	**Author**	**Publication with place, year and ISBN**
1	Automobile Mechanics	Dr. N. K. Giri	Khanna Publishers, Delhi, 2008. ISBN: 9788174092168
2	Theory of Machines	Theory of Machines	Theory of Machines
3	Theory of Machines	S. S. Rattan	McGraw Hill Education India Pvt. Ltd., Noida, 2017. ISBN: 978-9351343479
4	Vehicle Dynamics	Martin Meywerk	Wiley Publishing Company, New York, 2015. ISBN: 9781118971352
5	A Course in Internal Combustion Engines	V.M. Domkundwar	Dhanpat Rai Publishing Company (P) Limited, 2008, ISBN: 8177000039, 9788177000030

6	Fundamentals of Vehicle Dynamics	Thomas D. Gillespie	SAE International, Warrendale, 2021 978-1468601756
7	Engine Testing: Theory and Practice	A. J. Martyr, M. A. Plint	Elsevier, 3rd Edition. ISBN: 978-0750684393
8	Internal Combustion Engines	V. Ganesan	Tata McGraw-Hill, New Delhi. ISBN: 978-1259006197

(b) Open-source software and website:

S. No.	Website	Focus Area	Link
1	NPTEL: Fundamentals of Automotive Systems	Units 1, 2, 4 & 5: Comprehensive lectures on automotive mechanics, steering, and engine performance.	nptel.ac.in/courses/107106088
2	NPTEL: Vehicle Dynamics	Unit 1, 2 & 4: In-depth analysis of road loads, tire mechanics, and vehicle stability.	nptel.ac.in/courses/107106080
3	NPTEL: IC Engines and Gas Turbines	Unit 5: Detailed procedures for engine testing, Morse tests, and heat balance calculations.	nptel.ac.in/courses/112104033
4	NPTEL: Mechanical Vibrations	Unit 3: Fundamental terminology, isolation techniques, and multi-degree of freedom systems.	nptel.ac.in/courses/112107212
5	Speed-Wiz Automotive	Unit 2 & 4: Online simulators for Ackermann steering geometry and braking efficiency.	speed-wiz.com

6	How a Car Works	Unit 1 & 5: Visual guides and technical articles on basic mechanisms and engine performance.	howacarworks.com

Suggested Project List:

1. Prepare a chart/model of kinematic links, pairs, and mechanisms used in automobiles
2. Prepare a visual chart explaining aerodynamic forces, SAE vehicle axis system, and vehicle motions
3. Prepare a Comparative study of conventional steering and four-wheel steering systems.
4. Prepare a short report on turning radius and steering geometry with examples.
5. Group discussion on vibration control methods and ride comfort in vehicles.
6. Prepare a chart showing different types of vibrations in vehicles.
7. Prepare a Comparative study of braking conditions (front, rear, all-wheel braking).
8. Prepare a simple report on vehicle performance parameters (acceleration, gradability, etc.).
9. Prepare a formula sheet for vehicle performance and engine performance calculations.
10. Group discussion on methods to improve engine performance and efficiency.

Suggested Activities for Students:

Unit	Activity Title	Description
1	Diagram labeling exercise	Students label the parts of basic mechanisms and identify automotive force terms from given figures.
2	Steering parts identification	Students identify steering components from a diagram or actual system and state their functions.
3	Concept quiz	Students answer short questions on vibration terms, sources, and isolation methods.
4	Numerical worksheet	Students solve simple problems on tractive effort, resistance, and stopping distance.
5	Engine test terms matching	Students match performance terms such as IP, BP, FP, efficiency, dynamometer, and Morse test with their meanings.

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