

AUTOMOBILE TESTING AND VALIDATION**Course Code : 315378**

Programme Name/s : Automobile Engineering.
Programme Code : AE
Semester : Fifth
Course Title : AUTOMOBILE TESTING AND VALIDATION
Course Code : 315378

I. RATIONALE

Vehicle testing and validation are fundamental in the automobile manufacturing industry to ensure vehicles meet high performance and quality standards. Through comprehensive testing and homologation, manufacturers can confirm the safety, reliability, and efficiency of their vehicles, adhering to global standards. This course provides students with in-depth knowledge of testing procedures for various vehicle subsystems and components, using industry-standard equipment and techniques. By learning these testing processes, students will be equipped to contribute to the development of high-quality, safe, and compliant vehicles, ultimately enhancing their proficiency in automotive engineering.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Apply standard testing procedures to ensure vehicle compliance with regulatory and safety standards

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Apply vehicle testing standards for validation and homologation.
- CO2 - Select appropriate vehicle-level tests for various types
- CO3 - Perform test of vehicle on test tracks.
- CO4 - Use chassis dynamometer for vehicle testing.
- CO5 - Interpret NCAP rating for comfort and safety of passengers.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme						Credits	Assessment Scheme												Total Marks
				Actual Contact Hrs./Week			SLH	NLH	Paper Duration		Theory				Based on LL & TL				Based on SL				
															Practical								
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA				
							Max	Max	Max						Min	Max	Min	Max			Min	Max	
315378	AUTOMOBILE TESTING AND VALIDATION	ATV	DSE	4	-	2	-	6	2	3	30	70	100	40	25	10	25#	10	-	-	150		

Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	<p>TLO 1.1 Explain the need for vehicle testing and homologation</p> <p>TLO 1.2 State the requirements for a given test</p> <p>TLO 1.3 Identify parameters measured by the specified equipment.</p> <p>TLO 1.4 Identify test standards for vehicle testing and validation</p> <p>TLO 1.5 Describe steps for production part approval process.</p>	<p>Unit - I Vehicle Testing and Homologation</p> <p>1.1 Overview of Vehicle Testing - Need and importance of vehicle testing and homologation.</p> <p>1.2 Basis of tests - Driving cycles, Homologation</p> <p>1.3 Requirements of test - a) Test equipments, b) Procedure, c) Quality Personnel.</p> <p>1.4 Testing instruments and equipments: Use, Capabilities and Parameters measured by - Engine dynamometer, Compression tester, Stroboscope, Petrol/Diesel engine scanner, Exhaust gas analyzer, Diesel smoke meter, Vacuum tester, Chassis dynamometer.</p> <p>1.5 Testing standards - a) SAE standards, b) ASMT standards, c) ARAI standards, d) CMVI regulations.</p> <p>1.6 Significance of test.</p> <p>1.7 Production part approval process.</p>	<p>Chalk-Board</p> <p>Flipped Classroom</p> <p>Video</p> <p>Demonstrations</p> <p>Presentations</p>
2	<p>TLO 2.1 Identify effect of different parameters on vehicle performance.</p> <p>TLO 2.2 Describe effects of change in steering geometry on vehicle performance.</p> <p>TLO 2.3 Explain test procedure for tyre testing.</p>	<p>Unit - II Vehicle Performance Testing</p> <p>2.1 Identify the effect of different parameters on vehicle performance.</p> <p>2.2 Describe the effects of changes in steering geometry on vehicle performance</p> <p>2.3 Explain the test procedure for tire testing</p>	<p>Chalk-Board</p> <p>Video</p> <p>Demonstrations</p> <p>Presentations</p> <p>Case Study</p>

AUTOMOBILE TESTING AND VALIDATION**Course Code : 315378**

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	<p>TLO 3.1 : Explain the purpose and justification of different test tracks for vehicles</p> <p>TLO 3.2 Describe the importance of vehicle-level performance testing</p> <p>TLO 3.3 Explain the procedure for conducting different tests on specific tracks.</p> <p>TLO 3.4 : Explain the procedure for conducting vehicle-level performance tests.</p>	<p>Unit - III Road and Track Testing</p> <p>3.1 Testing of Vehicles on road: Introduction of sampling technique.</p> <p>3.2 Vehicle level performance test: a) Acceleration, b) Driveability, c) Gradeability, d) Restartability, e) Brakes testing, f) Steering effort Testing, g) Speedometer and odometer testing.</p> <p>3.3 Accelerated endurance testing procedures: Torture tracks - Belgian Pave, Corrugated, Long wave pitching, Pot hole, Sand patch, Mud patch, Steering pad, High speed, Serpentine courses, Gradient, Shallow water trough, Deep wading trough, Cross Country, Step Climbing.</p> <p>3.4 Draw bar or winch pull test.</p>	<p>Lecture Using Chalk-Board</p> <p>Video</p> <p>Demonstrations</p> <p>Presentations</p> <p>Flipped Classroom</p>
4	<p>TLO 4.1 Describe the construction and operational principles of two-wheeler and four-wheeler dynamometers</p> <p>TLO 4.2 Explain procedure of different tests on chassis dynamometer.</p> <p>TLO 4.3 Interpret data obtained from dynamometer tests to assess vehicle performance and compliance with standards</p> <p>TLO 4.4 Follow standard procedures for testing vehicle components on a chassis dynamometer to ensure vehicle safety and reliability</p>	<p>Unit - IV Vehicle Testing on Chassis Dynamometers</p> <p>4.1 Two wheeler and four wheeler dynamometers: Construction and working.</p> <p>4.2 Vehicle testing lanes: Side slip testers, wheel alignment testing, wheel balancing, brake test, head light alignment and light intensity testing.</p>	<p>Lecture Using Chalk-Board</p> <p>Video</p> <p>Demonstrations</p> <p>Presentations</p> <p>Site/Industry Visit</p>
5	<p>TLO 5.1 Explain the crashworthiness test procedures and standards of Global NCAP, Euro NCAP, and Bharat NCAP.</p> <p>TLO 5.2 Identify BNCAP car testing protocols, including full frontal, frontal offset, side impact, and pedestrian protection testing.</p> <p>TLO 5.3 Perform rollover and inverted vehicle drop tests to evaluate vehicle safety</p> <p>TLO 5.4 Interpret the results from various safety tests to assess the effectiveness of active and passive safety systems in vehicles</p>	<p>Unit - V Testing of Active and Passive Safety Systems</p> <p>5.1 Crashworthiness test of vehicle: Global NCAP, Euro NCAP, Bharat NCAP.</p> <p>5.2 BNCAP car testing protocols: Full frontal, Frontal offset testing, Side impact testing, Pedestrian protection testing.</p> <p>5.3 Roll over test without collision. Inverted vehicle drop test.</p>	<p>Lecture Using Chalk-Board</p> <p>Video</p> <p>Demonstrations</p> <p>Presentations</p> <p>Site/Industry Visit</p>

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify the process of ensuring a vehicle meets regulatory standards before it is approved for sale LLO 1.2 Identify safety standards and regulatory requirements for sale of vehicle LLO 1.3 Identify vehicle emissions under different operating conditions.	1	* Vehicle testing and homologation process	2	CO1
LLO 2.1 Identify regulatory compliance and standards for Noise Level Testing and Structural Integrity Testing of vehicles. LLO 2.2 Identify specialized testing equipment for above vehicle testing. LLO 2.3 Prepare testing protocols and documentation.	2	Approval of Component/System/Vehicle from Concerned Organizations for the following Test: Noise Level Testing and Structural Integrity Testing.	2	CO1
LLO 3.1 Identify various industry standards and specifications. LLO 3.2 Compare vehicle components against AIS, IS, SAE, ECE, BIS standards. LLO 3.3 Prepare comparative analysis of materials used in vehicles for compliance with standards.	3	Standards for Vehicle Testing - AIS, IS, SAE, ECE, BIS	2	CO1
LLO 4.1 Identify measurement tool and software. LLO 4.2 Determine the aerodynamic drag and rolling resistance of the vehicle.	4	*Coast Down Test on a Vehicle by following Test 1. Aerodynamic Drag calculations 2. Rolling Resistance Assessment	2	CO2
LLO 5.1 Measure fuel consumption in real-time during various driving conditions. LLO 5.2 Measure the distance travelled to calculate fuel efficiency. LLO 5.3 Record and analyse the data.	5	On-Road Fuel Consumption Test on Two-Wheeler	2	CO2
LLO 6.1 Identify various braking measurement tools. LLO 6.2 Measure the force applied by the braking system on the basis of the online practical demonstration. LLO 6.3 Record data and analysis.	6	*Brake efficiency test on a vehicle (stopping distance test).	2	CO3

AUTOMOBILE TESTING AND VALIDATION**Course Code : 315378**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 7.1 Identify various noise level measurement techniques and tools. LLO 7.2 Measure noise levels emitted by a vehicle passing by at different speeds. LLO 7.3 Record data and analysis.	7	Pass-by Noise Test.	2	CO3
LLO 8.1 Identify various acceleration measurement tools. LLO 8.2 Measure the acceleration of a vehicle when the throttle is fully opened from idle. LLO 8.3 Analyse emissions produced during free acceleration.	8	Free acceleration test.	2	CO4
LLO 9.1 Use websites for above practical demonstrations. LLO 9.2 Identify various vehicle performance parameters. LLO 9.3 Follow procedures for testing vehicle performance parameters such as power, torque, and emissions using a chassis dynamometer.	9	*Vehicle Performance Testing Using Chassis Dynamometer.	2	CO4
LLO 10.1 Use websites for practical demonstrations. LLO 10.2 Write procedures and outcomes of vehicle crash tests to assess safety.	10	*Crash Test	2	CO5
Note : Out of above suggestive LLOs - <ul style="list-style-type: none"> • '*' Marked Practicals (LLOs) Are mandatory. • Minimum 80% of above list of lab experiment are to be performed. • Judicial mix of LLOs are to be performed to achieve desired outcomes. 				

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING) : NOT APPLICABLE

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Stroboscope: Digital ignition timing gun with LED Display, 12 V system, for 1 to 8 cylinder S.I. engine, Ignition adjustment from 0 to 60 degrees, engine speed range: 200 to 9999 rpm. additional crocodile clips and inductive pliers.	2
2	Brake efficiency tester: It is composed of a roller brake tester, a suspension tester and a side slip tester. Braking, suspensions & side slip, Productivity: totem with PC, touch screen and remote control, S9010 PTI testing process, Epoxy rollers.	6

AUTOMOBILE TESTING AND VALIDATION**Course Code : 315378**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
3	Pass-by test set up: Single Mini Input Module, 1 x 100 Hz GPS Data Logger, 1 x Laser Light Barrier Kit, 2 x 5 Ahr Li Ion battery pack, 1 x Vehicle Telemetry Radio, 1 x Road side Telemetry Radio, PC or Tablet, B&K 2250 SLM DC output cable to Min Input Module.	7
4	Chassis dynamometer for two/four-wheeler: Drive- 2WD, Torque-5000Lb-ft, Max power-500 HP, Dynamometer capable of supporting speeds up to 175+ MPH and 1250+ HP. The maximum axle weight is 6,500 lbs and the track width range is 36"-86". Dynamometer shall be capable for different testing scenarios – FWD/RWD Cars, Sport Compacts, Diesel Trucks, Motorcycles and ATV's. Eddy brake to perform acceleration, step, sweep and steady-state tests. • View in real-time torque/horsepower output, at steady and changing speeds, • Diagnose engine and drivetrain problems. • Troubleshoot drivability issues. • Run track ¼ mile or circle track lap simulations with reaction times that you determine in the software parameters. • Bi-Directional roller for testing of both RWD and FWD vehicles. It shall be fully upgradeable in the field, it can be coupled with any other Chassis Dynamometer (7500, 15,000, or DC POD's) for All-Wheel-Drive Testing.	9
5	Working Two-wheeler: Engine- single cylinder, air cooled, 4-stroke, 100-150CC, Min Power- 7ps @7500 rpm, torque-8 Nm @5000 rpm. Complying BS VI norms.	All
6	Working Four-wheeler vehicle: 3 cylinder – 4 stroke, petrol/ diesel engine, Min 800CC, Min- 35ps @5000 rpm, Torque 5 Nm @2500 rpm, complying BS VI norms.	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Vehicle Testing and Homologation	CO1	6	2	8	2	12
2	II	Vehicle Performance Testing	CO2	10	2	6	8	16
3	III	Road and Track Testing	CO3	10	2	6	8	16
4	IV	Vehicle Testing on Chassis Dynamometers	CO4	6	2	4	4	10
5	V	Testing of Active and Passive Safety Systems	CO5	8	2	6	8	16
Grand Total				40	10	30	30	70

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- Two-unit tests of 30 marks and average of two-unit tests.
- For laboratory learning 25 Marks
- For Self Learning 25 Marks.

Summative Assessment (Assessment of Learning)

- End semester assessment of 70 marks.
- End semester assessment of 25 marks for laboratory learning.
- End semester assessment of 70 marks.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	-	-	-	3	2	3			
CO2	3	-	-	2	3	2	3			
CO3	3	2	-	2	3	2	3			
CO4	3	2	-	2	3	2	3			
CO5	3	2	-	2	3	2	3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
 *PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	K. V. Fadadu and B. H. Kadiya	VEHICLE TESTING AND HOMOLOGATION	Books India Publication, ASIN B07R9Y9JFK
2	Dr. N. K. Giri	Automobile Mechanics	Khanna Publications, ISBN13, 978-8174092168
3	G.B.S. Narang	Automobile Engineering	Khanna publication, 1995 ISBN 13 : 978-9387394254
4	--	AIS- Automotive Industry Standards	Ministry of road transport and highways
5	---	Central Motor Vehicle regulations 1989	Ministry of road transport and highways
6	---	SAE handbook	Society of Automotive Engineers.
7	W. H. Crouse, L. Anglin	Motor vehicle inspection	McGraw-Hill, Gregg Division 1978, ISBN: 0070148139

XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=yIovz10bMpk	Vehicle crash test
2	https://www.youtube.com/watch?v=m9vdYeTVUrs	Vehicle crash test
3	https://www.youtube.com/watch?v=WrcvprZavI	Chassis dynamometer test
4	https://youtu.be/M8I9X5ssEfw?feature=shared	Pass by noise test
5	https://youtu.be/ZWI80ETZ480?feature=shared	Chassis dynamometer test for two wheeler
6	https://youtu.be/jNngrem0Li7M?feature=shared	Testing and validation of Braking system
7	https://youtu.be/_8aPLp2FqOE?feature=shared	Brake testing
8	https://youtu.be/fKCR09JH7pU?feature=shared	Brake stopping distance test

AUTOMOBILE TESTING AND VALIDATION**Course Code : 315378**

Sr.No	Link / Portal	Description
Note : <ul style="list-style-type: none">Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students		

MSBTE Approval Dt. 24/02/2025**Semester - 5, K Scheme**