

ADVANCES IN AUTOMOTIVE TECHNOLOGIES**Course Code : 315376**

Programme Name/s : Automobile Engineering.
Programme Code : AE
Semester : Fifth
Course Title : ADVANCES IN AUTOMOTIVE TECHNOLOGIES
Course Code : 315376

I. RATIONALE

This course equips students with a solid foundation in understanding the transformative impact of technology on the automotive sector. By exploring recent trends, technological innovations, and emission regulations, students gain a holistic perspective essential for pursuing careers in automotive engineering and related fields. This course not only prepares students for current industry demands but also fosters a forward-thinking mindset necessary for adapting to future advancements in automotive technologies. Key technologies covered include Electric Vehicles (EVs), Hybrid Electric Vehicles (HEVs), Dual Clutch Transmission (DCT), Active Cylinder Management (ACM), and Electronic Stability Control (ESC).

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Apply advanced automotive technologies to meet the changing needs of the industry.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Identify advancements in Hybrid Electric Vehicle (HEV) and Fuel Cell Vehicle technologies influenced by emission standards.
- CO2 - Select suitable Electric Vehicle (EV) systems based on battery technologies and charging infrastructure.
- CO3 - Compare EV propulsion systems and advanced transmission technologies based on performance.
- CO4 - Assess the benefits of Active Cylinder Management (ACM), Start-Stop system and engine downsizing.
- CO5 - Analyze vehicle dynamics, safety systems, and factors affecting ride comfort.

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	Min	Max	Min	Max	Min	Max	Min		
315376	ADVANCES IN AUTOMOTIVE TECHNOLOGIES	AAT	DSC	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	TLO 1.1 Explain the concept of HEV and its architecture. TLO 1.2 Explain regenerative braking with the help of a block diagram. TLO 1.3 Compare EV and FCV based on vehicle range, battery capacity, performance, and efficiency. TLO 1.4 Justify the use of CNG in two-wheeler vehicles. TLO 1.5 Compare BS IV and BS VI emission standards.	Unit - I Hybrid Electric Vehicles 1.1 Environmental and Regulatory Considerations: Bharat stage (BS) Emission Standards influencing automotive technology development, hydrogen fuel, Use of CNG in two-wheeler vehicles. 1.2 Hybrid Electric Vehicles (HEV): Introduction to HEV, classification of HEV on the basis of Hybridization Level, Powertrain, Plug-in Capability, Vehicle Segment, Driving Mode 1.3 Common features of hybrid vehicles 1.4 Levels of Hybrid Vehicles: Mild, Medium and Full Hybrid vehicles. 1.5 Efficiencies of Electric motors and I.C. Engines. 1.6 Plug-in Hybrid Electric Vehicles (PHEVs): Differences from HEVs- ability to charge from external power sources, extended electric-only range, and operation modes (electric mode, hybrid mode) 1.7 Fuel Cell Vehicles (FCVs): Proton exchange membrane (PEM) fuel cells and solid oxide fuel cells (SOFCs).	Lecture Using Chalk-Board Presentations Video Demonstrations Site/Industry Visit Model Demonstration

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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.
2	TLO 2.1 Describe an electric propulsion system with a block diagram. TLO 2.2 Select an appropriate electric motor for a given two-wheeler EV. TLO 2.3 Choose an appropriate electric motor for a given four-wheeler EV. TLO 2.4 Compare different types of batteries used in EVs based on capacity, power, and weight. TLO 2.5 Explain the need for a Battery Management System (BMS) in EVs. TLO 2.6 Classify EV charging systems. TLO 2.7 Specify the requirements for high-speed charging of a two/four-wheeler.	Unit - II Electric Vehicles 2.1 Electric Vehicles (EVs): Introduction to electric vehicles system- propulsion systems, battery technologies, and charging infrastructure. 2.2 Layout of EV - Two, Three & Four Wheeler vehicles. 2.3 Battery: Types of battery (Lithium ion battery, nickel metal hydride, lead acid), capacity, size, weight and power, Battery Characteristics 2.4 Battery Management System (BSM)- operation 2.5 Electric Motor: Types, components, functions and applications 2.6 Charging Infrastructure: Overview of charging technologies (AC Vs. DC charging), charging stations, connectors, and smart charging solutions.	Lecture Using Chalk-Board Video Demonstrations Presentations Site/Industry Visit
3	TLO 3.1 Differentiate powertrain technologies based on torque, efficiency, and performance. TLO 3.2 Compare propulsion systems using single, dual motors, and all-wheel drive. TLO 3.3 Explain the dual clutch transmission system with a sketch. TLO 3.4 Describe the working of the Automated Manual Transmission (AMT) system. TLO 3.5 Explain the Intelligent Manual Transmission (IMT) system with a sketch.	Unit - III Powertrain Technologies 3.1 EV Propulsion Systems: Types of EV propulsion systems (single motor, dual motor, all-wheel drive) and their impact on vehicle performance 3.2 HEV Powertrains: Series Hybrid vehicle, Parallel Hybrid Vehicle, Series parallel Hybrid Vehicle, Comparison of different Powertrain Technologies 3.3 Advanced Transmission Technology: Dual-Clutch Transmission, Automated Manual Transmissions (AMTs), Intelligent Manual Transmission System	Lecture Using Chalk-Board Presentations Model Demonstration Video Demonstrations
4	TLO 4.1 Explain the working principle of Active Cylinder Management and list its benefits. TLO 4.2 Describe the working of the start-stop system at a crossroad signal. TLO 4.3 Explain the concept of a downsized engine and state the benefits of downsizing.	Unit - IV Advanced Engine Technologies 4.1 Active Cylinder Management (ACT): Principle and benefits 4.2 Start-Stop Systems: Belt Alternator Starter system- Operation & Benefits. 4.3 Downsizing: Concept of downsizing engines while maintaining or improving performance through turbocharging / Supercharging and direct injection.	Lecture Using Chalk-Board Presentations Video Demonstrations

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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.
5	TLO 5.1 Justify the need for a traction control system under certain road conditions. TLO 5.2 Explain the benefits of Electronic Stability Control (ESC). TLO 5.3 Illustrate the working of ESC with sketches. TLO 5.4 identify the factors affecting ride comfort. TLO 5.5 Explain the working of the collision avoidance system with a sketch.	Unit - V Vehicle Dynamics and Control Systems 5.1 Handling Characteristics: Study of vehicle dynamics principles, including steering response, cornering behavior, and traction management: Traction Control System (TCS). 5.2 Stability Control System: Principles and operation of electronic stability control (ESC) systems to enhance vehicle stability during cornering and slippery conditions. 5.3 Ride Comfort: Factors affecting ride quality such as suspension design, damping characteristics, and vehicle weight distribution. 5.4 Active Safety Systems: Collision Avoidance System.	Lecture Using Chalk-Board Presentations Video Demonstrations

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 Use emission tester for emission measurement. LLO 1.2 Compare pollutants emitted from Petrol and CNG engines.	1	* Assessment of Engine Emissions and Fuel Impacts Using an Emissions Analyzer	2	CO1
LLO 2.1 Use OBD II scanner LLO 2.2 Test the Start Stop feature of given vehicle. LLO 2.3 Write a report to assess above technology's impact on fuel consumption and emissions.	2	* Impact of Start-Stop Technology on Fuel Consumption and Emissions Using an OBD-II Scanner	2	CO1
LLO 3.1 Demonstrate the operation of Fuel cell using kit. LLO 3.2 Operate Fuel cell kit under different conditions	3	Hydrogen Production and PEM Fuel Cell Efficiency Demonstration Using FCV Kit	2	CO1
LLO 4.1 Identify the aggregates of EV. LLO 4.2 draw layout of EV chassis LLO 4.3 Record benefits of EV chassis as compared to chassis with I.C. engine.	4	* EV Chassis Component Identification and Layout Analysis	2	CO2
LLO 5.1 Use battery analyzer for EV. LLO 5.2 Analyze EV battery pack parameters for performance.	5	* Analysis of EV Battery Voltage and Current Using Multimeter and Analyzer	2	CO2
LLO 6.1 Identify different charging methods and innovative solutions. LLO 6.2 Compare the working of different EV charging methods. LLO 6.3 Record relevant Standard Operating Procedures, precautions, charging times while adopting different charging technologies.	6	Comparative Study of EV Charging Technologies: Home, Public Stations, and Innovative Solutions.	2	CO2

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 7.1 Collect information on three vehicles from the same category. LLO 7.2 Compare their features, specifications and performance. LLO 7.3 Write report containing technology features and performance benefits of the above vehicles.	7	* Performance and Feature Assessment of Contemporary Vehicles: A Three-Brand Comparison.	2	CO1 CO2 CO3 CO4 CO5
LLO 8.1 Visit vehicle manufacturer's website for data collection relevant to the downsizing. LLO 8.2 Report benefits of downsizing of engine on vehicle performance and efficiency	8	Performance and Fuel Efficiency Comparison of Downsized Engines Versus Larger Engines	2	CO3
LLO 9.1 Demonstrate Antilock braking system features using relevant video link. LLO 9.2 Demonstrate Electronic stability control system features using relevant video link. LLO 9.3 Report benefits of ABS and ESC on vehicle stability and drivability	9	Demonstration of ABS and ESC Functions Through Braking in Various Condition	2	CO4
LLO 10.1 Demonstrate Automatic emergency braking system features using relevant video link. LLO 10.2 Report benefits of AEB, Lane-Keeping assist and Adaptive cruise control functions on vehicle safety and driver comfort	10	Demonstration of AEB, Lane-Keeping Assist, and Adaptive Cruise Control Functions	2	CO5
Note : Out of above suggestive LLOs - • '*' 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)**Assignment**

- Not applicable

Micro project

- Not applicable

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Exhaust Gas analyzer: ARAI Approved Device with relevant accessories; Measurement Range: CO- 0 to 10 %, HC- 0 to 10000 ppm, CO ₂ - 0 to 20 %, O ₂ - 0 to 25 %, A/F ratio- 7.35 to 29.40, Lambda- 0.500% to 2.000 % .	1
2	Scan tool: Make: BOSCH and alike; On Board Diagnostics (OBD) II and Generation Scan Tool, Controller area network enabled, Colour Display, Operating Temperature: 0 to 50°C, Internal Storage: 4 AAA batteries, External Power: 7 to 18 volts; Generic tool; Accessories: Extender cable, OBD II Cable; Relevant optional accessories;	2
3	Fuel Cell kit: Demonstration kit for fuel cell electric car principle	3
4	Digital Multimeter: LCD Display, 0 to 50°C Operating Temperature, DC voltage- 200mV to 1000 V DC, 2 to 1000 V Alternating Current, Current: 2mA to 20 A DC, Diode Test, Continuity Test- Audible buzzer, Resistance: 200 Ohm to 200 Mega Ohm; Accessories: Test leads, Current Clamp 300 A, Current Clamp Adapter.	3,4,5,6
5	Electric Vehicle chassis or operational cut section of EV. Any make and model	4,5,6
6	EV Integrated Detection Tool: - Specifications/ Capabilities: electric vehicle battery detection and vehicle system detection functions and integrates oscilloscope, multimeter, insulation tester and current clamp. compatible with the latest EV architecture.	5

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	Hybrid Electric Vehicles	CO1	12	4	8	8	20
2	II	Electric Vehicles	CO2	10	4	4	8	16
3	III	Powertrain Technologies	CO3	6	2	4	6	12
4	IV	Advanced Engine Technologies	CO4	4	0	4	4	8
5	V	Vehicle Dynamics and Control Systems	CO5	8	2	4	8	14
Grand Total				40	12	24	34	70

X. ASSESSMENT METHODOLOGIES/TOOLS

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

Summative Assessment (Assessment of Learning)

- 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	2	-	2	2	-	2			
CO2	3	2	1	2	-	2	2			
CO3	3	1	-	1	-	1	2			
CO4	3	2	-	2	-	1	1			
CO5	3	-	-	-	-	-	2			
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	Approx. 280 authors from industry and the university and college sector	Automotive Handbook	11th Edition April 2022, Robert Bosch GmbH ISBN13: 9781119911906
2	Jack Erjavec	Automotive Technology A Systems Approach	7th Edition Year: 2010, Delmar ISBN13:9781337794213 ISBN10: 133779421X
3	James D. Halderman	Automotive Technology: Principles, Diagnosis, and Service	4th Edition Year: 2012, PEARSON ISBN10: 0132542617 ISBN13: 9780132542616
4	G. K. Awari, V. S. Kumbhar, R.B. Tirpude	Automotive Systems, Principles and practices	1st edition 2021, CRC Press, ISBN13: 9780367498429
5	Rajesh Rajamani	Vehicle Dynamics and Control	Second Edition 2012, ISBN13: 9781461414322

XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
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Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=nrxmQhbZUTc	The Battery Basics: Understanding Lithium-Ion, Lead-Acid and More
2	https://www.youtube.com/watch?v=pnw1_ClC5Uw	Making of Electric vehicle Battery in India.
3	https://nap.nationalacademies.org/read/25542/chapter/9#203	Hybrid EV Powertrain
4	https://www.youtube.com/watch?v=h8yXOdS7Cb0	Smart hybrid cars dual battery engine support SHVS
5	https://www.youtube.com/watch?v=w-s3BqLIJ4A	Hybrid Electric Vehicle E-Learning Module
6	https://www.youtube.com/watch?v=mNOYS-duUJY	EV Electrical Systems basics
7	https://www.youtube.com/watch?v=HfN5dEeUyuE	Electric Vehicle Powertrain Components - Basics
8	https://www.youtube.com/watch?v=q7D1SaQF1T8	The Future of Automotive Innovation
9	https://www.youtube.com/watch?v=yoohR8sar5g	ACT - Active cylinder management

Note :

- 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**