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AUTOTRONICS **Course Code : 316350**

Programme Name/s : Automobile Engineering.

Programme Code : AE

Semester : Sixth

Course Title : AUTOTRONICS

Course Code : 316350

I. RATIONALE

As the automotive industry continues to embrace automation, electrification, and smart technologies, there is an increasing demand for skilled professionals capable of bridging traditional automotive engineering with modern electronics. These professionals must be equipped with the skills necessary to adapt to the rapidly evolving automotive landscape, where technology, electronics, and mechanics are becoming more integrated. This includes expertise in areas such as automotive sensors, actuators, control systems, and advanced vehicle diagnostics, all of which are crucial in shaping the future of the automotive industry.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following industry identified outcome through various teaching learning experiences: Perform remedial actions using advanced diagnostic tools of an automobile systems.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Apply the fundamentals of automotive digital electronics and Instrumentation.
- CO2 - Interpret the Computer Electronic Control Module (ECM), different memories and vehicle network systems.
- CO3 - Test the operation of automotive sensors and actuators.
- CO4 - Evaluate the performance of vehicle control systems.
- CO5 - Interpret diagnostic trouble codes in automotive systems.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme										
				Actual Contact Hrs./ Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical					
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316350	AUTOTRONICS	ATN	DSE	4	-	2	-	6	3	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.* 15 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 State the importance of digital electronics in automotive applications. TLO 1.2 Explain the relationship between Voltage, current, resistance and power using Ohm's Law. TLO 1.3 Solve simple circuit problems involving series and parallel configurations. TLO 1.4 List the types of diodes used in automotive applications. TLO 1.5 Describe the purpose of given instrumentation system in Automotive application.	**Unit - I Automotive Digital Electronics & Instrumentations** 1.1 Introduction to Automotive Electronics. 1.2 Overview of Electrical Principles: Voltage, current, resistance, and power. Ohm's Law and basic circuit analysis (Series and Parallel Circuits.) 1.3 Application of Zener Diode, Photo diode and LED in Automobiles. 1.4 Binary number system. 1.5 Instrumentation - Digital Cockpit, Heads Up Display.	Lecture Using Chalk-Board Video Demonstrations Site/Industry Visit
2	TLO 2.1 Explain the function of computer Electronic Control Module (ECM) using block diagram. TLO 2.2 Select the relevant type of computer memory (s) used in automobiles with justification. TLO 2.3 Compare open loop and closed loop control system in automotive application on basis of given parameters. TLO 2.4 Explain multiplexing improves communication in modern vehicle systems. TLO 2.5 Describe the working of a given network system used in vehicle communication. TLO 2.6 Explain Controller Area Network (CAN) Bus is preferred over Local Interconnect Network (LIN) Bus in critical automotive applications.	**Unit - II Automotive Computer Networks** 2.1 Computer Electronic Control Module (ECM): Processor, Control unit, Clock, Input/Output devices 2.2 Computer Memory: - Types:- RAM,ROM,PROM,EPROM,EEPROM,KAM 2.3 Control Theory: Open Loop and Closed loop system in automotive application. 2.4 Multiplexing: - Principle of multiplexing. 2.5 Vehicle Network System: - The principle of Controller Area Network (CAN) Bus, Local Interconnect Network (LIN) Bus.	Lecture Using Chalk-Board Video Demonstrations Site/Industry Visit
3	TLO 3.1 Describe with sketch the construction of	**Unit - III Automotive Sensors and Actuators** 3.1 Automotive Sensors: -Construction and working of	Lecture Using Chalk-Board

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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.
	the given automotive sensors. TLO 3.2 Analyze the output signals of given automotive sensors. TLO 3.3 Describe with sketch the construction of the given automotive actuators. TLO 3.4 Examine the input signals of given automotive actuators.	Accelerator pedal position sensor, Speed sensor – Cam shaft, Crank shaft, wheel speed. Knock sensor, Lambda sensor. 3.2 Automotive Engine Control Actuators: - Construction and Working of Electronic Throttle Control, Idle speed controller, Electronic Unit injector, Exhaust Gas Recirculation (EGR) Valve, Purge control Valve, Exhaust Throttle Valve.	Video Demonstrations Site/Industry Visit
4	TLO 4.1 Describe working of given power train control systems with block diagram. TLO 4.2 Illustrate the given motion control system functions with the help of a block diagram. TLO 4.3 Inspect the components of safety control systems. TLO 4.4 Explain necessity of given safety/ motion control system with justification.	**Unit - IV Automotive Control Systems** 4.1 Power train control system: Electronic control system used in Fuel Stratified Injection (FSI)/Turbo Stratified Injection (TSI) and Common Rail Direct Injection (CRDI) system. 4.2 Motion Control System: Anti-Lock Braking System (ABS) - Electronic Stability Program, Electronic Brakeforce Distribution, Traction control system, Electronic Differential Lock, Adaptive cruise control System, Electronic Suspension Control System, 4.3 Safety systems: Automatic emergency braking. Lane departure warning, Blind spot monitoring	Lecture Using Chalk-Board Video Demonstrations Site/Industry Visit
5	TLO 5.1 Describe with flow chart the six-step approach in testing given component. TLO 5.2 Illustrate the diagnostic procedure of given electronic control systems. TLO 5.3 Recommend procedure of stand-alone diagnosis of the given electronic components. TLO 5.4 Measure signals of given sensors and actuators using suitable measuring instrument.	**Unit - V Diagnostic Techniques in Automotive Systems** 5.1 The “Six step” approach of component testing. 5.2 On board diagnostic (OBD-II) procedure of Turbo Stratified Injection (TSI) system. 5.3 Emission Related Diagnosis: - Oxygen Sensor, Air mass flow sensor, Throttle position sensor, MAP Sensor, Coolant Temperature Sensor. 5.4 Measuring Instruments:- Digital multi-meters, Scan tool.	Lecture Using Chalk-Board Video Demonstrations Site/Industry Visit

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 Measure the required parameters of diodes (Zener, LED, Power, P-N diode)	1	*Test condition of given diodes using multimeter.	2	CO1
LLO 2.1 Identify key components of the Heads-up Display system. LLO 2.2 Use the Features of Heads-up Display system in given situations (speed, navigation, alerts, etc.).	2	Heads-up Display system.	2	CO1

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 3.1 Demonstrate functioning of various sensors using real-time data of different vehicle control units LLO 3.2 Demonstrate interconnectivity of various ECMs using real-time data of different vehicle control units.	3	Case study on "Real-Time Sensor Data Processing for Vehicle Control.	2	CO2
LLO 4.1 Measure the oxygen sensor feedback and other relevant engine parameters to evaluate the system's performance. LLO 4.2 Interpret the oxygen sensor feedback to evaluate the system's performance.	4	Engine Performance Optimization Using Closed-Loop Lambda Control.	2	CO2
LLO 5.1 Capture the waveform output from the Accelerator pedal position sensor using an oscilloscope. LLO 5.2 Interpret the waveform to identify any irregularities, such as noise, flatlines, or unexpected voltage levels. LLO 5.3 Analyze the waveform for expected voltage fluctuations corresponding to pedal position changes.	5	*Diagnosis of Accelerator pedal position sensor.	2	CO3
LLO 6.1 Measure the resistance of the Crank Shaft Position sensor using a multimeter. LLO 6.2 Verify the measured resistance values of CKP with the manufacturer’s specifications to detect possible sensor failure. LLO 6.3 Analyze the waveform of CKP signal patterns for proper functioning.	6	*Diagnosis of Crank shaft position sensor.	2	CO3
LLO 7.1 Check the voltage output of the wheel speed sensor while the vehicle is stationary and during wheel rotation using a multimeter or oscilloscope. LLO 7.2 Verify the voltage signal changes in direct proportion to the wheel's rotation speed.	7	*Diagnosis of Wheel Speed Sensor.	2	CO3
LLO 8.1 Test the Response of the Idle Speed Actuator. LLO 8.2 Measure the Voltage or Resistance of the Idle Speed Actuator. LLO 8.3 Test the Voltage and Pulse Duration of the Solenoid-Operated Fuel Injector.	8	*Test Idle speed actuators and Solenoid operated Fuel Injector.	2	CO3
LLO 9.1 Test the Response of the EGR Actuator. LLO 9.2 Measure the Voltage or Resistance of the EGR Actuator. LLO 9.3 Measure the Voltage or Resistance of the Purge Control Actuator.	9	Test EGR actuator and Purge control actuator.	2	CO3
LLO 10.1 Retrieve Diagnostic Trouble Codes for EBD System using scan tool. LLO 10.2 Identify the EBD-Related DTCs and Their Meanings.	10	Diagnostic trouble codes for Electronic Brakeforce Distribution.	2	CO4
LLO 11.1 Connect the diagnostic tool and retrieve the relevant DTCs for the traction control system LLO 11.2 Identify and explain the meaning of the DTCs, determining the cause of the problem in the traction control system.	11	*Diagnostic trouble codes for Traction control system.	2	CO4
LLO 12.1 Interpret the DTCs to identify faults related to Lane Departure Warning. LLO 12.2 Examine the DTCs to understand any	12	Diagnostic procedure of Lane departure warning (LDW), Blind spot monitoring (BSM).	2	CO4

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
malfunctions or faults in the BSM system.				
LLO 13.1 Connect the OBD-II scan tool to the TSI engine and ensure communication with the ECU. LLO 13.2 Retrieve and interpret DTCs using the scan tool to identify system faults in the TSI engine.	13	*On-Board Diagnosis (OBD-II) of the given TSI engine.	2	CO5
LLO 14.1 Connect the OBD-II scan tool to the CRDI engine and ensure communication with the ECU LLO 14.2 Interpret DTCs using the scan tool to identify system faults in the CRDI engine.	14	*On Board Diagnosis (OBD-II) of the given CRDI engine.	2	CO5
LLO 15.1 Identify symptoms that suggest a malfunction affecting engine performance during starting and idling.	15	Diagnosis of engine conditions at Starting, idling and Acceleration.	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)

NOT APPLICABLE

- 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 judicial 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	Digital multi-meters; Make: Reputed manufacturers Measure Voltage and Current AC and DC, Resistance, Capacitance, diodes, continuity, frequency, min-max functions; LCD Display, 0 to 50ºC 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 ? to 200 M?; Accessories: Test leads, Current Clamp 300 A, Current Clamp Adapter.	1,5,6,7,8,9
2	Automotive Diagnostic Oscilloscope; Type- PC based or hand held Analog Channel: 8; Bandwidth: 100kHz; Input Impedance: Resistance: 1M?, Input Sensitivity: 10mV/div to 5V/div	10,11,12,13,14
3	Scan tool: Make: Reputed manufacturers On Board Diagnostics (OBD-II) Generation Scan Tool, Controller area network enabled, Color Display, Operating Temperature: 0 to 50ºC, Internal Storage: 4 AAA batteries, External Power: 7 to 18 volts; Generic tool;	13,14

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
	Accessories: Extender cable, OBD II Cable; Relevant optional accessories	
4	A car equipped with modern automotive power train control, motion control and safety control system; Make: Reputed manufacturers Cubic Capacity: 1000 cc to 2200 cc; Power: 55 KW to 100 KW @ 4000 rpm.	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	Automotive Digital Electronics & Instrumentations	CO1	10	2	4	6	12
2	II	Automotive Computer Networks	CO2	12	4	4	6	14
3	III	Automotive Sensors and Actuators	CO3	16	4	6	8	18
4	IV	Automotive Control Systems	CO4	12	2	4	8	14
5	V	Diagnostic Techniques in Automotive Systems	CO5	10	2	4	6	12
Grand Total				**60**	**14**	**22**	**34**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

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

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			
CO2	3	2	-	2	-	-	2			
CO3	3	2	2	2	2	-	2			
CO4	3	2	2	2	-	-	2			
CO5	3	2	2	2	2	-	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	Bonnick, Allan	Automotive Computer Controlled System	Butterworth-Heinemann, UK, 24 April

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Sr.No	Author	Title	Publisher with ISBN Number
	W.M.		2001 ISBN 13:978-0750650892
2	Ribbens, William B.	Understanding Automotive Electronics	Butterworth-Heinemann, UK, 18th June 2017 ISBN 13:978-0128104347
3	Bosch, Robert	Automotive Handbook	Bentley Publishers, UK, 9th Edition, 21st Nov 2014 ISBN 13:978-1119975564
4	Mosher, Lynn	Auto mechanic’s Guide to Electronic Instrumentation and Microprocessor.	Prentice – Hall, Inc. USA, 1987 ISBN 13: 978-0130546869
5	Denton, Tom	Advanced Automotive Fault Diagnosis	Routledge, New York, 2012 ISBN 13: 978-0415725767
6	Hollembeak, Barry	Today's Technician Automotive Electricity and Electronics-classroom and shop manual	Cengage Learning, New York, 2011 ISBN 13: 978-1305178403
7	Santini, Al	Automotive Electricity and Electronics	Cengage Learning, New York, 2013 ISBN 13: 978-1133713432

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=Fljk_j6VUHE	Introduction to the course; Current and Voltage; Kirchhoff\'s Current and Voltage laws
2	https://www.youtube.com/watch?v=RogF0ohkMJ4&list=PLdD-IdNhF9PE7kpHawAmk1Z8p9XLBbEU-	Vehicle Network System
3	https://www.youtube.com/watch?v=ceIykzivaw4	Automotive Sensors & Actuators.
4	https://www.youtube.com/watch?v=R5YfLySWQAc	Automotive Sensors & Actuators.
5	https://www.youtube.com/watch?v=RR8LsMBwL2I	OBD-II
6	https://www.youtube.com/watch?v=KzF8ieiJ9UY	Power train control system
7	https://www.youtube.com/watch?v=DaLmofF5iWU	malfunction affecting engine performance during starting and idling.
8	https://www.youtube.com/watch?v=PEBeRtuA6CE	Heads-up Display

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students