

AUTOMOTIVE ELECTRICAL AND ELECTRONIC SYSTEM**Course Code : 316009****Programme Name/s : Automobile Engineering.****Programme Code : AE****Semester : Sixth****Course Title : AUTOMOTIVE ELECTRICAL AND ELECTRONIC SYSTEM****Course Code : 316009****I. RATIONALE**

Modern vehicles are equipped with a variety of electrical, electronic, and computer-controlled systems that play a crucial role in enhancing performance, drivability, and safety. These systems are managed by multiple control units to ensure optimal efficiency and functionality. Diploma holders in automobile engineering are expected to identify electrical, electronic and computer controlled system components and demonstrate diagnosis thereof. This course is designed to provide students with the essential skills needed to maintain and troubleshoot these advanced systems, preparing them for the demands of automobile 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: Maintain automotive electrical and electronic systems efficiently and safely.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Test components of automotive electrical and electronic circuits.
- CO2 - Test automotive batteries and charging system.
- CO3 - Test cranking system and ignition system.
- CO4 - Troubleshoot automotive transducers and OBD-II systems.

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				
				CL	TL	LL					Practical											
											FA-TH	SA-TH	Total	FA-PR		SA-PR		SLA				
														Max	Max	Max	Min	Max	Min	Max	Min	
316009	AUTOMOTIVE ELECTRICAL AND ELECTRONIC SYSTEM	AES	AEC	2	-	2	-	4	2	-	-	-	-	-	25	10	50@	20	-	-	75	

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 function of electrical components in the given circuit. TLO 1.2 Describe the operation of the given circuit protection device. TLO 1.3 Describe the test procedure of the given circuit. TLO 1.4 Describe the impact of integrating a smart wiring harness with Flexible Data-rate Controller Area Network (CAN-FD) on modern vehicles.	Unit - I Electrical Components, Circuit Protection Devices, and Smart Wiring Systems 1.1 Purpose and operation of electrical components and circuit protection devices. a)Switches: Single Pole Single Throw (SPST), Single Pole Double Throw (SPDT), Ganged switch. b)Relays, Solenoids, Buzzers, Resistors. c)Fuses, Maxi fuses, Fusible links, Smart fuses and circuit breakers with self-resetting capabilities. 1.2 Testing of circuit defects: Open circuit, short circuit, short to ground, voltage drop. 1.3 Smart Wiring Harness & Flexible Data-rate Controller Area Network (CAN-FD) – Evolution from traditional wiring harness to high-speed communication networks. 1.4 Wiring diagrams: Headlight, turn indicators, Horn, Windshield wiper, Stop light.	Lecture Using Chalk-Board Video Demonstrations 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 working of the given type of battery. TLO 2.2 List the causes of battery failure based on given symptoms. TLO 2.3 Explain working of Computer/ ECM -controlled alternator. TLO 2.4 Explain working of the computer controlled charging system.	Unit - II Automotive Batteries and Charging System 2.1 Battery: Types of Battery, Construction and Working of following types: Lead acid battery, Maintenance free battery, Hybrid Battery, Lithium-ion battery, Battery rating and specifications. 2.2 Standard procedure of battery charging. 2.3 Battery failure: Types and causes 2.4 Charging system: Charging system circuit, Alternator – Principle of working, Construction and working, Computer/ Electronic Control Module (ECM) controlled alternator.	Lecture Using Chalk-Board Video Demonstrations Model Demonstration
3	TLO 3.1 Describe working of the given cranking system aggregates. TLO 3.2 State remedial measures for starting system trouble with justification. TLO 3.3 Explain working of the computer-controlled ignition system.	Unit - III Cranking and Ignition System 3.1 Cranking system: solenoid-operated starter circuit, components and their functions. 3.2 Types of starter drive: overrunning clutch and Integrated Starter Generator (ISG) system. Stop-Start System: components and working. 3.3 Computer-controlled cranking system. 3.4 Starter motor components, working principle. 3.5 Cranking system: Symptoms and troubleshooting. 3.6 Computer controlled ignition system: operation with block diagram.	Lecture Using Chalk-Board Video Demonstrations Model Demonstration
4	TLO 4.1 Describe working of the given transducer on engine. TLO 4.2 Describe testing procedure of the given transducer. TLO 4.3 Describe diagnosis procedure of the given sensors using scan tool.	Unit - IV Automotive Transducers and On Board Diagnostics (OBD) -II System 4.1 Transducers - construction, working: Camshaft position sensor, Coolant temperature sensor, Throttle position sensor, Oxygen sensor, Manifold absolute pressure sensor, Mass air flow sensor, electronic fuel injector, idle air control valve. 4.2 OBD II procedure for body computer and relevant transducers: Function, diagnosis and procedure to erase fault code.	Video Demonstrations Demonstration Site/Industry Visit Flipped Classroom

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 Inspect given electrical/ electronic component using multi meter. LLO 1.2 Inspect given circuit protection device.	1	*Electrical components and circuit protection devices.	2	CO1
LLO 2.1 Diagnose given parallel/ series circuit fault using service manual standard procedure. LLO 2.2 Troubleshoot fault in wiring harness.	2	Troubleshooting of the faults in automobile circuit/ wiring harness.	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 Perform battery specific gravity test. LLO 3.2 Perform battery terminal test.	3	*Battery specific gravity test and battery terminal test.	2	CO2
LLO 4.1 Perform battery load test. LLO 4.2 Perform battery drain test.	4	Battery load test and battery drain test.	2	CO2
LLO 5.1 Inspect the battery visually. LLO 5.2 Test the battery terminals and clamps. LLO 5.3 Test the battery voltage. LLO 5.4 Perform battery charging.	5	*Regular maintenance of battery.	2	CO2
LLO 6.1 Dismantle the given alternator. LLO 6.2 Examine the internal components of alternator. LLO 6.3 Assemble the given alternator. LLO 6.4 Measure alternator drive belt tension.	6	*Dismantle and assemble the alternator.	2	CO2
LLO 7.1 Test the Continuity of the stator windings. LLO 7.2 Test the Continuity of rotor winding. LLO 7.3 Inspect the diode rectifier.	7	Continuity test of alternator stator and rotor windings.	2	CO2
LLO 8.1 Perform the Current Output Test. LLO 8.2 Perform the Field Current Draw Test.	8	Current Output Test and Field Current Draw Test on alternator.	2	CO2
LLO 9.1 Perform the Regulator Output Test. LLO 9.2 Perform the Charging Circuit Resistance Test.	9	*Regulator Output Test and Charging Circuit Resistance Test on alternator.	2	CO2
LLO 10.1 Dismantle the given starter motor. LLO 10.2 Identify the components of starter motor. LLO 10.3 Assemble the starter motor.	10	*Dismantle and assemble the starter motor.	2	CO3
LLO 11.1 Perform the Current Draw Test. LLO 11.2 Perform the Insulated Circuit Resistance Test.	11	Current Draw Test, Insulated Circuit Resistance Test on starter motor.	2	CO3
LLO 12.1 Perform the Ground Circuit Test. LLO 12.2 Perform the No-Crank Test. LLO 12.3 Perform the Free Speed Test.	12	*Ground Circuit Test, No Crank Test and Free Speed Test on starter motor.	2	CO3
LLO 13.1 Interpret timing marks on the crankshaft pulley or flywheel. LLO 13.2 Make use of a stroboscope for measuring ignition timing. LLO 13.3 Modify ignition timing or Electronic Control Unit (ECU) settings.	13	Ignition timing inspection of a multi-cylinder engine with Stroboscope.	2	CO3
LLO 14.1 Test the given transducer.	14	Test the sensor and fuel injector.	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
LLO 15.1 Make use of a diagnostic scan tool. LLO 15.2 Diagnose faults in body control functions. LLO 15.3 Interpret Diagnostic Trouble Codes (DTCs) related to the Body Control Unit (BCU).	15	*Fault diagnosis of the body control unit using a scan tool.	2	CO4

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)**Micro project**

- Not Applicable

Assignment

- 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	Wiring harness of two and four wheeled vehicle.	1,2
2	Digital Multimeter: LCD Display, 0 to 50°C Operating Temperature, DCvoltage-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.	1,2,3,4,5,6,7,8,9,11,12,14
3	Trainer electrical circuits of two and four wheeled vehicle.	1,2,3,9,11,12
4	Starter Motor – 12V, 0.7KW. Over running clutch type.	10,11,12

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Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
5	Stroboscope/ Timing gun: Ignition Advance: 0 to 45°, 12V DC system, Reverse polarity protection, Bright flash for daylight use.	13
6	Multiport Fuel Injection engine with sensors, actuators and Electronic Control Module, Exhaust Gas Regulation valve and Positive Crankcase Ventilation valve; Power: 25 KW @ 5000 rpm to 55KW@ 5000 rpm, Cubic Capacity: 800 CC to 2000 CC.	13,14,15
7	Scan tool: On Board Diagnostics (OBD) II 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.	15
8	Battery – 12V,100Amp or above.	3,4,5,9,11,12
9	Hydrometer bulb type or digital 1.100-1.300 Sp. gravity at 27 degree Celsius.	3,5
10	Battery Charger. 2A-10A, 12V-24V	5
11	Alternator – 12V, 40A	6,7,8,9
12	Direct Current Clamp meter: Current measurement – 400 Amperes DC / AC.	8,11,12
13	Auto electrical Test bench –3 phase, 5 HP	8,9,11,12
14	Hand tools: spanner set: Open ended spanner set, Ring spanner set, Box spanner set; Screw driver set, Pliers: Nose plier, Circlip plier, Grip plier ; Engine Belt Tension Gauge, Allen key set, wire brush: internal and external brushes for battery terminal and battery clamp.	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	Electrical Components, Circuit Protection Devices, and Smart Wiring Systems	CO1	8	0	0	0	0
2	II	Automotive Batteries and Charging System	CO2	8	0	0	0	0
3	III	Cranking and Ignition System	CO3	8	0	0	0	0
4	IV	Automotive Transducers and On Board Diagnostics (OBD) -II System	CO4	6	0	0	0	0
Grand Total				30	0	0	0	0

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

- For laboratory learning, 25 marks. For FA PR ,Formative (Continuous) assessment shall be based on process and product related performance indicators. Course teacher may assign 60%, weightage for process and 40% weightage for product related LL work .

Summative Assessment (Assessment of Learning)

- For SA PR At the end of semester PR examination will be conducted by course teacher and based on PR exam performance marks out of 50 will be allocated.

XI. SUGGESTED COS - POS MATRIX FORM

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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	1	-	3	-	-	3			
CO2	3	1	-	3	-	-	3			
CO3	3	1	-	2	-	-	3			
CO4	3	1	-	3	-	-	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	James D. Halderman	Automotive Electricity and Electronics	5th Edition Year: 2016, PEARSON ISBN-13: 978-0-13-576442-8
2	James D. Halderman	Diagnosis and Troubleshooting of Automotive Electrical, Electronic, and Computer Systems	5th Edition, Year: 2009, Pearson College Div., ISBN-13: 978-0135066966
3	Tom Denton	Automobile Electrical and Electronic Systems	5th Edition, Routledge, ISBN-13: 978-0415725774
4	A.K. Babu	Automotive Electrical and Electronics	2nd Edition, Year: 2024, Khanna Publishing House ISBN 13 978-93-82609-69-8
5	Dr. P. Thangavel, Dr. M. Vijay Anand, Mr. M. Makesh Kumar	Automotive Electrical & Electronics Concepts	Year: 2025, Notion Press, ISBN-13: 979-8896991731

XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=mEJEHxlb9o	How to Use Wiring Diagrams for Car Electrical Diagnosis and Repair
2	https://www.youtube.com/watch?v=0ihkfUddsk	Circuit Breakers and Fuses Explanation
3	https://www.youtube.com/watch?v=wWGYUpUsZkU	What is Can bus cable, construction, application Automotive ECU to MCU wiring connection
4	https://www.youtube.com/watch?v=hObLxIXJPPM	Working Principle of Lead Acid Battery
5	https://www.youtube.com/watch?v=nrxmQhbZUTc&t=780s	The Battery Basics: Understanding Lithium-Ion, Lead-Acid Battery

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Sr.No	Link / Portal	Description
6	https://www.youtube.com/watch?v=cxkVxi9P0EA	Battery Rating
7	https://www.youtube.com/watch?v=v4JGYu4aaEc	Causes and Types of Battery Failure
8	https://www.youtube.com/watch?v=V7EFAvFPOhw&t=25s	Battery Maintenance
9	https://www.youtube.com/watch?v=Gc1hWC3XQI0	Hydrometer Test of Lead Acid Battery
10	https://www.youtube.com/watch?v=YrNRaPP7EKU	Battery Terminal Test
11	https://www.youtube.com/watch?v=jdSKlg80DjU	Alternator Working Principle
12	https://www.youtube.com/watch?v=EVPol5wgZ4o	Alternator Testing
13	https://www.youtube.com/watch?v=INUikOnGlAE	PCM (Computer) Controlled Alternators
14	https://www.youtube.com/watch?v=1bK0De9XOP0	Alternator Testing
15	https://www.youtube.com/watch?v=9UKg71wa0e4	Alternator Belt Tension
16	https://www.youtube.com/watch?v=Lfvig36a3og&t=20s	SHVS mild hybrid + DUALJET
17	https://www.youtube.com/watch?v=arWoIjk6seA&t=17s	How electrical and ignition systems work
18	https://www.youtube.com/watch?v=4dPXUzYiGmQ	Camshaft Position Sensor Explained with Animation
19	https://www.youtube.com/watch?v=CpmOv83HYhQ	Throttle Position Sensor Explained with Animation
20	https://www.youtube.com/watch?v=OhShoU_E-0g&t=394s	OBD2 Explained - A Simple Intro
21	https://www.youtube.com/watch?v=YGG9VLzeMk8&t=11s	How to Use an OBD2 Scan Tool

Note :

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