

AUPC3002 AUTOMOTIVE ELECTRICAL AND ELECTRONICS (3-0-0)

Course Objectives:

1. To impart fundamental knowledge of automotive electrical and electronic systems.
2. To explore various sensors, actuators, and vehicle control units.
3. To understand diagnostics, onboard communication protocols, and safety features in modern vehicles.

Module-I Electrical System Components (08 Hours)

Battery Systems: Lead-acid, AGM, Li-ion batteries – construction, working, charging and discharging characteristics. Charging System: Working of dynamo, alternators (AC generators), rectifiers, regulators, voltage control. Starting System: Working of starter motors, solenoids, Bendix drive mechanism, safety relay circuits. Wiring Systems: Wiring harness layout, fuses, relays, and switches. Grounding and Earthing: Importance and layouts in vehicles.

Module-II Lighting and Accessories (08 Hours)

Lighting Systems: Headlights (halogen, HID, LED, adaptive), fog lamps, tail lamps, indicators, brake and reverse lights. Interior Lighting and Illumination: Cabin lamps, dimmers, and ambient lighting. Accessories: Wipers and washers, defoggers, cigarette lighters, horns, and 12V sockets. Dashboard Instruments: Analog and digital meters, odometer, speedometer, fuel, temperature and oil gauges. Infotainment Systems: Audio systems, Bluetooth, GPS, rear camera interface, touch screen consoles.

Module-III Sensors and Actuators (09 Hours)

Introduction: Role in control systems and automation. Common Automotive Sensors:

Temperature sensors (coolant, intake air), Pressure sensors (oil, fuel rail), Oxygen sensors, knock sensors, Speed sensors (vehicle speed, wheel speed), Position sensors (throttle, camshaft, crankshaft, pedal)

Actuators:

Electromagnetic: Solenoids, fuel injectors, Electromechanical: Stepper motors, servo motors, Piezoelectric and electrohydraulic types

Module-IV Electronic Control Unit (ECU) (08 Hours)

ECU Basics: Role and types (engine, transmission, body, airbag ECUs). Architecture: Microcontroller-based structure, I/O interfaces, memory systems. Embedded System Programming: Basic logic control, lookup tables, signal conditioning.

Communication Protocols:

Controller Area Network (CAN) – structure, message format, arbitration. Local Interconnect Network (LIN) – structure and application. FlexRay and Ethernet (brief overview).

ECU Testing and Calibration: Tools and simulation environments.

Module-V Diagnostics and Safety Systems (07 Hours)

Onboard Diagnostics: OBD-I and OBD-II standards, Diagnostic Trouble Codes (DTCs), Diagnostic connectors and scan tools

Safety Systems: Airbag control systems – types, sensors, deployment logic, Tire Pressure Monitoring Systems (TPMS) – direct and indirect methods, Electronic Stability Control (ESC) – yaw, lateral acceleration, traction control

Future Trends: ISO 26262 for functional safety, ADAS integration overview

Course Outcomes:

Upon completion of this course, students will be able to:

- CO1: Identify and explain the functioning of basic automotive electrical components.
- CO2: Understand and analyze the functioning of lighting, wipers, infotainment, and accessory systems.
- CO3: Evaluate the role of sensors and actuators in vehicle automation.
- CO4: Explain the architecture of ECUs and communication protocols.
- CO5: Apply knowledge of diagnostic standards and safety systems in modern vehicles.

Textbooks:

1. William Ribbens, Understanding Automotive Electronics, Elsevier.
2. Robert Bosch GmbH, Automotive Handbook, Bentley Publishers.
3. Jack Erjavec, Automotive Technology: A Systems Approach, Delmar Cengage.

Reference Books:

1. K. Ramalingam, Automobile Electrical and Electronics, Scitech.
2. James D. Halderman, Automotive Electricity and Electronics, Pearson.
3. U.K. Singh and M. Kanchan, Automotive Electrical and Electronics Systems, Pearson.