

Introduction to Automotive Engineering

Introduction to Automotive Engineering Technology
Course level overview – key concepts, tools, and career pathways

1. What Is Automotive Engineering Technology?

Aspect	Definition
Scope	Application of engineering principles to design, develop, test, manufacture, and maintain motor vehicles and their subsystems.
Focus	Practical implementation of mechanical, electrical, electronic, and software systems in automobiles.
Goal	Create safer, more efficient, and environmentally responsible vehicles while meeting market and regulatory demands.

2. Core Disciplines & Subsystems

Subsystem	Primary Functions	Typical Technologies
Powertrain	Generates and transmits motive power.	Internal combustion engines (ICE), hybrid electric drivetrains, full electric motors, transmissions, torque converters.
Chassis & Suspension	Supports vehicle body, provides ride comfort and handling.	MacPherson struts, multi-link rear suspensions, adaptive dampers, lightweight frames (high-strength steel, aluminum, composites).
Steering & Braking	Controls direction and deceleration.	Rack-and-pinion, electric power-steer, ABS, ESC, regenerative braking.
Electrical/Electronic (E/E) Architecture	Manages power distribution and data communication.	CAN, LIN, FlexRay, Ethernet, high-voltage battery management systems (BMS), infotainment, ADAS sensors.
Thermal Management	Controls temperature of engine, batteries, cabin.	Radiators, coolant loops, heat pumps, HVAC, active grille shutters.

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Subsystem	Primary Functions	Typical Technologies
Body & Interior	Provides structural integrity, aesthetics, occupant comfort.	High-strength steel, aluminum, composites, acoustic insulation, ergonomics, lighting (LED/Laser).
Software & Controls	Implements vehicle logic and driver assistance features.	ECU/ECU networks, firmware, OTA updates, machine learning based perception.

3. Design & Development Process

1. Concept Generation

- Market analysis, target specifications, feasibility studies.

2. Pre-concept & Feasibility

- Sketches, benchmark comparisons, early cost estimates.

3. System Architecture Definition

- Block diagrams, interface matrices, power budgets.

4. Detailed Design

- CAD modeling (SolidWorks, CATIA), CAE simulations (FEA, CFD, MBD).

5. Prototyping & Testing

- Rapid prototyping (3D printing), bench tests, dynamometer runs, vehicle-level validation.

6. Verification & Validation (V&V)

- Compliance with standards (ISO 26262, FMVSS, UNECE).

7. Production Planning

- Tooling design, assembly line layout, quality control plans (Six Sigma, APQP).

8. Launch & Post-Launch Support

- Field data collection, OTA software updates, warranty analysis.
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4. Key Engineering Tools & Software

Category	Representative Tools	Typical Use
CAD/3D Modeling	SolidWorks, CATIA, Siemens NX	Part design, assembly modeling, BOM generation.

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CAE Simulation	ANSYS, Altair HyperWorks, SolidWorks, Cruise	Structural analysis, fluid dynamics, NVH, thermal studies.
Control & Embedded Development	MATLAB/Simulink, dSPACE, Vector CANoe	Control algorithm design, hardware-in-the-loop (HIL)