AUPC3003 VEHICLE BODY ENGINEERING (3-0-0)

Course Objectives:

1. To understand the concepts of vehicle body types, styling, ergonomics, and comfort.
2. To study materials and fabrication methods used in body construction.
3. To analyze vehicle aerodynamics and its influence on performance and fuel efficiency.
4. To gain knowledge on crashworthiness, safety norms, and NVH mitigation strategies.

Module-I Introduction to Body Design (07 Hours)

Classification of vehicle bodies: sedan, hatchback, SUV, MPV, coupe, convertible, pickup. Body-on-frame and monocoque (unitary) construction – features and applications. Ergonomics: driving position, visibility angles, ingress/egress, control placement. Aesthetic design and styling: concept sketches, surface development, clay modeling. Visibility and space requirements: driver and passenger visibility, luggage space. Current trends: crossover designs, modular platforms.

Module-II Body Materials and Manufacturing (08 Hours)

Common materials: mild steel, high strength steel (HSS), aluminum alloys, fiber-reinforced plastics (FRP), carbon fiber. Material selection criteria: strength, weight, manufacturability, corrosion resistance, cost. Sheet metal forming processes: blanking, deep drawing, hemming, hydroforming.

Joining techniques:

Mechanical: riveting, clinching, bolting. Thermal: spot welding, MIG/TIG, laser welding. Adhesive bonding: types, applications, hybrid joining.

Surface treatment: painting, e-coating, anti-corrosion layers. Smart materials: shape memory alloys, self-healing coatings.

Module-III Aerodynamics (09 Hours)

Importance of aerodynamics in fuel economy, performance, and stability. Fundamental forces: drag (form, skin friction, interference), lift, side force. Drag coefficient, lift coefficient – definitions and factors affecting them. Aerodynamic shapes for different vehicle classes (cars, buses, trucks). Devices for aerodynamic enhancement: spoilers, diffusers, undertrays. Wind tunnel testing: types (open jet, closed circuit), models, test instrumentation. Computational Fluid Dynamics (CFD) basics and software used (e.g., ANSYS Fluent).

Module-IV Safety and Crashworthiness (08 Hours)

Introduction to vehicle safety: active and passive safety systems. Crashworthiness terminology: crumple zones, intrusion resistance, load paths. Crash energy management: deformation mechanisms and reinforcements. Side, frontal, rear impact and rollover protection. Occupant protection systems: airbags, seat belts, child restraint systems. Crash test types and dummies (Hybrid III, THOR). Global safety standards and NCAP testing (Euro NCAP, GNCAP, AIS-098).

Module-V NVH and Comfort (08 Hours)

Sources of noise and vibration in vehicles: engine, road, wind, transmission. Noise path analysis and structure-borne vs. airborne noise. NVH countermeasures: damping materials, absorbers, insulators, active noise control. Vehicle interior acoustics: reverberation and insulation materials. Thermal comfort systems: layout and functioning of HVAC (Heating, Ventilation, and Air Conditioning). Air circulation types: fresh air vs. recirculation, multi- zone climate control. Cabin sealing and vibration damping techniques for improved comfort.

Course Outcomes:

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

CO1: Identify types and characteristics of vehicle bodies and apply ergonomic principles.
CO2: Explain the materials and joining techniques used in modern automotive body construction.
CO3: Analyze aerodynamic characteristics and apply principles to reduce drag.
CO4: Evaluate crashworthiness features, safety standards, and passive safety systems.
CO5: Assess NVH levels and design for comfort and thermal management.

Textbooks:

1. Powloski, J., Vehicle Body Engineering, Business Books Limited.
2. Reimpell, J., and Stoll, H., The Automotive Chassis – Volume 2: System Design, Butterworth-Heinemann.
3. Giles, J.G., Body Construction and Design, Butterworths.

Reference Books:

1. Jason C. Brown, Vehicle Aerodynamics, SAE International.
2. R.K. Rajput, Automobile Engineering, Laxmi Publications.
3. John Fenton, Handbook of Vehicle Design Analysis, SAE.