SPECIAL PURPOSE VEHICLES

Course Objectives:

1. To provide fundamental knowledge of the design, construction, and operation of special purpose vehicles.
2. To study agricultural, construction, industrial, defence, and emergency service vehicles used in specialized applications.
3. To develop understanding of vehicle modifications, power transmission systems, and hydraulic systems used in special vehicles.
4. To analyze performance requirements, safety considerations, and operational characteristics of specialized vehicles.
5. To familiarize students with emerging technologies such as electric, autonomous, and intelligent special purpose vehicles.

Module I: Introduction to Special Purpose Vehicles (9 Hours)

Introduction to special purpose vehicles and their significance in modern industries. Classification of special purpose vehicles based on application. Design philosophy and engineering requirements. Vehicle performance parameters and operational constraints. Payload considerations and power requirements. Chassis design modifications. Stability and manoeuvrability requirements. Regulatory standards and homologation requirements. Occupational safety standards and safety considerations. Environmental considerations and sustainability aspects. Selection criteria for special purpose vehicles.

Module II: Agricultural Vehicles and Farm Mechanization (9 Hours)

Agricultural mechanization and its importance. Tractor classification and applications. Power tillers and compact agricultural vehicles. Agricultural transmission systems. Tractor power take-off (PTO) systems. Hydraulic systems used in agricultural machinery. Harvesters and combine harvesters. Seders, planters, cultivators, and spraying equipment. Traction and soil-vehicle interaction. Performance evaluation of agricultural vehicles. Precision farming technologies. GPS-guided agricultural machinery. Maintenance and operational practices of farm vehicles.

Module III: Construction and Industrial Vehicles (9 Hours)

Construction equipment and earthmoving machinery. Excavators: construction, working principles, and applications. Wheel loaders and skid-steer loaders. Bulldozers and crawler vehicles. Dump trucks and articulated haulers. Cranes and lifting equipment. Forklifts and material handling vehicles. Industrial utility vehicles. Hydraulic actuators and control systems. Power transmission systems for construction equipment. Safety requirements and operational guidelines. Maintenance practices and productivity assessment of industrial vehicles.

Module IV: Defence, Emergency and Utility Vehicles (9 Hours)

Military vehicle classifications and operational requirements. Armoured personnel carriers and armoured fighting vehicles. Military transport vehicles and tactical mobility systems. Amphibious military vehicles. Fire-fighting vehicles and fire suppression equipment. Ambulance design and emergency medical response vehicles. Rescue and disaster management vehicles. Police and law enforcement vehicles. Airport rescue and firefighting vehicles. Special safety systems, communication systems, and navigation aids. Reliability and survivability considerations in defence vehicles.

Module V: Advanced Special Purpose Vehicles and Future Trends (9 Hours)

Marine utility vehicles and amphibious vehicles. Airport ground support vehicles. Space exploration rovers and planetary vehicles. Mining and underground transportation vehicles. Autonomous and remotely operated special purpose vehicles. Electric and hybrid special purpose vehicles. Alternative fuels for specialized applications. Intelligent vehicle systems

and telematics. Artificial intelligence applications in special vehicles. Smart sensors and condition monitoring systems. Future mobility concepts and emerging trends in specialized transportation systems.

Course Outcomes (COs):

On successful completion of the course, students will be able to:

CO1: Classify various types of special purpose vehicles and identify their applications.

CO2: Explain the construction, working principles, and functional systems of specialized vehicles.

CO3: Analyze design requirements and performance characteristics for different operating environments.

CO4: Evaluate operational efficiency, safety, and maintenance requirements of special purpose vehicles.

CO5: Assess recent technological developments and future trends in specialized vehicle engineering.

Text Books:

1. Liljedahl, J.B., Turnquist, P.K., Smith, D.W., and Hoki, M., Tractors and Their Power Units, CBS Publishers.
2. Wong, J.Y., Theory of Ground Vehicles, 4th Edition, Wiley Publications.
3. Crolla, D.A., Automotive Engineering: Powertrain, Chassis System and Vehicle Body, Butterworth-Heinemann.

Reference Books:

1. Crouse, W.H. and Anglin, D.L., Automotive Mechanics, Tata McGraw-Hill.
2. SAE International, Special Vehicle Design and Engineering Manuals.
3. Goering, C.E., Stone, M.L., and Snyder, L.L., Off-Road Vehicle Engineering Principles, ASABE Publications.
4. Gillespie, T.D., Fundamentals of Vehicle Dynamics, SAE International.
5. Heisler, H., Advanced Vehicle Technology, Butterworth-Heinemann.
6. Brixius, W.W., Agricultural Vehicle Technology, ASABE Publications.