AUPE3001 AUTOMOTIVE FUELS AND LUBRICANTS (3-0-0)

Course Objectives:

1. To study the types and properties of automotive fuels and methods of fuel testing.
2. To understand the combustion process in SI and CI engines and the role of additives.
3. To explore the types, properties, and applications of lubricants in vehicles.
4. To familiarize with various alternative fuels and their influence on performance and environment.
5. To analyze the impact of fuels and lubricants on vehicle emissions and after-treatment systems.

Module-I Fuel Properties and Testing (08 Hours)

Types of automotive fuels: Gasoline, Diesel, Kerosene. Key properties: calorific value, density, volatility, sulphur content.

Performance parameters:

Octane number – significance in SI engines, knocking tendency. Cetane number – ignition delay in CI engines.

Fuel testing methods:

ASTM distillation test, Reid vapor pressure test. Flash point, fire point, pour point, cloud point. Bomb calorimeter for calorific value determination. Distillation curve and its effect on drivability.

Module-II Combustion and Additives (07 Hours)

Combustion processes in:

Spark Ignition (SI) Engines – pre-ignition, detonation. Compression Ignition (CI) Engines – knocking, delay period.

Stoichiometry, air-fuel ratio, lean and rich mixtures. Additives for gasoline: Tetraethyl lead (TEL), MTBE, ethanol blending. Additives for diesel: Cetane improvers, anti-smoke additives, cold flow improvers. Fuel stability and storage requirements.

Module-III Lubricants (09 Hours)

Classification of lubricants: Engine oils, gear oils, greases, transmission fluids. Properties: Viscosity index, pour point, cloud point, flash point, thermal stability, anti-wear characteristics. Additives in lubricants: anti-wear, anti-oxidant, detergent, dispersant. SAE and API classification of oils (SAE 10W-30, API SN). Lubrication mechanisms: boundary, hydrodynamic, and elastohydrodynamic lubrication. Application of lubricants in engines, gearboxes, and differentials. Used oil analysis and condition monitoring.

Module-IV Alternative Fuels (08 Hours)

Gaseous fuels:

Compressed Natural Gas (CNG): composition, storage, injectors. Liquefied Petroleum Gas (LPG): handling, mixing, combustion.

Liquid fuels:

Alcohols (Methanol, Ethanol): blend ratios, effects on performance. Biodiesel: feedstocks, transesterification, fuel properties, B5 to B100 grades.

Emerging fuels: Hydrogen, synthetic fuels (e-fuels), ammonia. Dual-fuel and flexible fuel vehicle systems. Comparison of engine performance, efficiency, emissions, and durability.

Course Outcomes:

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

CO1: Analyze different fuel types and interpret their key performance parameters through standard tests.

CO2: Explain combustion characteristics and the function of fuel additives in engine performance.

CO3: Classify automotive lubricants and assess their behavior in various conditions. CO4: Evaluate the feasibility, advantages, and limitations of alternative fuels.

CO5: Examine the role of fuels and lubricants in controlling automotive emissions and their compatibility with emission control technologies.

Module-V Emission Control and Environmental Impact (08 Hours)

Effect of fuel composition on tailpipe emissions: CO, HC, NOx, particulate matter. Influence of lubricant additives and base oil on engine-out emissions. Emission norms: Bharat Stage VI, Euro VI – fuel and lubricant compliance.

After-treatment systems:

Catalytic converters, particulate filters, SCR (Selective Catalytic Reduction). Compatibility of fuels and lubricants with emission systems.

Role of low-sulphur fuel and synthetic lubricants in emission reduction. Greenhouse gas emissions and global warming potential (GWP) of fuels.

Textbooks:

1. Ganesan, V., Internal Combustion Engines, McGraw Hill.
2. Mathur and Sharma, A Course in Internal Combustion Engines, Dhanpat Rai Publications.
3. Gupta, H.N., Fundamentals of Internal Combustion Engines, PHI.

Reference Books:

1. Bosch Automotive Handbook, Robert Bosch GmbH, Wiley.
2. Heywood, J.B., Internal Combustion Engine Fundamentals, McGraw Hill.
3. Speight, J.G., The Chemistry and Technology of Petroleum, CRC Press.