

Course Code	Course Name	Credits
MEDLO7031	Automotive Power Systems	03

Objectives:

1. To familiarize with the working of S.I. and C.I. engines and its important systems
2. To provide insight into the harmful effects of engine pollutants and its control
3. To familiarise with the latest technological developments in engine technology

Outcomes: Learner will be able to...

1. Demonstrate the working of Fuel supply and ignition system of I.C. engines
2. Illustrate the working of lubrication, cooling and supercharging systems.
3. Comprehend the different technological advances in engines and alternate fuels
4. Identify and describe the history and different EV/HEV drivetrain topologies
5. Compare and evaluate various energy sources and energy storage components for EV and HEV application.
6. Comprehend EV and HEV working through Case studies.

Module	Details	Hours
1.	<p>Constructional Features of I.C. Engines. Parts of I.C. engine and their materials.</p> <p>Fuel Supply System :</p> <p>Fuel-Air ratio, Fuel air mixture requirement, Conventional fuels used in IC engines, Fuel injection system in SI and CI engine and MPFI Engine.</p> <p>Ignition System :</p> <p>Battery Ignition System, Magneto Ignition System, Functions and working of ignition coil, spark plug, contact breaker point, Requirements and working of Ignition advance mechanisms; mechanical and vacuum, Electronic Ignition Systems; Capacitor Discharge Ignition System, Transistorized Coil Assisted Ignition System, Transistor Ignition system with contactless breaker.</p>	08
2.	<p>Lubrication System :</p> <p>Types of lubricants and their properties, SAE rating of lubricants, Types of lubrication systems</p>	06

	<p>Cooling System :</p> <p>Necessity of engine cooling, disadvantages of overcooling, Cooling systems and their comparison: Air cooling, Liquid cooling</p> <p>Supercharging/Turbocharging :</p> <p>Objectives, Limitations, Methods and Types, Different arrangements of turbochargers and superchargers (No Numericals)</p>	
3.	<p>Engine Exhaust Emission and its control</p> <p>Constituents of exhaust emission at its harmful effect on environment and human health, Formation of NO_x, HC, CO and particulate emissions, Methods of controlling emissions; Catalytic convertors, particulate traps, Exhaust Gas Recirculation, EURO and BHARAT norms.</p> <p>Alternative Fuels</p> <p>Alcohol - Hydrogen - Natural Gas and Liquefied Petroleum Gas – Biodiesel- Biogas - Producer Gas - Properties - Suitability - Engine Modifications - Merits and Demerits as fuels.</p> <p>Basics of Electronic Engine Controls:</p> <p>Electronic Control module (ECM), Inputs required and output signals from ECM, Sensors: Throttle Position, Inlet Air Temperature, Coolant Temperature, Crankshaft Position, Camshaft Position, Mass Air flow and Exhaust Gas Oxygen sensors, their construction and importance in ECM. Electronic Spark control, Air Management system, Idle speed control</p>	08
4.	<p>Introduction to Hybrid and Electric Vehicles:</p> <p>History of Electric Vehicles (EV) and Hybrid electric vehicles (HEV), need and importance of EV and HEV, Indian and Global Scenario of EV and HEV.</p> <p>Drivetrain topologies:</p> <p>Electric traction and hybrid traction system, Electric drive topologies, hybrid drivetrain topologies.</p> <p>Power energy supply requirement for EV/HEV applications.</p>	06

5.	<p>Electric Drives and controller:</p> <p>Electric system components for EV/HEV, AC and DC motor drives, RPM and Torque calculation of motor, Motor Controllers,</p>	05
6.	<p>Energy Sources for EV/HEVs:</p> <p>Requirement of energy supplies and storage in EV/HEV, Types of batteries(Lead Acid/Li-ion/NiMH) and its working, battery specifications, Battery Management system; Fuel cells, flywheels and ultra-capacitors as energy sources for EV/HEV, Concept of Hybridisation for different energy sources.</p> <p>Energy Management Strategies:</p> <p>EV/HEV energy management strategies, classification and comparison of various energy management strategies</p> <p>Battery charging:</p> <p>Type of battery charging systems, Selection and Sizing of charging station, Components of charging station. Single line diagram of charging station, On board Charger.</p> <p>Payback period of EV and HEV</p> <p>Case Study: Toyota Prius, Honda Insight, Tata Nexon EV</p>	06

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum.**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

Text Books:

1. A Course on Internal Combustion Engine, Mathur and Sharma, Dhanpat Rai & Sons, New Delhi, 2001.
2. Internal Combustion Engine, V. Ganesan, Mc Graw Hill, 1995
3. Internal Combustion Engine, Domkundwar & Domkundwar, Dhanpat Rai & Sons, New Delhi, 2013.
4. Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, CRC Press, 2005

Reference Books:

1. Fundamental of Internal Combustion Engines, Gill and Smith, Oxford & IBH Publishing Company Pvt. Ltd, 2007
2. Internal Combustion Engine Fundamentals, Heywood, McGraw Hill, 1988
3. Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Hussein, CRC Press, 2003
4. Electric Vehicle Technology Explained, James Larminie, John Lowry, Wiley, 2003

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/107106088>
2. <https://nptel.ac.in/courses/112103262>
3. <https://nptel.ac.in/courses/108102121>
4. <https://nptel.ac.in/courses/108106170>