

Devi Ahilya University, Indore, India Institute of Engineering & Technology				M.E.(Design & Thermal) Full Time			
Subject Code & Name	Instructions Hours per Week			Credits			
DTR1C2 Design of Internal Combustion Engine Systems	L	T	P	L	T	P	Total
	3	1	2	3	1	1	5
Duration of Theory Paper: 3 Hours							

Objectives: To impart the knowledge of Internal combustion engine from systems design perspective.

Pre requisites: Fundamentals of thermodynamics, Combustion process, Theory of Internal combustion Engines.

COURSE CONTENT

UNIT-1

Genesis

Evolution: Limitation of Steam Engines, Hot Air Engine, Internal Combustion Engines, Atmospheric Engines, Lenoir Engines, Otto-Langen Engine; Engine Cycles; Flow chart of typical Internal Combustion engine processes; Classification; Configurations; Operational and performance parameters; Fuels for engines: composition, characteristics.

UNIT-2

Induction and Exhaustion Systems

Gas exchange; Intake system: Air-filter, Carburetor, Injectors: throttle body, port, direct injection; Diesel Injection: Low and High pressure Common Rail Systems, Jerk pump systems, Electronically controlled; Manifolds; Superchargers and turbochargers; Exhaust Systems; Exhaust manifold, Exhaust Pipe, Catalytic Converter, Muffler; Valves Flows:Flow Patterns, Discharge Coefficient, Performance, Timing and its Effects; Scavenging: Performance parameters; Volumetric Efficiency.

UNIT-3

In-cylinder flows and Combustion Thermochemistry

In-cylinder flows: Measurement; Swirl: Induction Swirl, Swirl Coefficient, Swirl Ratio; Swish; Tumble; Squish; Prechamber flows;Stoichiometry Relations: Air required for Complete Combustion based on Fuels, Incomplete Combustion, Calculation of Dry Flue Gases for known fuel composition, Estimating Fuel Composition and Excess Air quantity from Exhaust Gas Analysis, Flue Gas Analysis (O₂, CO₂, CO, NO_x, SO_x); Combustion Terminology: Adiabatic Flame temperature, Combustion Rates, Equilibrium Coefficient, First Law applied to Chemical Reactions Combustion Efficiency.

UNIT-4

IC Engines Sub Systems

Starting and Charging systems; Ignition Systems; Engine Heat transfer and Cooling systems; Engine friction and lubrication systems; Mechanisms for system operations.

UNIT-5

Pollutant Formation and Control

Emission Formation in SI Engines: Constituents, Formation Mechanisms: Hydrocarbon, Carbon Monoxide, Oxides of Nitrogen, Carbon dioxide, Aldehydes; Control Techniques; Fuel Injection Technologies, Heated Oxygen Sensors, Emission formation in CI Engines: Constituents, formation Mechanisms: Carbon Monoxide, Unburned Hydrocarbons, Oxides of Nitrogen, Compounds of Sulphur, Particulate Matter, Control Techniques: Fuel Injection Technology, Electronically Controlled Distribution, Electronic Unit injector System, After Treatment Devices.

Text Books:

- [1] Engineering Fundamentals of internal Combustion Engines, Willard W. Pulkrabek, Printice Hall New Jersey.
- [2] Internal Combustion Engine Fundamentals, John B Heywood, McGraw-Hill Book Company, New York, 1988.

Reference Books

- [3] Internal Combustion Engines Applied Thermosciences, Colin R. Ferguson and Allan T. Kirkpatrick, John Wiley & Sons, 2e, 2004
- [4] Internal Combustion Engines, V. Ganesan, Tata McGraw-Hill, New-Delhi, 1990
- [5] An Introduction to Combustion: Concept and Applications, Stephen R. Turns, McGraw-Hill Education (India), New-Delhi, 2011

List of Experiments

1. Study of various IC engine Components and Sub-systems.
2. Study of Induction and Exhaustion Systems
3. Study of Ignition Systems, Cooling systems, lubrication systems for IC engine systems
4. Simulation and Modeling of Spark Ignition engines
4. Simulation and Modeling of Compression Ignition engines
5. Emission measurement in Spark Ignition and Compression Ignition Engines.