ADVANCED IC ENGINES
(Professional Elective II)

I Semester

Course Code: 19ME2253

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Prerequisites: Engineering Thermodynamics and Thermal Engineering

Course Outcomes: At the end of the course, the student shall be able to

CO1: Explain the design and operating parameters of an engine and analyze thermodynamic concepts of fuel- air cycles.
CO2: Summarize the concepts of volumetric efficiency, turbo charging and supercharging.
CO3: Explain the concepts of types of charge motion within the cylinder and flow in intake manifold.
CO4: Analyze different stages of combustion in SI and CI engines and explain the formation of different pollutants, their affect and their treatment.
CO5: Discuss the concepts of modern trends in IC engines.

UNIT-I: **(10-Lectures)**

Engine types and their operation, engine design and operating parameters, Characterization of flames, first law of thermodynamics and combustion, second law of thermodynamics and combustion, Effects of Fuel/Air Ration Non uniformity, Comparison with real engine cycles.

Learning outcomes: At the end of this unit, the student will be able to

1. Explain different types of engines, engine design and its operating parameters (L2)
2. Derive relation between the combustion and laws of thermodynamics (L6)
3. Discuss the real engine cycle and the effects of A/F non uniformity (L6)

UNIT-II: **(10-Lectures)**

Gas Exchange Processes - Volumetric efficiency, flow through valves, residual gas fraction, exhaust gas flow rate and temperature variation, flow through ports, supercharging and turbo charging.

Learning outcomes: At the end of this unit, the student will be able to

1. Explain the concepts of volumetric efficiency and the factors that effect it (L2)
2. Explain the role of residual gases effecting the volumetric efficiency (L2)
3. Apply the concepts of supercharging and turbocharging (L3)

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UNIT-III: **(10-Lectures)**

Charge motion- Mean velocity and turbulence characteristics, swirl, squish, pre-chamber engine flows, crevice flows and blowby. Fuel metering and manifold phenomenon-SI engine mixture requirements, carburetors, Fuel injection systems.

Learning outcomes: At the end of this unit, the student will be able to

1. Interpret different air motions in the cylinder (L2)

2. Discuss the mixture preparation in SI engines (L6)
3. Explain the fuel supply systems in both SI and CI engines (L2)

UNIT-IV: **(10-Lectures)**

SI Engine combustion-Stages, Effect of engine variables on ignition lag, effect of engine variables on flame propagation and abnormal combustion.
CI Engine combustion-Stage, effect of engine variable on delay period, fuel spray behavior, ignition delay. Pollutant formation and control- Nature and extent of problem, nitrogen oxides, carbon monoxide, unburned hydrocarbon emissions, particulate emissions, exhaust gas treatment.

Learning outcomes: At the end of this unit, the student will be able to

1. Explain combustion phenomenon in SI engines and CI engines (L2)
2. Evaluate the factors that effect the normal combustion and abnormal combustion in both SI and CI engines (L5)
3. Analyze the emission formation and methods to control emissions (L4)

UNIT-V: **(10-Lectures)**

Modern trends in I.C. engines, Duel fuel and multi fuel engines, Stratified charge Engine, Variable compression ratio engine, Free Piston Engine, lean burning engines-rotary engines, modification in I.C engines to suit Bio – fuels, GDI concepts.

Learning outcomes: At the end of this unit, the student will be able to

1. Compare between standard engine and stratified engine (L2)
2. Evaluate different modern trends in IC engines like lean burn, VCR and GDI (L5)
3. Examine the working of bio-diesel in the engine and the modifications required for the current IC engines to run on either CNG, LNG and bio-diesel (L4)

TEXT BOOKS:

1. John B. Heywood, “Internal Combustion Engine Fundamental”, 1st Edition, Tata McGraw-Hill Education, 2011. (Units I,II,III, & Partially IV).
2. M.L. Mathur and R.P. Sharma, “Internal Combustion Engines”, Dhanpat Rai, 2008. (Units IV& V)

REFERENCE BOOKS:

1. Heinz Heisler, “Advanced Engine Technology”, Trafalgar Square, 1997.
2. V. Ganesan, “Internal Combustion Engines”, 2nd Edition, Tata McGraw Hill, 2002.