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|-----------------------|-----------------------------|
| <b>Branch Name:</b>   | Mechanical Engineering      |
| <b>Semester/Year:</b> | Semester VI / Third Year    |
| <b>Subject Title:</b> | Internal Combustion Engines |
| <b>Subject Code:</b>  | 1ET1010601                  |
| <b>Pre-requisite:</b> | Engineering Thermodynamics  |

**Course Objectives:**

1. To present a problem oriented in depth knowledge of Internal Combustion Engine.
2. To address the underlying concepts, methods and application of Internal Combustion Engine.

| Teaching Scheme<br>(Hours per week) |                 |                  |        | Evaluation Scheme (Marks) |                          |                          |                          |                  |
|-------------------------------------|-----------------|------------------|--------|---------------------------|--------------------------|--------------------------|--------------------------|------------------|
| Lecture<br>(L)                      | Tutorial<br>(T) | Practical<br>(P) | Credit | Theory (Marks)            |                          | Practical (Marks)        |                          | Total<br>(Marks) |
|                                     |                 |                  |        | University<br>Assessment  | Continuous<br>Assessment | University<br>Assessment | Continuous<br>Assessment |                  |
| 03                                  | 00              | 02               | 04     | 70                        | 30                       | 30                       | 20                       | 150              |

| Subject Contents |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |                  |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------------|
| Sr.<br>No        | Topic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Total<br>Hours | Weightage<br>(%) |
| 1                | <b>Introduction:</b><br>Basic components and terminology of IC engines, working of four stroke/two stroke - petrol/diesel engine, classification and application of IC engines, engine performance and emission parameters                                                                                                                                                                                                                                                                                                                                                                          | 2              | 5                |
| 2                | <b>Fuel Air Cycles and Actual Cycles:</b><br>Assumptions for fuel-air cycles, Reasons for variation of specific heats of gases, change of internal energy and enthalpy during a process with variable specific heats, isentropic expansion with variable specific heats, effect of variable specific heats on Otto, Diesel and Dual cycle, dissociation, comparison of air standard and fuel air cycles, effect of operating variables, comparison of air standard and actual cycles, effect of time loss, heat loss and exhaust loss in Petrol and Diesel engines, valve and port timing diagrams. | 7              | 16               |
| 3                | <b>Combustion:</b><br>Combustion equations, stoichiometric air fuel ratio, enthalpy of formation, adiabatic flame temperature, determination of calorific values of fuels – calorimeter - Bomb and Junkers gas calorimeter.<br><b>Combustion in SI and CI Engines:</b><br>Stages of combustion in SI engines, abnormal combustion and knocking in SI engines, factors affecting knocking, effects of knocking, control of knocking, combustion chambers for SI engines, Stages of combustion in CI engines, detonation in C.I. engines, factors affecting detonation, controlling                   | 11             | 25               |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |    |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|
|   | detonation, combustion chamber for SI and CI engine.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |    |
| 4 | <b>Fuels and its supply system for SI and CI engine:</b><br>Important qualities of IC engine fuels, rating of fuels, Carburetion, mixture requirement for different loads and speeds, simple carburetor and its working, types of carburetors, MPFI, types of injection systems in CI engine, fuel pumps and injectors, types of nozzles, spray formation.                                                                                                                                                                                                                                                     | 7 | 16 |
| 5 | <b>Ignition and Governing System:</b><br>Battery and magneto ignition system, spark plug, firing order, quality, quantity & hit and miss governing<br><b>Supercharging and Turbo charging :</b><br>Need for supercharging, Effect of supercharging, types of supercharger, methods of supercharging, thermodynamic analysis of supercharged engine cycle, limitations of supercharging, turbo charging .                                                                                                                                                                                                       | 7 | 16 |
| 6 | <b>Engine Lubrication and Cooling:</b><br>Lubrication of engine components, Lubrication system – wet sump and dry sump, crankcase ventilation, Types of cooling systems – liquid and air cooled, comparison of liquid and air cooled systems<br><b>Engine Emission and their control:</b><br>Air pollution due to IC engines, Euro I to VI norms, HC, CO and NOx emission, catalytic convertor                                                                                                                                                                                                                 | 5 | 12 |
| 7 | <b>Measurement and Testing of IC engines :</b><br>Measurement of indicated power, brake power, fuel consumption and emission, Measurement of friction power by William's Line Method* and Morse Test*, testing of engines as per Indian Standard 10001, calculation of brake thermal efficiency, brake power and brake specific fuel consumption of IC Engines, variable compression ratio engines, heat balance sheet of IC Engines .<br><b>Diesel Power Plant:</b><br>Application of diesel engines in power field, merit and demerits of diesel engine power plants, layout of diesel engine power plants . | 4 | 10 |

**\*To be covered during laboratory sessions.**

### Course Outcomes:

#### The student will be able to

1. Do in-depth cycle analysis for different types of engines.
2. Analyze fuel supply systems, ignition and governing systems of IC Engines.
3. Demonstrate need and methods of engine testing.
4. Understand combustion process of SI and CI Engines.

### List of Reference Books:

1. Ganesan, V. Internal combustion engines. McGraw Hill Education (India) Pvt Ltd, 2012.
2. Domkundwar, V. M. "Internal combustion engines." Dhanpat Rai & Co (2001).
3. Mathur, M. L., and R. P. Sharma. A course in internal combustion engines. Dhanpat Rai, 1981.
4. Heywood, John B. "Internal Combustion Engine Fundamental" publication Tata McGraw Hill Education Private Limited." New delhi, Edition (1988).
5. Gupta, Hari N. Fundamentals of internal combustion engines. PHI Learning Pvt. Ltd., 2012.

### List of Practicals:

1. To Study about Valve timings for four stroke Petrol/Diesel Engine.
2. To Study about Ignition and governing systems of I.C Engines.

3. To Study about supercharging and turbo charging of I C engines.
4. Performance test of Two Stroke Petrol Engine.
5. Performance test of Four Stroke Single Cylinder Diesel Engine.
6. Determination of friction power of multi cylinder petrol engine using Morse Test Method.
7. To Study about various methods for measurements and testing of I C engines.
8. To determine the friction power of Two Stroke Petrol Engine using Williams line method.
9. To Study about engine emissions and their control.
10. Tutorials

**E-Resources:**

1. <http://nptel.ac.in/>
2. <http://ocw.mit.edu/>