

B.E Semester: VI Mechanical Engineering

Subject Name: Internal Combustion Engine

A. Course Objective

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

B. Teaching / Examination Scheme

SUBJECT		Teaching Scheme				Total Credit	Evaluation Scheme				Total Marks	
		L	T	P	Total		THEORY		IE	CIA		
CODE	NAME	Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks		
ME605	Internal Combustion Engine	3	0	2	5	4	3	70	30	20	30	150

C. Detailed Syllabus

1 Comparison of SI and CI Engines :

Difference in thermodynamic and operating variables, comparison of performance characteristics, comparison of initial and maintenance costs application of SI and CI engine.

2 Two Stroke Engines:

Comparison of Two stroke and Four stroke engines, theoretical scavenging processes, comparison of different scavenging systems, supercharging of two stroke engines.

3 Air Capacity of Four Stroke Engines:

Ideal air capacity, determination of volumetric efficiency and factors affecting volumetric efficiency, Ideal and actual induction processes.

4 Super Charging:

Limits of super charging, super charging power problems and turbo charging methods of arrangements of exhaust manifold in multi cylinder engine limitations of turbo charging.

5 Carburetor:

Properties of air, petrol mixture, mixture requirements of SI engine for steady state operation, transient operation various systems of complete carburetor, air compensating devices, theory of simple carburetor, air compensating devices, carburetor types, introduction to some important makes of carburetor like sole, crater, and SU carburetor, carburetor trouble, petrol injection, Lucas petrol injection system, electronic fuel injection, advantages and disadvantages of petrol injection.

6 Fuel Injection :

Principle and Heat release pattern, nozzles their construction and working, quantity of fuel per cycle, calculation of diameter and stroke of plunger, size of nozzle orifice, formation of diesel spray, atomization, penetration, dispersion factors affecting spray characteristics, resilience of components and effect of elasticity of pipe and fuel.

7 Combustion in I.C. engines:

Combustion in SI engines:

Limits and stages of combustion, factors affecting ignition lag, flame propagation, effect of engine variable on flame propagation, abnormal combustion, effect of detonation, detonation and engine variables and other factors affecting knocking and its prevention, theory of detonation in SI engines and chemistry of detonation, control of detonation surface ignition, design principle of combustion chamber, types of combustion chamber and their comparison.

Combustion in CI engines:

Stages of combustion in CI engines, air fuel ratio, delay period or ignition lag, variables effecting delay period, diesel knock, methods of controlling diesel knock, CI engine combustion chamber requirements, types of combustion chambers, cold starting of CI engine and cold starting aids.

8 **Ignition:**

Ignition timing and its advance vacuum advance, centrifugal spark advance, ignition timing and its effects on exhaust, spark plugs heat range electronic ignition system using contact breaker and contact less triggers, factors affecting energy requirements of the ignition systems.

9 **Governing of C I Engines:** Quality, Q quantity and Hit and Miss governing,10 **Rating, Testing and Performance:**

Measurements of speed, air flow, fuel consumption, indicated power brake power, frictional horse power, and smoke, testing of engines as per Indian Standard 10001, performance test for variable speed I C Engines, heat balance sheet, governing test for constant speed IC engines, effect of fuel injection parameters in CI engines and ignition advance of SI engines on performance of engine. Rating of internal combustion engine based on (I) continuous operation of engine (II) Maximum power an engine can develop (III) Power calculated from empirical formula.

11 **Emission of IC engine:**

Emission from SI engine, effect of engine maintenance on exhaust emission control of SI engine, diesel emission, diesel smoke and control, diesel and control comparison of gasoline and diesel emission. Measurement and calculation for of emission constituents.

12 **Alternative Fuels for IC Engine:**

Methanol, Ethanol, vegetable oils, bio gas, bio-fuels, comparison of their properties with Diesel and petrol, method of manufacturing.

13 **Unconventional Engines:**

Working principle of stratified charge engines sterling engine Wankel engine.

14 Trouble Shooting and Overhauling of Engines.

D. Lesson planning

SR.NO	DATE/WEEK	UNIT NO	%WEIGHTAGE	TOPIC NO
1	1 ST , 2 ND , 3 RD	1,2,3	20	1,2,3
2	4 TH ,5 TH , 6 TH	4,5,6	20	4,5,6
3	7 TH ,8 TH , 9 TH	7,8	20	7,8
4	10 TH ,11 TH , 12 TH	9,10	20	9,10
5	13 TH ,14 TH , 15 TH	11,12,13,14	20	11,12,13,14

E. Instructional Method & Pedagogy

- At the start of course, the course delivery pattern , prerequisite of the subject will be discussed
- Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all topics while teaching and conduction of all examinations.
- Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation.
- One/Two internal exams may be conducted and total/average/best of the same may be converted to equivalent of 30 marks as a part of internal theory evaluation.
- Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation.
- Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concept being taught in lectures.

- 8.** Experiments shall be performed in the laboratory related to course contents. Proposed list of experiments are as follows:
1. To demonstrate various engines and their components.
 2. To demonstrate about internal combustion engines fuels.
 3. To demonstrate about ignition system of S.I. Engines.
 4. To demonstrate about the fuel injection system for C.I. Engine
 5. To demonstrate about carburetor and its types.
 6. To demonstrate the single cylinder two stroke petrol engine and its characteristics.
 7. To demonstrate the multi cylinder four stroke petrol engine and its characteristics.
 8. Performance test on four stroke Diesel engine.
 9. Comparison of Otto, Diesel and Dual combustion cycles.
 10. Various Performance tests: Morse Test and William Line Plot
 11. Demonstration of valve timing diagram
 12. Performance characteristics of single cylinder engine
- 9.** Practical / Oral: The candidate shall be examined on the basis of term-work.

F. Students Learning Outcomes

- The student can identify different areas of Internal Combustion Engines.
- Can find the applications of all the areas in day to day life.

G. Recommended Demonstrate Materials

1. I. C. Engines by Heywood.
2. I. C. Engines by Mathur & Sharma, Dhanpatrai
3. I. C. Engines by V.Ganeshan, Tata McGraw Hill
4. I. C. Engines by Domkundwar & Domkundwar, Dhanpatrai
5. I. C. Engines by R.K.Rajput, Laxmi Prakashan
6. I. C. Engines by R. Yadav, Central Pub., Allahabad