



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Engineering (Part Time)**

**Subject Code: 2971901**

**Semester –VII**

**Subject Name: Internal Combustion Engine**

**Type of course:** Professional Core

**Prerequisite:** Zeal to learn the subject and Basics of Thermodynamics

**Rationale:** The course aims at providing fundamental knowledge of internal combustion engines. The principles that govern engine operation and working are discussed. The course is a basic course in Internal Combustion Engines that provides the student with sufficient knowledge to take active part in design and development work within the automotive industry.

### Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
3	0	2	4	70	30	30	20	150

### Content:

Sr. No.	Content	Total Hrs
1	<b>Introduction:</b> 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.	04
2	<b>Fuels and its supply system for SI and CI engine:</b> 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.	06
3	<b>Combustion in SI and CI Engines:</b> Combustion equations, calculations of air requirement in I C Engine, stoichiometric air fuel ratio, proximate and ultimate analysis, enthalpy of formation, adiabatic flame temperature. 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 detonation, combustion chamber for SI and CI engine	08
4	<b>Engine lubrication:</b> Types of lubricants and their properties, SAE rating of lubricants, Types of lubrication systems <b>Engine Cooling:</b> Necessity of engine cooling, disadvantages of overcooling, Cooling systems and their comparison: Air cooling, Liquid cooling <b>Supercharging/Turbo-charging:</b> Objectives, Limitations, Methods and Types, Different arrangements of turbochargers and superchargers	07
5	<b>Rating, Testing and Performance:</b> Measurements of speed, air flow, fuel consumption,	08



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	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, Trouble Shooting and Overhauling of Engines.	
6	<b>Emission of IC engine:</b> 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.	06
7	<b>Unconventional Engines &amp; Alternative Fuels for IC Engine:</b> Working principle of stratified charge engines sterling engine, Wankel engine Methanol, Ethanol, vegetable oils, bio gas, bio-fuels, hydrogen and comparison of their properties with Diesel and petrol.	06

### Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	30	30	10	0	0

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

### Reference Books:

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

### Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Describe and explain the major phenomena going on in an internal combustion engine such as gas exchange, combustion and emissions formation/reduction.	40
CO-2	Explain the performance and evaluation of internal combustion engine and to discuss how this is affected.	35
CO-3	Reflect on the role of internal combustion engines for transports in society as well as the emissions issue from both a sustainable and ethical perspective.	10
CO-4	To aware about the alternative fuels and their properties.	10
CO-5	To brief the latest development of unconventional engines.	5



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**List of Experiments:**

1. To demonstrate various engines and their components.
2. Demonstration of valve timing diagram
3. To demonstrate about the fuel injection system for C.I. Engine
4. To demonstrate about carburetor and its types.
5. To carry out the performance analysis of single cylinder two stroke petrol engine.
6. To carry out the performance analysis of multi cylinder four stroke petrol engine.
7. To carry out the performance analysis of multi cylinder four stroke diesel engine.
8. To carry out various Performance tests: Morse Test and William Line Plot

**Major Equipment:**

Internal combustion engines, Bomb calorimeter, Junker gas calorimeter

**List of Open Source Software/learning website:** <https://nptel.ac.in/course.php>