Program : **Diploma in Automobile Engineering**	
Course Code : **3054**	Course Title: **Internal Combustion Engines**
Semester : **3**	Credits: **4**
Course Category: **Program Core**	
Periods per week: **4 (L:3, T:1, P:0)**	Periods per semester: **60**

Course Objectives:

- To understand the different fuel systems and components in Petrol and Diesel engines.
- To impart basic knowledge on the necessity of lubrication and cooling systems in automobiles.
- To familiarize with intake and exhaust systems.

Course Prerequisites:

Topic	Course code	Course Title	Semester
Knowledge of basic science		Applied Physics I	1
Knowledge of basic science		Applied Physics II	2
Basic Knowledge in Automobile Engineering		Basic Automobile Engineering	2

Course Outcomes:

On completion of course, the student will be able to:

COn	Description	Duration (Hours)	Cognitive Level
CO1	Identify fuel systems employed in petrol vehicles.	15	Applying
CO2	Illustrate the working of fuel system employed in diesel vehicles	14	Understanding
CO3	Explain the working of Engine lubrication and cooling systems	15	Understanding
CO4	Outline the details of components in Intake and Exhaust systems used in engines.	14	Understanding
	Series Test	2	

CO – PO Mapping:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3						
CO2	2						
CO3	2						
CO4	3						

3-Strongly mapped, 2-Moderately mapped, 1-Weakly mapped

Course Outline:

Module Outcomes	Description	Duration (Hours)	Cognitive Level
CO1	**Identify fuel systems employed in petrol vehicles**		
M1.01	Demonstrate the conventional fuel system employed in petrol vehicles	3	Understanding
M1. 02	Explain the various components in petrol fuel system and different circuits in carburetor	5	Understanding
M1. 03	Identify the various electronic fuel injection systems in vehicles	3	Applying
M1. 04	Explain gasoline direct Injection system.	4	Understanding
Contents: **Petrol fuel system** Different fuel feed system components - fuel feed pump, Petrol fuel filters, and air cleaners. Working of simple carburetor, Air fuel ratios, stoichiometric air - fuel ratio, Introduction to Electronic Fuel Injection (EFI) systems - basic working, Types of petrol injection - indirect injection methods-single point injection, multi point injection, direct injection, components - fuel tank, fuel supply pump, fuel lines, fuel filters, fuel pressure regulator, fuel injectors - operation, EFI subsystems - air intake system, fuel delivery system, electronic control system, sensors and actuators - different types, idle air control, on board diagnostics of EFI.			
CO2	**Illustrate the working of fuel system employed in diesel vehicles**		
M2.01	Outline the conventional fuel system employed in Diesel vehicles	3	Understanding
M2.02	Understand the various components in Diesel fuel system	5	Understanding
M2.03	Understand the various types of fuel injection pumps in diesel vehicles	3	Understanding

M2.04	Illustrate the various components in common rail diesel fuel system	3	Understanding
	Series Test-I	1	

Contents:

Diesel fuel system

Layout of a conventional diesel fuel system. Fuel filters - primary filter - secondary filters- purpose - construction - working of each type. Solid fuel injection system - Jerk and distributor type pumps. Working of Inline and distributor type FIP, fuel feed pump. Types of diesel fuel filter. Working of fuel injector, types of fuel injector, Governors - purpose and types (Pneumatic andcentrifugal governors)

Electronic diesel fuel system - working, various sensors and their working, fuel injection pump, common rail diesel fuel system, fuel tank, fuel delivery pump, high pressure fuel injection pump, fuel rail, fuel rail pressure sensor, electronic diesel fuel injector - working, injection control, pressure relief valve, fuel temperature control, glow plugs, emission control devices.

CO3	**Explain the working of Engine lubrication and cooling systems**		
M3.01	Summarize the various properties of lubricating oil and different methods of engine lubrication	3	Understanding
M3.02	Summarize the functions of various components in Engine lubrication system	4	Understanding
M3.03	Outline the various methods of engine Cooling	3	Understanding
M3.04	Explain the functions of various components in Engine Cooling system	5	Understanding

Contents:

Cooling and Lubrication

Properties of lubricating oil, Single and multi - grade oils. Oil additives, Concept of lubrication, Working of engine lubrication system - Petroil, splash, pressure, dry sump and wet sump. Types of oil pumps - construction and working of gear pump, vane pump and rotor pump, Layout and working of Full flow filtering system and By-pass flow filtering system, Functions of oil cooler, oil filter, pressure relief valve.

Cooling system, significance, Types - Air cooling & Water cooling system, Types of coolant, Water pump - working, Radiator - necessity, Expansion tank - necessity, Construction and working of Thermostat valve, Anti-freeze solutions - purpose, Radiator Pressure Cap.

CO4	**Outline the details of components in Intake and Exhaust systems used in engines.**		
M4.01	Explain the different valve timing technologies and its operations	4	Understanding

M4.02	Illustrate the constructional details of Different types of Mufflers	3	Understanding
M4.03	Explain the Turbo Charging system and	4	Understanding
M4.04	Compare different types of turbo chargers	3	Understanding
	Series Test-II	1	

Contents:

Intake and Exhaust System:

Intake manifolds, Types, AirCleaners - Types, Variable intake system, Electronic throttle body, VVT, (Variable valve timing) CVVT (Continuously varying valve timing), VTVT (Variable time valve train), VVTI (Variable valve timing intelligent) technologies.

Exhaust Manifold, Mufflers, Resonator, Catalytic Converter - constructional details and working, Tail pipe - Types of mufflers, construction of exhaust manifold - purpose of mufflers - constructional details of absorber type, baffle plate type, wave cancellation type and resonance type mufflers

Turbo charging system, Types of Turbo chargers,1) Normal Turbo Charger,2) WGT (Waste Gate Turbo Charger) 3) Turbo - lag (Variable geometry turbo charger).

Text /Reference:

T/R	BookTitle/Author
T1	Kirpal Singh S - Automobile Engg., Vol. II – Standard Publications 12th E.
R1	R.B. Guptha - Automobile Engg. – Satya Prakasan 9th E
R2	K.M.Guptha - Automobile Engg., Vol. I& II – Umesh Publications 1st E
R3	Anil Chikara- Automobile Engg., Vol. I -Satya Prakasan 3rd E
R4	William.H.Crouse Automotive mechanics – McGraw-Hill Publications 10th E
R5	K.K.Ramalingam - Automobile Engg., Theory and Practice – Scitech Publications 1st E
R6	Dr.N.K. Giri - Automobile Technology – Khanna publishers 8th E
R7	Mathur and Sharma - I.C. Engines – Dhanpat rai publications 2nd E

Online Resources:

Sl.No	Website Link
1	https://www.youtube.com/watch?v=LjJSbHxIvnM
2	https://www.dieselnet.com/tech/diesel_fi.php
3	https://www.youtube.com/watch?v=qId3Th6_a4U
4.	https://www.youtube.com/watch?v=y5p31F_dVJU
5	https://www.youtube.com/watch?v=DqWKNuTppmU