Program :	**Diploma in Automobile Engineering**
Course Code : **4051**	Course Title: **Heat Power Engineering**
Semester : **4**	Credits: **4**
Course Category: **Program Core**	
Periods per week: **4 (L:3, T:1, P:0)**	Periods per semester: **60**

Course Objectives:

- To get elementary knowledge about thermodynamic processes, cycles, fundamental laws of thermodynamics.

- To understand the laws of conversion of heat energy into work or power and its applications in automobile industries.

- To deal with thermodynamic systems such as heat engines, heat exchangers (radiators), automobile air conditioning, compressors etc.

- To understand the terminologies used in the testing of engine performances.

Course Prerequisites:

Topic	Course code	Course Title	Semester
Knowledge of basic Mathematics		Mathematics I	1
Knowledge of basic Mathematics		Mathematics II	2
Knowledge of basic science		Applied physics I	1
Knowledge of basic science		Applied Physics II	2
Knowledge of program core course		Basic Automobile Engineering	2

Course Outcomes

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

COn	Description	Duration (Hours)	Cognitive level
CO1	Choose the basic terms, laws and types of processes in thermodynamics	15	Applying
CO2	Select air standard efficiency of Carnot cycle, Otto cycle and Diesel cycles.	14	Applying
CO3	Solve the performance parameters of engines.	15	Applying
CO4	Make use of the principles of heat transfer and working of air compressors.	14	Applying
	Series Test	2	

CO – PO Mapping:

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

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

Course Outline:

Module Outcomes	Description	Duration (Hours)	Cognitive Level
CO1	**Choose the basic terms, laws and types of processes in thermodynamics.**		
M1.01	Define basic terms of thermodynamics	3	Remembering
M10.2	Explain First, Second, Third and Zeroth Laws of thermodynamics.	1	Understanding
M1.03	Summarize the basic concepts of entropy, enthalpy and internal energy.	2	Understanding
M1.04	Make use of various types of thermodynamic processes.	6	Applying
M1.05	Solve problems on different types of thermodynamic processes.	3	Applying

Contents:

Fundamentals of thermodynamics and thermodynamic processes

Classification of thermodynamics, Application areas of thermodynamics, Dimensional homogeneity, Basics of thermodynamics - thermodynamic system, surroundings, boundary, types of system, properties of a system, state, thermodynamic equilibrium, Ideal gas equation of state - Derivation, pressure and its units, temperature and its units, Zeroth law of thermodynamics, Specific heat at constant pressure and constant volume, relationship between specific heats and gas constant, Internal Energy, flow energy and moving boundary work, First law of thermodynamics - Enthalpy, Second law of thermodynamics, Entropy-Third law of thermodynamics.

Processes and cycle.

Pressure volume diagram, Temperature entropy diagram,

Types of processes - Derivations on PVT relationship, heat transfer, work transfer, change in entropy, enthalpy and internal energy of isochoric, isobaric, isothermal and adiabatic processes. Simple problems to find change in internal energy, heat transfer, work transfer etc.

CO2	Select air standard efficiency of Carnot cycle, Otto cycle and Diesel cycles		
M2.01	Summarize the assumptions made in thermodynamic cycles. Classify and compare thermodynamic cycles.	2	Understanding,
M2.02	Define available energy, theoretical thermal efficiency / air standard efficiency.	2	Remembering,
M2.03	Summarize the theoretical thermal efficiency of Carnot cycle.	2	Understanding
M2.04	Solve simple problems on Carnot cycle.	2	Applying
M2.05	Explain theoretical thermal efficiency of Otto cycle and Diesel Cycle.	3	Understanding,
M2.06	Solve problems on Otto cycle and Diesel cycle.	3	Applying
	Series test -I	1	

Contents:

Air standard cycles.

Assumptions made in thermodynamic cycles, Classification of thermodynamic cycles. Available energy, theoretical thermal efficiency, Air standard efficiency. Derivation of theoretical thermal efficiency of Carnot cycle, Otto cycle and Diesel cycle -Simple problems to find out air standard efficiency.

CO3	Solve the performance parameters of engines.		
M3.01	Outline the Performance parameters of I.C. engines such as indicated power, brake power, friction power, indicated thermal efficiency, brake thermal efficiency, volumetric efficiency, Mechanical efficiency, Mean effective pressures, and specific fuel consumption.	6	Understanding
M3.02	Solve the problems related to testing of Internal combustion engines.	4	Applying
M3.03	Summarize how Morse test is conducted in multi cylinder engines.	1	Understanding
M3.04	Explain how heat balance sheets are prepared.	1	Understanding
M3.05	Solve the problems on Morse test and Heat balance sheet	3	Applying

Contents:

Performance parameters - indicated power, brake power, friction power, indicated thermal efficiency, brake thermal efficiency, volumetric efficiency, Mechanical efficiency, mean effective pressures and specific fuel consumption - Simple problems to find out various efficiencies. Morse test and preparation of heat balance sheet. Simple problems.

CO4	**Make use of the principles of heat transfer and working of air compressors.**		
M4.01	Explain the different Modes of heat transfer. Identify the fields of application of heat transfer.	4	Applying
M4.02	Compare three modes of heat transfer and their rate equations.	1	Understanding
M4.03	Illustrate two types of convective mode of heat transfer- natural and forced.	2	Understanding
M4.04	Define air compressor, explain uses of compressed air and classify air compressors.	3	Understanding
M4.05	Illustrate the working of single stage and multistage air compressors. Explain the merits and demerits of multistage compression.	4	Understanding
	Series Test -II	1	

Text / Reference:

T/R	Book Title/Author
T1	Thermal Engineering R.S.Khurmi S Chand & Co
T2	Basic and applied thermodynamics P.K.Nag Tata MCgraw-Hill Niranjan.Murthy Sapna Publications
T3	I C Engines V. Ganeshan Tata MCgraw-Hill
R1	R. C. Patel and Karmchandani.C .J. - Elements of Heat engines – Acharya book
R2	Lakshminarayana - Thermal engineering Vol.-I
R3	N.K.Giri - Automobile mechanics – Khanna publishers
R4	R. Rudra Moorthy and K. Mayil Swamy - Heat and Mass transfer- pearson education india
R5	J G Giles-Vehicle operations and testing
R6	V. Ganesan - Internal combustion engines – Tata McGraw-Hill
R7	S. P. Sen - Internal combustion engines theory and practice – Khanna publishers
R8	Mathur and Sharma - Internal combustion engines – Dhanpat Rai
R9	V.L. Malaev - IC Engines – McGraw-Hill
R10	P.M. Heldt - IC Engines
R11	Ramalingam - Thermal engineering - New age international
R12	B B Ghosh - A Text book of Engineering Thermodynamics – Vikas publishing

Online Resources:

Sl. No	Website Link
1	https://www.toppr.com/guides/chemistry/thermodynamics/applications-of-thermodynamics/
2	https://chemed.chem.purdue.edu/genchem/topicreview/bp/ch21/chemical.php
3	https://en.wikipedia.org/wiki/Thermodynamic_process
4	http://www.thermodynamicsheatengines.com/HeatEnginesVol%202%20Chapter%207%20RS.pdf
5	https://www.academia.edu/15057433/CHAPTER_8_Testing_of_I.C.Engines,https://www.mechanicalbooster.com/2015/08/difference-between-otto-cycle-and-diesel-cycle.html
6	https://engineeringinsider.org/heat-transfer-conduction-convection-radiation/
7	https://www.brighthubengineering.com/hvac/63725-effects-of-a-multi-stage-air-compressor/