Program : **Diploma inMechanical Engineering**	
Course Code :**4021**	Course Title: **Thermal Engineering**
Semester : **4**	Credits: **4**
Course Category: **Program Core**	
Periods per week: **4 (L:3, T:1, P:0)**	Periods per semester:**60**

CourseObjectives:

- To Explain the basics of thermodynamics and different thermodynamic processes.
- To Classify different air standard cycles and familiarize testing of IC engines
- To identify the Properties of steam, working of boilers, turbines and compressors.
- To explain different modes of Heat transfer, working of heat exchangers and compressors.

Course Prerequisites:

Topic	Course Code	Course Name	Semester
Knowledge of basic Mathematics		Mathematics I&II	1&2
Knowledge of basic physics		Applied Physics I &II	1&2

Course Outcomes:

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

COn	Description	Duration (Hours)	Cognitive Level
CO1	Explain the concepts in thermodynamics and laws of thermodynamics.	16	Applying
CO2	Describe air standard efficiency of thermodynamic cycles and performance testing of IC engines.	15	Understand

CO3	Explain the properties of steam and working principle of boilers and turbines.	15	Applying
CO4	Explain different modes of Heat transfer and working of heat exchangers and compressors.	11	Understand
	Series Test	3	

CO-PO Mapping:

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

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

Course Outline

Module Outcomes	Description	Duration (Hours)	Cognitive Level
CO1	**Explain the concepts in thermodynamics and laws of thermodynamics.**		
M1.01	Recognize the scope and application of thermal engineering.	2	Understanding
M1.02	Identify and define the terms in thermodynamics	3	Understanding
M1.03	State different thermodynamics laws	2	Understanding
M1.04	Explain different thermodynamic processes	5	Understanding
M1.05	Explain different gas laws and apply them to derive fundamental relations and equations in thermodynamics	4	Applying
Content: Scope and application of thermal engineering -Define and classify thermodynamic system- boundary – surrounding-thermodynamic properties- intrinsic and extrinsic properties- Define-pressure, temperature, enthalpy, and their SI units -Boyle's law, Charle's law, Joule's law, Avogadro's law-Derive characteristic gas equation, Mayors relation- heat and work Thermodynamic equilibrium - Quasistatic processes-Illustrate thermodynamic processes such as Isochoric, Isobaric, Isothermal, adiabatic, Polytrophic.			

Derive the expressions for the expansion work, change in internal energy, heat transferred and enthalpy change in each process -Simple problems using above relations. Statement of Zeroth law, first law, and second law of thermodynamics (Kelvin Plank and Clausius statements) -concept of entropy – reversible and irreversible process- P-V, T-S diagrams of pure substance.

CO2	**Describe air standard efficiency of thermodynamic cycles and performance testing of IC engines.**		
M2.01	Explain different Air standard cycles and Illustrate with P-V, T-S diagram.	5	Applying
M2.02	Appreciate the working of petrol and diesel engine.	2	Understand
M2.03	Solve simple problems related to air cycles.	2	Applying
M2.04	Explain Valve timing and Port timing diagram for petrol and diesel engines.	2	Understanding
M2.05	Define Indicated power Brake power Friction power and simple problems.	2	Understanding
M2.06	Define mechanical, Brake thermal and Indicated thermal efficiencies and simple problems.	2	Understanding
	Series Test – I	2	

Contents:

Air standard cycles - assumptions- air standard efficiency -Illustrate with P-V, T-S diagram.

Carnot cycle, Otto cycle, Diesel cycle. Derive air standard efficiency -simple problems on Otto and Carnot cycle. Working of petrol and diesel engine (two stroke and four stroke). -Comparison of petrol and diesel engines. Compare SI, CI engines. Explain Valve timing diagram for diesel and petrol engines (two and four stroke). **Performance of IC Engines**: Define Indicated power, Brake power, Friction power and Mechanical efficiency. Define Indicated Thermal efficiency, Brake thermal efficiency, Relative efficiency. Define total fuel consumption and specific fuel consumption. Explain the Morse test. Heat balance sheet -simple problems.

CO3	**Explain the properties of steam and working principle of boilers and turbines.**		
M3.01	Explain the formation of steam at constant pressure and illustrate it with a graph.	2	Applying
M3.02	Identify and Apply steam table to compute the enthalpy of wet, dry and superheated steam.	2	Applying
M3.03	Illustrate the condition of steam, enthalpy, entropy using Mollier chart.	2	Applying
M3.04	Solve simple problems using steam tables and Mollier chart.	3	Applying
M3.05	Discuss the classification, Functions and working of steam boilers.	3	Understanding

M3.06	Explain the working of impulse and reaction turbine.	3	Understanding

Contents:
Steam and its properties: Understand the formation of steam at constant pressure with a graph indicating the effect of pressure and temperature. Distinguish between wet, dry, superheated steam. Compute the enthalpy of wet, dry and super-heated steam at the given pressure and state using steam table. Determine conditions of steam- enthalpy, entropy, specific volume of steam using mollier chart. Throttling process- Simple problems. **Steam generators**: Functions and use of steam boilers. -classification- Difference between fire tube and water tube boilers-working of Cochran boiler-Babcock and Wilcox boiler-boiler mountings and accessories. **Steam turbines**: working principle-Classification -Explain the working of impulse and reaction turbine.

CO4	**Explain different modes of Heat transfer and working of heat exchangers and compressors.**		
M4.01	Identify different modes of heat transfer and state Fourier's law	1	Understanding
M4.02	Discuss Conduction through a plane wall and solve simple problems.	2	Applying
M4.03	Describe the terms related to thermal radiation and solve simple problems	2	Understanding
M4.04	Discuss types of thermal convection and state Newton Rickman law	1	Understanding
M4.05	Identify different types of heat exchangers and their effectiveness	2	Applying
M4.06	Explain the working of single stage air compressor.	1	Understanding
M4.07	Discuss the classification and working of different types of air compressors.	2	Understanding
	Series Test – II	1	

Contents:
Heat transfer-modes of heat transfer-conduction-convection and radiation. Fourier's law of thermal conduction. -Thermal conductivity-conduction through a plane wall -simple problems. Thermal radiation-definition-reflection, absorption, transmission, absorptivity, reflectivity and transmissivity. concept of a black body- -Planks law of thermal radiation-Stefan –Boltzman law of total radiation-Concept of grey body- -free and forced convection (elementary ideas only). **Heat exchangers**-Classification- parallel flow- counter flow type – shell and tube –effectiveness of a heat exchanger (definition only). **Air compressors**-classification- Uses of compressed air. -Single stage reciprocating compressor its construction and working (with line diagram) using P-V Diagram-Rotary compressors: centrifugal compressors, Axial flow type compressors, vane type compressors, lobe type compressors (working principle with line diagram.)

Text / Reference

T/R	Book Title/Author
T1	Thermal Engineering -D.S.Kumar
R1	A text book of Thermal Engineering -R.S.Khurmi&J.K.Gupta
R2	Thermal Engineering -P.L.Ballany
R3	Elements of Heat engines volume I & II -R.C. Patel & C.J. Karamchandani
R4	Fundamentals of Thermal-Fluid Sciences, Yunus A. Cengel
R5	Elements of Mechanical Engg: - Prof: Sadhu Singh

Online Resources

Sl.No	Website Link
1	https://www.youtube.com/watch?v=2BRpJ4Owo84
2	https://www.youtube.com/watch?v=c52hmb-IPJw
3	https://www.youtube.com/watch?v=_E6H-uVEgh0