GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Mechanical Engineering

Course / Subject Code: DI03019011

Course / Subject Name : Engineering Thermodynamics

W. e. f. Academic Year:	2024-25
Semester:	3rd
Category of the Course:	PCC

Prerequisite:	Zeal to learn the subject.
Rationale:	Thermodynamics is a branch of science that deals with energy transformations and are primarily concerned with the two forms of energy heat and work. The energy transformations are governed by the various laws of thermodynamics known as zero, first, second and third laws. These laws were deducted from experimental observations and logical reasoning. Extensive applications of thermodynamics can be found in fields ranging from refrigeration and air-conditioning to aerospace. Its principles are used to design energy converting devices, automobile engines, steam and gas turbines, power plants, compressors, HVAC, alternators, propulsion systems of aircraft and rockets, etc. Thus, every student of Diploma Mechanical Engineering should have a fundamental knowledge of this course. It is a pre-requisite course for many courses of Thermal Engineering in higher semesters.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
01	Identify thermodynamic properties and systems by interpreting the basic concepts of thermodynamics.
02	Apply various thermodynamic laws and gas laws to thermal systems.
03	Calculate various parameters of different thermodynamic processes and cycles using P-V and T-s diagrams

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA (M)	PA(I)	ESE (V)	
3	0	0	3	70	30	00	00	100

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Basic Concepts of Thermodynamics** 1.1 Introduction and applications of Engineering thermodynamics. 1.2 Basic thermodynamic Concepts. 1.3 State, System, Boundary and Surroundings. 1.4 Types of Systems and boundaries. 1.5 Energy, Heat, Work, Power and Exergy 1.6 Thermodynamic properties and their units. 1.7 Simple numerical based on above. 1.8 Thermodynamic equilibrium. 1.9 Zeroth law of thermodynamics and its application.	8	20
2.	**First Law of Thermodynamics** 2.1 Heat and work relation with Joule's Experiment. 2.2 Law of conservation of energy. 2.3 Statement of the first law of thermodynamics. 2.4 Application of the first law of thermodynamics: - Closed system (Non-flow Processes). - Open system (Flow Processes). 2.5 Definition of the flow process, control volume and flow work. 2.6 Steady and unsteady flow processes. 2.7 Steady Flow Energy Equations (SFEE) and its applications in Nozzle, Diffuser, Boiler, Turbine, Compressor, Condenser, and throttling devices. 2.8 Simple numerical examples based on the above.	09	20
3.	**Second Law of Thermodynamics** 3.1 Limitations of the first law of thermodynamics. 3.2 Concept of heat source, heat sink, heat engine, heat pump, refrigerator, reversible process and irreversible process. 3.3 Statement of the second law of thermodynamics: - Kelvin Planck Statement - Clausius Statement 3.4 Applications of the second law of thermodynamics. 3.5 Simple numerical on thermal efficiency and Coefficient of Performance (C.O.P.). 3.6 Concept of Entropy and its T-ds equation. (**Without Derivations**) 3.7 Statement of the third law of thermodynamics.	05	12

4.	**Ideal Gases and Thermodynamic Processes** 4.1 Concept of Ideal gas. 4.2 Boyle's law, Charle's law and Gay-Lussac law for ideal gases. 4.3 Characteristic gas equation and Universal gas constant, Specific heats of gas and their relationship. 4.4 Thermodynamic Processes, its representation on P-V (Pressure-Volume) and T-S (Temperature-Entropy) diagram: - Constant Volume Process - Constant Pressure Process - Constant Temperature Process - Adiabatic Process - Polytropic Process - Throttling Process 4.5 Equations of P-V-T relationship, work transfer, heat transfer and internal energy of the above processes. (**Without derivations**) 4.6 Simple numerical based on the above.	10	24
5.	**Thermodynamic Cycles** 5.1 Classifications of Thermodynamic cycles 5.2 Carnot cycle and its representation on P-V and T-s diagram. 5.3 Derivation of thermal efficiency of Carnot cycle and simple numerical based on it. 5.4 Concept of air standard efficiency. 5.5 Otto, Diesel, dual and Brayton: Representation on P-V & T-s diagram, Equation of air standard efficiency (**Without derivations**) and simple examples. 5.6 Representation of Reversed Carnot cycle and Reversed Brayton cycle on P-V and T-s diagram respectively.	10	24
	Total	**42**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
40	**40**	**20**	-	-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

Sr. No.	Title of Books	Author	Publication& ISBN
1.	Engineering Thermodynamics	Yunus A. Cengel	Tata McGraw Hill 975-1-25-906256-8
2.	Thermodynamics	R. Yadav	CPH ISBN-13: 9788185444031
3.	Thermodynamics for Engineers	M. L. Mathur	Dhanpatrai & sons 81-200-0029-3
4.	Heat Engines	C. S. Shah & N. C. Pandya	Charotar Publi. House 81-85594-49-X
5.	Elements of Heat Engines Vol. I & II	R. C. Patel	Acharya Book Depot
6.	Thermodynamics	SAAD	Prentice-Hall
7.	Engineering Thermodynamics- 2nd Edition	P.K. Nag	Mc-Graw Hill Education 978-0-07-026062-7
8.	Applied Thermodynamics	R. C. Patel	Acharya Book Depot
9.	Thermodynamics	Gupta	Pearson 9788131717950
10.	Thermodynamics	J.P. Holman	Tata Mc Graw-Hill
11.	Thermodynamics – Theory & Application	Robert Balmer	Jaico publication house
12.	Fundamentals of Thermodynamics	Sonntag, Borgnakke & Van wylen	John Wiley & sons (ASIA) PVT. LTD

(b) Open source software and website:

Sr. No.	Software/Website address	Topic covered
1.	CALPHAD software	Thermodynamic modeling
2.	https://lawofthermodynamicsinfo.com/what-is-thermodynamic-system/	Basic of thermodynamics
3.	https://thermo.pressbooks.com/chapter/chapter-4/	Problems based on first law of thermodynamics
4.	https://study.com/academy/lesson/First-law-of-thermodynamics-law-of-conservation-of-energy.htm	First law of thermodynamics

5.	https://vimeo.com/94762428	First law of thermodynamics
6.	https://www.youtube.com/watch?v=OmhXb-miAhw	Thermodynamic cycles
7.	https://nptel.ac.in/courses/112/105/112105123/	All units
8.	http://www.thermofluids.net/	All units
9.	http://www.grc.nasa.gov/WWW/k-12/airplane/thermo.html	Basic concepts
10.	http://www.youtube.com/watch?v=Xb05CaG7TsQ	First law of thermodynamics
11.	http://www.youtube.com/watch?v=aAfBSJObd6Y	Carnot cycle
12.	http://www.youtube.com/watch?v=DHUwFuHuCdw	Second law of thermodynamics and heat engines
13.	http://www.youtube.com/watch?v=GKqG6n6nAmg	Zeroth law of thermodynamics
14.	https://www.youtube.com/watch?v=ty4F30dRdwk	Understanding entropy
15.	https://www.youtube.com/watch?v=WTtxlaeC9PY	Understanding second law of thermodynamics
16.	https://www.youtube.com/watch?v=Jsnv8L7HdEk	Thermodynamic processes

Suggested Activities for Students:

Sr. No.	Activity.
1.	Identify and list real situations working on a: Zeroth law of thermodynamics. b: First law of thermodynamics. c: Second law of thermodynamics.
2.	Prepare charts of diesel, dual and gasoline cycles. Tabulate the main points of differences between them.
3.	List out the thermodynamic laws/concepts used in the Solar system. Also, Prepare technical specifications of solar rooftop at your home or nearby areas.
4.	Write the specifications of the domestic refrigerator available at your home and I.C. Engine of any two-wheelers. Also, draw and explain the cycle on which domestic Refrigerator and I.C. Engine works.
5.	Presentations on “Smart Thermostat” of home appliances.
6.	Collect/ download product catalogs with the specification of various types of air compressors/ I.C. Engines /Refrigerators used in daily life.
7.	Take any thermal Device/system available in the Institute and identify it based on 1) type of system, 2) type of boundary.

8.	Prepare specification of some thermal devices/systems available in the Institute/surrounding.
9.	Give seminars on various topics learned in the course.
10.	Prepare chart on: (1) Types of system, (2) Temperature scale, (3) Types of process, (4) Types of thermodynamic cycles, and (5) Refrigeration cycle, etc.
11.	Interpret the relationship between different thermodynamic properties.

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