GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3131905
Semester – III
Subject Name: Engineering Thermodynamics

Type of course: Professional Core

Prerequisite: Zeal to learn the subject

Rationale: Engineering Thermodynamics is the first course on Thermal Science and Engineering. It studies various energy interactions notably heat and work transfer. It is based on certain laws of nature which are never seen to be violated.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Introduction, Basic Concepts: Thermodynamic system and control volume, Microscopic and macroscopic point of view, thermodynamic properties, state of a substance, process and cycle, Thermodynamic equilibrium, Concept of Continuum, Quasi-static process, The Zeroth Law of Thermodynamics, Temperature scales	4
2	First law of Thermodynamics: First law for a closed system undergoing a cycle and change of state, energy, PMM1, first law of thermodynamics for steady flow process, steady flow energy equation applied to nozzle, diffuser, boiler, turbine, compressor, pump, heat exchanger and throttling process, filling and emptying process Second law of thermodynamics: Limitations of first law of thermodynamics, Kelvin-Planck and Clausius statements and their equivalence, PMM2, causes of irreversibility, Carnot theorem, corollary of Carnot theorem, thermodynamic temperature scale	13
3	Entropy: Clausius theorem, property of entropy, inequality of Clausius, entropy change in an irreversible process, principle of increase of entropy, entropy change for non-flow and flow processes Exergy: Exergy of a heat input in a cycle, exergy destruction in heat transfer process, exergy of finite heat capacity body, exergy of closed and steady flow system, irreversibility and Gouy-Stodola theorem and its applications, second law efficiency	14
4	Vapor Power cycles: Carnot vapor cycle, Rankine cycle, comparison of Carnot and Rankine cycle, calculation of cycle efficiencies, variables affecting efficiency of Rankine cycle, reheat cycle, regenerative cycle, reheat-regenerative cycle, feed water heaters	23

	Gas Power cycles: Recapitulation of Carnot, Otto and Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles, air standard efficiency, mean effective pressure, brake thermal efficiency, relative efficiency, Simple Brayton cycle Refrigeration Cycles: Simple Vapour Compression Refrigeration (VCR) cycle on P-h and T-s diagrams, analysis of the simple cycle, factors affecting the performance of the cycle, actual cycle, Reversed Carnot cycle and its limitation, Bell-Coleman cycle	
5	Combustion: Combustion equations, stoichiometric air fuel ratio, enthalpy of formation, adiabatic flame temperature, determination of calorific values of fuels – calorimeter - Bomb and Junkers gas calorimeter	6

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**30**	**50**			

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. Engineering Thermodynamics by P.K. Nag, McGraw-Hill Education
2. Fundamentals of Thermodynamics by Borgnakke & Sonntag, 7th Ed. Wiley India (P) Ltd.
3. Thermodynamics – An Engineering Approach by Yunus Cengel & Boles, McGraw-Hill Education
4. Engineering Thermodynamics by Gordon Rogers and Yon Mayhew, Pearson Education Ltd.
5. Engineering Thermodynamics by Krieth, CRC Press
6. Engineering Thermodynamics by Jones and Dugan, PHI Learning Pvt. Ltd.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	To identify the unique vocabulary associated with thermodynamics and explain the basic concepts of thermodynamics	7
CO-2	To state and apply first law of thermodynamics for closed and open systems undergoing different thermodynamic processes and evaluate the feasibility of thermodynamic cycles and processes using second law of thermodynamics	22
CO-3	To apply the concept of entropy and exergy to different thermodynamic processes and cycles	23
CO-4	To analyze different gas power, vapor power and refrigeration cycles	38
CO-5	To make elementary calculation of combustion phenomenon.	10

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3131905

List of Experiments:

1. To verify First and Second Law with Mechanical Heat Pump
2. To verify First and Second Law with I.C. Engine
3. To determine heat loss from pipe-in-pipe heat exchanger using SFEE and to verify entropy principle for the heat exchanger.
4. To understand applications of SFEE
5. To understand applications of entropy principle and Gouy-Stodola theorem
6. To compare Otto, Diesel and Dual cycles
7. To study variables affecting the performance of Rankine cycle
8. To understand different components of VCR system and to determine its COP
9. To understand the effect of various operating parameters on performance of VCR cycle.
10. To find out the calorific value of given fuel with the help of Oxygen Bomb calorimeter.
11. To find out the calorific value of given fuel with the help of Junker gas calorimeter.

Major Equipment:

Mechanical Heat Pump, Internal combustion engine, Heat exchanger, Vapor compression test rig, Bomb calorimeter, Junker gas calorimeter

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