GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3132504
Semester – III
Subject Name: Basic and Applied Thermodynamics

Type of course: Professional Core

Prerequisite: Zeal to learn the subject

Rationale: The subject on basic and applied thermodynamics is important to understand the various modes of energy and energy conversion systems.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	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 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	20
3	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 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, open and closed cycle, gas turbine fuels, actual Brayton cycle, optimum pressure ratio for maximum thermal efficiency, work ratio, air rate, effect of operating variables on the thermal efficiency and work ratio and air rate, combined steam and gas turbine plant	26

	Refrigeration Cycles: Simple Vapor Compression Refrigeration (VCR) cycle on P-h and T-s diagrams, analysis of the simple cycle, factors affecting the performance of the cycle, Reversed Carnot cycle and its limitation, Bell-Coleman cycle	
5	Steam Turbine: (Principle of operation, types of steam turbines, compounding of steam turbines, impulse turbine – velocity diagram)*, calculation of work, power and efficiency, condition for maximum efficiency, Reaction turbines – velocity diagram, degree of reaction, reheat factor, (governing of steam turbine – throttle, nozzle and bypass governing)*, Methods of attachment of blades to turbine rotor, Labyrinth packing, Losses in steam turbine	6

* This topic should be covered during laboratory sessions

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. Power Plant Engineering, P.K. Nag, McGraw-Hill Education
5. Gas Turbines by V Ganeshan, McGraw Hill Education

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	6
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 and concept of entropy	34
CO-3	To analyze different gas power, vapor power and refrigeration cycles	46
CO-4	To explain construction of different steam turbines and analyse the same.	14

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 study variables affecting the performance of Brayton cycle.
11. To study construction and working of various steam turbines.

Major Equipment:
Mechanical Heat Pump, Internal combustion engine, Heat exchanger, Vapor compression test rig,

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