Gujarat Technological University
Mechanical Engineering (19)
Thermodynamics
PDDC Semester I
Subject Code: 2911902

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
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE Viva (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
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	7%
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	6	10%
3	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	7	12%
4	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	6	10%
5	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	8	13%
6	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	10	16
7	Gas Power cycles: Recapitulation of Carnot, Otto and Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles, air standard	7	12%

	efficiency, mean effective pressure, brake thermal efficiency, relative efficiency, Simple Brayton cycle		
8	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	6	10%
9	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	10%

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 Outcome:

After learning the course the students should be able to

1. Understand basic terms used in thermodynamics.
2. Understand laws of thermodynamics and its applications.
3. Comprehend the concept and applications of energy, entropy and exergy.
4. Understand various gas and vapor power cycles.
5. Understand combustion phenomenon

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 find out the calorific value of given fuel with the help of Oxygen Bomb calorimeter.
10. 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: http://nptel.iitm.ac.in/courses.php