GUJARAT TECHNOLOGICAL UNIVERSITY

MECHATRONICS ENGINEERING (20)
ENGINEERING THERMODYNAMICS
SUBJECT CODE: 2142004
B.E. 4th Semester

Type of course: Engineering Science

Prerequisite: NA

Rationale: This subject deals with engineering thermodynamics and its applications, which are useful for Mechatronics engineers.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	1	0	5	70	20	10	30	0	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Basic Concepts: Microscopic & macroscopic point of view, Thermodynamic system and control volume, Thermodynamic properties, processes and cycles, Thermodynamic equilibrium, Quasi-static process, pure substance, vapour- liquid-solid phase in a pure substance, p-v-t surface, critical and triple point of pure substance.	5	10
2	First law of Thermodynamics: First law for a closed system undergoing a cycle and change of state, Energy-A property of the system, Perpetual motion machine of the first kind, steady flow energy equation applied to nozzle, diffuser, boiler, turbine, compressor, pump, heat exchanger,throttling process.	5	10
3	Second law of thermodynamics & Entropy: Limitations of first law of thermodynamics, Kelvin-Planck and Clausius statements and their equivalence, Perpetual motion machine of the second kind, carnot cycle, carnot's theorem, corollary of carnot theorem, thermodynamic temperature scale. Clausius theorem, the property of entropy, inequality of Clausius, entropy change in a open system, reversible and irreversible process, principle of increase of entropy, Third law of thermodynamics, Entropy and disorder, concept of exergy.	8	16
4	Availability, Irreversibility & Thermodynamic Relations: Available and unavailable energy, available energy referred to a cycle, availability in non-flow and steady flow	8	16

	systems, reversibility and irreversibility. Maxwell's equation, T-ds equations, difference in heat capacities, ratio of heat capacities, Helm-holtz and Gibbs function, Internal energy relations, Clausius- Claperyon equation, Joule-Thomson co- efficient.		
5	Vapour & Gas Power cycles: Carnot cycle, Rankine cycle, comparison of carnot and rankine cycle, modified rankine cycle, calculation of cycle efficiencies, variables affecting efficiency of rankine cycle. Carnot, Otto, diesel, dual, atkinson and brayton cycle. Comparison of otto, diesel and dual cycles, calculation of air standard efficiencies, mean effective pressure, brake thermal efficiencies, relative efficiencies of I.C. engine.	12	24
6	Properties of gases and Mixtures: Avogadro's law, equation of state, ideal gas equation, Vander Waal's equation, reduced properties, law of corresponding states, compressibility chart. Gibbs-Dalton law, specific heat of a gas mixture, adiabatic mixing of perfect gases, gas and vapour mixtures.	12	24

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	U Level	A Level	N Level	E Level
50	30	5	10	5

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate 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, Tata McGraw-Hill , New Delhi
2. Thermodynamics – An Engineering Approach by YunusCengel& Boles, Tata McGraw-Hill, New Delhi
3. Thermodynamics by J.P. Holman, Tata Mc Graw-Hill.
4. Thermodynamics – Theory & Application by Robert Balmer, Jaico publication house.
5. Fundamentals of Thermodynamics by Sonntag, Borgnakke& Van wylen, John Wiley & sons (ASIA) PVT. LTD.
6. Engineering Thermodynamics by Gordon Rogers and Yon Mayhew, Pearson Education Ltd.
7. Engineering Thermodynamics byKrieth, CRC Press.

Course Outcomes:

After learning the course the students should be able to

1. Understand the knowledge about and basic laws of Thermodynamics with their applications.
2. Utilize the information about Available energy and unavailable energy with thermodynamic relations.
3. Gain the knowledge and basic idea about different power cycles.
4. Learn the knowledge regarding combustion of fuel and amount of heat liberated from the fuels and also about different properties of gases and mixture.

Tutorials:
Tutorial classes may be arranged as per the requirements of the subject.

Design based/open ended problem
Student may be given a task to exhibit the knowledge of the course studied during the academic year.

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.