GUJARAT TECHNOLOGICAL UNIVERSITY

BIOTECHNOLOGY (04)

THERMODYNAMICS
SUBJECT CODE: 2130405
B.E. 3rd Semester

Type of course: Biotechnology

Prerequisite: None

Rationale: The basic aim of this subject is to provide a clear understanding to the students about the laws of thermodynamics, its allied concepts and calculation of various quantities which predict the behaviour of various systems.

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		
3	1	0	4	70	20	10	30	0	20	150

Contents:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	INTRODUCTION : The scope of thermodynamics, Dimensions and units, Measures of amount or size, Force, temperature, pressure, work, energy, heat, etc.	5	40
2	THE FIRST LAW AND OTHER BASIC CONCEPTS : Internal Energy, Enthalpy, The first law of thermodynamics, Energy balance for closed systems, Equilibrium state, The Phase rule, The reversible process, Constant volume and constant pressure processes, Heat capacity, Application of first law of thermodynamics to steady state flow process, Mass and energy balance for open systems.	8	
3	VOLUMETRIC PROPERTIES OF PURE FLUIDS : PVT behavior of pure substances, Ideal and non-ideal gases, Equation of states, Virial, Cubic, Vanderwaals EOS etc., Calculation of constants in terms of Pc, Tc, Vc etc.	10	
4	HEAT EFFECTS: Sensible heat effects, Temperature dependence of the heat capacity, Latent heats of pure substances, Approximate methods for the estimation of the latent heat of vapourization, Standard heat of reaction, Standard heat of formation, Standard heat of combustion.	8	60
5	SECOND LAW OF THERMODYNAMICS: Statements of second law of thermodynamics, Heat engines, Concept of entropy. Introduction to third law	9	

	of thermodynamics.		
6	THERMODYNAMICS PROPERTIES OF FLUIDS: The fundamental property relations for homogeneous phases, Maxwell's equations, Mathematical relations among thermodynamic properties, Thermodynamic diagrams.	6	
7	REFRIGERATION: Carnot refrigerator, Vapour compression cycle, Absorption refrigeration, Choice of refrigerant, Heat pump.	8	

Reference Books:

1. "Introduction to Chemical Engineering Thermodynamics"; J. M. Smith, H. C.Van Ness, M. M. Abbott, the McGraw-Hill Companies, Inc.
2. "Chemical, Biochemical and Engineering Thermodynamics"; S.I. Sandler, Wiley India Edition.
3. "A text book of Chemical Engineering Thermodynamics"; K. V. Narayanan, Prentice-Hall of India Pvt. Ltd.
4. "Chemical and Process Thermodynamics"; B.G. Kyle, Prentice-Hall Inc.
5. "Introduction to Thermodynamics"; Y.V.C. Rao, 2nd Edition, Wiley Eastern Limited.

Course Outcome:

After learning the course, the students should be able to:

1. Develop a fundamental understanding of the basic principles of thermodynamics and calculations.
2. Examine and select pertinent data, and solve energy transformations problems.
3. Give examples of important application of thermodynamics laws in Bio processes.

List of Open Source Software/learning website:

- Students can refer to video lectures available on the websites including NPTEL.
- Students can refer to the CDs which are available with some reference books for the solution of problems using softwares. Students can develop their own programs for the solutions of problems.

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.