

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E Semester: 3

Bio-Technology

Subject Code 130405

Subject Name THERMODYNAMICS

Sr.No	Course content
1.	INTRODUCTION : The scope of thermodynamics, Dimensions and units, Measures of amount or size, Force, temperature, pressure, work, energy, heat, etc.
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.
3.	VOLUMETRIC PROPERTIES OF PURE FLUIDS : PVT behaviour of pure substances, Ideal and non-ideal gases, Equation of states, Virial, Cubic EOS, Vanderwaals, Berthelot equation etc., Calculation of constants in terms of P_c , T_c , V_c , , Calculations for different types of processes, viz. isobaric, isothermal, isochoric, adiabatic, polytropic, etc. Generalized correlations for gases and Liquids.
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, Temperature dependence of ΔH° , Heat effects of industrial reactions.
5.	SECOND LAW OF THERMODYNAMICS: Statements of second law of thermodynamics, Heat engines, Concept of entropy, entropy change of an Ideal Gas and irreversibility, Introduction to third law of thermodynamics.
6.	THERMODYNAMICS PROPERTIES OF FLUIDS: The fundamental property relations for homogeneous phases, Maxwell's equations, Mathematical relations among thermodynamic properties, Two phase systems, Temperature dependence of the vapour pressure of liquids, Thermodynamic diagrams.

7.	REFRIGERATION: Carnot refrigerator, Vapour compression cycle, Absorption refrigeration, Choice of refrigerant, Heat pump
8.	REACTION EQUILIBRIA: Reaction coordinate, Criteria of reaction equilibrium, Conversion X_e and equilibrium constant, effect of temperature and pressure on K , Evaluation of K by various methods, Evaluation of X_e , Analysis of some important reactions, Introduction to liquid phase and heterogeneous reactions, Multireaction equilibria.
9.	PHASE EQUILIBRIA: Vapour/Liquid Equilibrium (VLE) Introduction, Simple models for VLE, Dewpoint and bubblepoint calculations with Raoult's law, Modified Raoult's law, etc.

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.