Subject Code: 01CH0251

Subject Name: Chemical Engineering Thermodynamics-I

B.Tech. Year - II

Objective: To impart knowledge of Thermodynamics required to understand and design systems which exchange heat and work and to understand the conversion of one form of energy to another.

Credits Earned: 4 Credits

Course Outcomes: After completion of this course, student will be able to:

1. Inculcate a basic understanding of the fundamental principles of chemical engineering thermodynamics and its laws.
2. Examine and select data, and solve energy transformations problems.
3. Give examples of important application of thermodynamics laws in chemical engineering and biotechnology processes

Pre-requisite of course: Basic Physics, Chemistry & Mathematics

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	CSE	Internal (I)	Viva (V)	Term work (TW)	
4	2	0	4	50	20	30	25	25	150

Contents:

Unit	Topics	Contact Hours
1	**Introduction & First Law of Thermodynamics** Dimensions and units, Heat, Work, Internal Energy, Enthalpy, The first law of thermodynamics, Energy balance for closed systems, Equilibrium, The Phase rule, The reversible process, Heat capacity, Application of first law of thermodynamics.	8
2	**Volumetric Properties of Pure Fluids** PVT behaviour of ideal-pure substance, Gases: Ideal and non-ideal, Equation of states, Virial, Cubic, Vander waals EOS, Redlich/Kwong (RK) EOS etc., Calculation of constants in terms of critical Temp, Pressure, Volume. Generalized Correlations for liquids & gases.	8
3	**Heat Effects & Second Law of Thermodynamics** Sensible heat effects, Heat capacity & its Temperature dependence, Latent heats of pure substances, Approximate methods for the estimation of the latent heat of vaporization, Standard heat of formation, Standard heat of reaction, Standard heat of combustion, Temperature Dependence of ΔH^{o}. Statements of second law of thermodynamics, Heat engines, Thermodynamic Temperature Scales, Concept of entropy. Entropy change in an Ideal Gas, Introduction to Third law of thermodynamics.	14
4	**Thermodynamic Properties of Fluids** Maxwell's equations, entropy and enthalpy as functions of Temp. and Pressure, Internal energy as a function of Pressure, internal energy and entropy as function of Temp. & Volume. Two-phase systems: temperature dependence of the vapour pressure of liquids, two-phase vapour/liquid systems. Thermodynamic diagrams. Thermodynamic properties Table.	12
5	**Systems having Variable Composition** Ideal behaviour: ideal gas mixtures, ideal solution, fundamental property relationships, chemical potential and phase equilibria.	4
	Total Hours	**46**

Reference Books:

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

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
25%	35%	20%	15%	5%	-

Instructional Method:

a. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
b. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
c. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
d. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

Online Web Resources:

1. http://nptel.ac.in/courses/103101004/
2. https://ocw.mit.edu/courses/chemical-engineering/10-40-chemical-engineering-thermodynamics-fall-2003/
3. https://sites.google.com/site/chemicalenggthermo/learning-resources