Subject Code: 01CH1401

Subject Name: Chemical Engineering Thermodynamics-I

B.Tech. Year: II (Semester IV)

Objective: To impart knowledge of thermodynamics required to understand and design systems which can exchange heat and work.

Credits Earned: 4 Credits

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

1. Understand basic concepts of various laws of thermodynamics.
2. Apply the first and second law of thermodynamics to chemical processes.
3. Estimate heat and work requirements for industrial processes.
4. Compute the volumetric and thermodynamic properties of fluids.

Pre-requisite of course: None

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	IA (I)	CSE (C)	Viva (V)	Term work (TW)	
3	1	0	4	50	30	20	25	25	150

Contents:

Unit	Topics	Contact Hours
1	**First Law of Thermodynamics** Basic of Thermodynamics, First law of thermodynamics - energy balance for closed systems, First law for open systems, Application of first law of thermodynamics to steady state flow process.	**8**
2	**Volumetric Properties of Pure Fluids** PVT behavior of pure substances, Ideal and non-ideal gases, Equation of states, Virial Cubic, Vanderwaals EOS, Redlich/Kwong (RK) EOS etc., Calculation of constants in terms of Pc, Tc, Vc. Generalized Correlations for gases and liquids.	**10**

3	**Second and Third Law of Thermodynamics** Statements of second law of thermodynamics, Heat engines, Heat pump, Carnot cycle, Vapor compression cycle, Absorption refrigeration, Choice of refrigerant, Thermodynamic Temperature Scales, Concept of entropy, Entropy changes of an Ideal Gas, Third law of thermodynamics	**12**
4	**Thermodynamic Properties of Fluids** Fundamental property relations for homogeneous phases, Maxwell's equations, Residual properties, Mathematical relations among thermodynamic properties, Two phase systems, Joule-Thomson expansion, Thermodynamic diagrams.	**8**
	Total Hours	**38**

List of Tutorials:

1. Numerical based on First law of thermodynamics.
2. Numerical based on isothermal, isobaric, isochoric processes.
3. Numerical based on polytropic processes.
4. Numerical based on volumetric properties of pure fluid using different equation of state viz., Vanderwaals equation, Redlich/Kwong equation etc.
5. Numerical based on second law of thermodynamics.
6. Numerical based on thermodynamic cycles.
7. Numerical based on enthalpy and entropy change in a process based on Maxwell relations.
8. Numerical based on residual properties.
9. Numerical based on Joule-Thomson expansion

References:

1. "Introduction to Chemical Engineering Thermodynamics"; J. M. Smith, H.C., McGraw-Hill Education, 2005
2. "A text book of Chemical Engineering Thermodynamics"; K. V. Narayanan, Prentice-Hall of India Pvt. Ltd., 2004
3. "Chemical and Process Thermodynamics"; B.G. Kyle, Prentice-Hall Inc., 2006
4. " Introduction to Thermodynamics"; Y.V.C. Rao, 2nd Edition, Wiley Eastern Limited, 2004

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
20%	30%	30%	20%	-	-

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

Design Based Problems (DP)/ Open Ended project (OEP) :

In the beginning of the session, subject faculty will allot an OEP / DP to the students. Students will be free to choose a topic of their choice which will be relevant to the syllabus and they will either prepare a working model/ report / presentation / poster on their topic.

Web Resources:

a. https://nptel.ac.in/courses/103103144
b. https://nptel.ac.in/courses/103104151
c. https://www.coursera.org/learn/thermodynamics-intro#syllabus