Subject Code: 01CH0503
Subject Name: Chemical Engineering Thermodynamics-II
B.Tech. Year – III (Semester-V)

Objective:- To impart knowledge of Chemical Engineering Thermodynamics principles to various chemical processes as well as concepts of multiphase equilibrium in pure and multicomponent systems. Starting with ideal solutions to fugacity and activity coefficient as well as chemical reaction systems are also considered

Credits Earned: 4 Credits

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

1. Inculcate a basic understanding of the applications of fundamental principles of chemical engineering thermodynamics and its laws.
2. Calculations of various phase and reaction equilibrium.
3. Estimation of thermodynamic properties fugacity and activity coefficient
4. Learn basic concepts of liquid solution properties

Pre-requisite of course: Knowledge of Chemical Engineering Thermodynamics-I

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	2	0	4	50	30	20	25	25	150

Contents:

Unit	Topics	Contact Hours
1	**Properties of solutions** Partial molar properties, Fugacity and fugacity coefficient, Activity and activity coefficients, Gibbs-Duhem equations, Property change of mixing, Excess properties	8

2	**Vapor-liquid equilibrium** Criteria for equilibrium between phases, chemical potential and fugacity, Phase rule, Duhem's theorem, Pxy and Txy diagrams for homogeneous systems Simple models for VLE, Raoult's law, Dew point and bubble point calculations with Raoult's law for binary mixtures, VLE by modified Raoult's law, VLE from K-value correlations, flash calculations. Activity coefficient and its estimation from VLE data: van Laar equation, Margulus equation	14
3	**Phase Equilibra** Gamma/phi formulations for VLE, VLE from cubic equations of state, Equilibrium and stability, Liquid-liquid-equilibrium	6
4	**Chemical reaction equilibra** Reaction coordinate, application of equilibrium criteria to chemical reactions, standard Gibbs-energy change and the equilibrium constant, Effect of temperature on the equilibrium constant, evaluation of equilibrium constants Relation of equilibrium constants to composition: gas-phase reactions liquidphase reactions, equilibrium conversions for single reactions in homogeneous phase.	8
	Total Hours	**36**

Tutorials:

1. Determination of fugacity using different method
2. Determination of Vapor-liquid equilibrium
3. Determination of VLE from cubic equations of state
4. Determination of equilibrium constants
5. Determination of relation of equilibrium constants to composition

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:

a. http://nptel.ac.in/courses/103101004/

b. https://ocw.mit.edu/courses/chemical-engineering/10-40-chemical-engineering-thermodynamics-fall-2003/

c. https://sites.google.com/site/chemicalenggthermo/learning-resource\

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.