BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE-PILANI, HYDERABAD CAMPUS
FIRST SEMESTER 2020-2021
COURSE HANDOUT (PART-II)

17-08-2020

In addition to Part I (General Handout for all courses appended to the Time Table), this portion gives further specific details regarding the course.

Course No. : CHE F213
Course Title : Chemical Engineering Thermodynamics
Instructor-in-Charge : D. Purnima
Instructor : D. Purnima

1. Course Description:
Development and applications of the combined first and second laws; relations between state properties; chemical equilibria in reacting and non-reacting systems; statistical concepts, and brief exposure to irreversible thermodynamics; extensive problem assignments throughout.

2. Scope & Objective:
The purpose of this course is to provide a comprehensive treatment of thermodynamics (maintaining the standard of rigor demanded by sound thermodynamic analysis) from a chemical engineering viewpoint. The most important problems the chemical engineer must be able to cope with will be emphasized, viz. heat and work requirements for many physical and chemical process, determination of equilibrium constants for chemical reactions and for the transfer of chemical species between phases.

Learning objectives:
- Student will be able to estimate the energy requirements for various processes taking place in chemical engineering and also able to evaluate the feasibility of a process.
- Able to predict the PVT behavior for various substances which deviate from ideal behavior
- Able to predict to predict the phase behavior of ideal and non-ideal systems
- Able to study the reaction equilibrium

3. Text Book:
J. M. Smith, and H.C. Van Ness, "Intro to Chemical Engineering Thermodynamics", TMH, 7th ed.,2005.

Reference Books:
YVC Rao, "Chemical Engineering Thermodynamics", Universities Press, 1997.
KV Narayanan, "A Textbook of Chemical Engineering Thermodynamics". Prentice Hall of India, 2001.

4. Course Plan:

Lecture No.	Learning Objectives	Topics to be covered	Reference/Ch./ Sec.#(Book)
1	Introduction	Scope and Objectives of course, methodology	Chap. 1
2 – 4	First Law of Thermodynamics: Basic Concepts	First law, Closed System, State and State functions Equilibrium, Phase rule, Reversible Process, Const-V and Const-P Processes Enthalpy, heat capacity, First law for Open systems	2.1 to 2.12
5 – 8	Volumetric Properties of Pure Fluids	PVT behaviour of pure substances, Virial Equations, Ideal gas, Applications of Virial Equations, Cubic Equations of State, Generalized correlations for gases and liquids	3.1 to 3.7
9 – 11	Heat Effects: Heat of reaction	Sensible heat effects, Latent heat Standard heats of reaction, formation, combustion Temperature dependence of $\Delta H°$, heat effects of industrial reactions.	4.1 to 4.7

12 – 16	Second Law: Entropy and Third Law	Statements of second law, Heat engines, Thermodynamic temperature Scale, Entropy, ΔS for an ideal gas, Entropy balance for Open Systems, Ideal work, Lost work, Third law .	5.1 to 5.10
17 – 21	Thermodynamic Properties of Fluids	Property relations for homogeneous phases, Residual properties and their calculations by cubic equations Two-phase systems, thermodynamic diagrams and tables Generalized property correlations for gases.	6.1 to 6.7
22 – 24	Applications of Thermodynamics to Flow Processes	Duct flow of compressible fluids, Expansion Processes, Compression Processes.	7.1 to 7.3
25 – 28	Introduction to vapour/liquid Equilibrium	Nature of Equilibrium, Phase rule, Duhem's theorem VLE; Qualitative behaviour, Simple models for VLE VLE by Modified Raoult's law, K-value correlations	10.1 to 10.6
29 – 33	Basic concepts of Solution Thermodynamics: Theory	Fundamental Property Relation, Chemical potential and Phase equilibrium, Partial Properties, Ideal gas mixtures, Fugacities of pure species, Fugacities of Species in solution, Generalized Correlations, Ideal Solution, Excess Properties	11.1 to 11.9
34 – 37	Solution Thermodynamics: Applications	Liquid-phase properties from VLE data, Activity coefficients from VLE data, Models for Excess Gibbs energy, Property changes of Mixing, Heat effects of Mixing processes	12.1 to 12.4
38 – 43	Chemical Reaction Equilibria	Reaction coordinate, Equilibrium criteria for chemical reactions, Equilibrium constants and their variation with temperature, Evaluation of Equilibrium constants, Relation of Equilibrium Constants with Compositions, Equilibrium conversions for Single Reactions, Phase Rule and Duhem's theorem for Reacting Systems and Multireaction Equilibria	13.1 to 13.9

5. Evaluation Scheme:

EC No.	Evaluation Component	Duration	Weightage %	Date, Time	Remarks
1.	Test I	30 min	15	September 10 –September 20 (During scheduled class hour)	OB
2.	Test II	30 min	15	October 09 –October 20 (During scheduled class hour)	OB
3.	Test III	30 min	15	November 10 – November 20 (During scheduled class hour)	OB
4.	Assignments		20		OB
5.	Comprehensive exam	2hrs	35	TBA	OB

Chamber Consultation Hour: To be announced in the class.

Notices: All notices concerning this course will be displayed in CMS

Make-up Policy: Make-up for the test may be granted with prior permission from Instructor-in-charge.

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

D.Purnima

Instructor-in-charge of CHE F213