CH2351 Chemical Engineering Thermodynamics II

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Introduction to the Course

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Questionnaire (Duration: 15 min)

1. What is the maximum efficiency of a thermal power plant working between temperatures of 350°C and 30°C ?
2. During Joule-Thompson expansion of an ideal gas, temperature of the gas _____ (decreases / increases / remains constant).
3. Work required for compression will be _____ (more/ less) for isentropic compression over irreversible adiabatic compression.
4. What do you mean by **1 ton** Air Conditioner ?
5. Write few sentences about **Ice House** in Chennai.
6. 1 liter of ethanol and 1 liter of water are mixed at constant temperature and pressure. What is the expected volume of the resultant mixture ?
7. Two components ***A*** (normal boiling point: 100°C), and ***B*** (normal boiling point: 60°C) are present in a liquid mixture in equal molar amounts. The mixture is heated, and the vapor and liquid are in equilibrium. In the vapor the mole fraction of ***A*** will be _____ (more than / less than / same as) that of ***B***.
8. Why is the reaction $N_2 + 3H_2 = 2NH_3$ carried out at high pressure?

About this Course

- This part of thermodynamics deals with topics of thermodynamics principles of refrigeration, phase equilibria, reaction and equilibria.
- Refrigeration is a one of the common utilities in chemical industries and also has growing importance in our day-to-day life
- Phase equilibria finds application in distillation, absorption, and liquid-liquid extraction (Mass Transfer)
- Reaction Equilibria finds application in estimating the maximum possible conversion in chemical reactions (Reaction Engineering)
- The concepts of PVT, thermodynamic properties of pure components, heat engine, entropy will form the basis for understanding this course.

Syllabus – CH 2351 (4 credit)

- *UNIT I Properties of Solutions:* (10)

  Partial molar properties, ideal and non-ideal solutions, standard states definition and choice, Gibbs-Duhem equation, excess properties of mixtures.

- *UNIT II Phase Equilibria:* (14)

  Criteria for equilibrium between phases in multi component non-reacting systems in terms of chemical potential and fugacity, application of phase rule, vapour-liquid equilibrium, phase diagrams for homogeneous systems and for systems with a miscibility gap, effect of temperature and pressure on azeotrope composition, liquid-liquid equilibrium, ternary liquid-liquid equilibrium.

- *UNIT III Correlation and Prediction of Phase Equilibria:* (12)

  Activity coefficient-composition models, thermodynamic consistency of phase equilibria, application of the correlation and prediction of phase equilibria in systems of engineering interest particularly to distillation and liquid extraction processes.

- *UNIT IV Chemical Reaction Equilibria:* (14)

  Definition of standard state, standard free energy change and reaction equilibrium constant, evaluation of reaction equilibrium constant, prediction of free energy data, equilibria in chemical reactors, calculation of equilibrium compositions for homogeneous chemical reactors, thermodynamic analysis of simultaneous reactions.

- *UNIT V Refrigeration:* (10)

  Principles of refrigeration, methods of producing refrigeration, liquefaction process, coefficient of performance, evaluation of the performance of vapour compression and gas refrigeration cycles.

Order of Coverage

0.	Introduction	1
1.	Refrigeration (and Power plant cycle)	12
2.	Properties of Solutions	15
3.	Phase Equilibria (qualitative)	14
4.	Phase Equilibria (calculations)	8
5.	Chemical Reaction Equilibria	10

Total: **60** hrs

Text Books

- Smith, J.M., Van Ness, H.C., & Abbot M.C, "Introduction to Chemical Engineering Thermodynamics", McGraw Hill VII Edition 2004.

- Narayanan K.V "A Text Book of Chemical Engineering Thermodynamics" Prentice Hall of India Pvt. Ltd. 2001.

Reference Books

- Sandler, S.I., "Chemical and Engineering Thermodynamics 2nd edn.", Wiley, 1989.
- O'Connell, J.P, and Haile, J.M - Thermodynamics Fundamentals for Applications, Cambridge University Press, 2005, UK.
- Hougen, O.A., Watson, K.M., and Ragatz, R.A., "Chemical Process Principles Part II, Thermodynamics", John Wiley 1970.
- Dodge, B.F., "Chemical Engineering Thermodynamics", McGraw-Hill, 1960.

Instructor's Expertise

- Handled this subject 4 times
  - Two times at SSN: 2011-12, 2012-13
  - Two times at SVCE: 2001-02 and 2003-04