Scheme - I

Sample Question Paper

Program Name : **Diploma in Chemical Engineering**
Program Code : **CH**
Semester : **Fourth**
Course Title : **Chemical Engineering Thermodynamics**
Marks : **70** **Time: 3 Hrs.**

22406

Instructions:

(1) All questions are compulsory.

(2) Illustrate your answers with neat sketches wherever necessary.

(3) Figures to the right indicate full marks.

(4) Assume suitable data if necessary.

(5) Preferably, write the answers in sequential order.

Q.1) Attempt any FIVE of the following. **10 Marks**

a) Define cyclic process.

b) Define reversible process.

c) State first law of thermodynamics and give the mathematical statement.

d) Give the expression for C_p and C_v

e) Give the expression showing the temperature dependency of heat capacity.

f) State Gibb's phase rule.

g) Define standard entropy.

Q.2) Attempt any THREE of the following. **12 Marks**

a) Define state function and path function with two examples each.

b) Prove that $C_p - C_v = R$ for an ideal gas.

c) A given mass of gas at 0^oC is compressed reversibly and adiabatically to a pressure 20 times the initial value. Calculate the final temperature of the gas. Specific heat ratio of the gas (γ) is 1.42

d) Assuming that air is a mixture of 21% oxygen and 79% nitrogen by volume, calculate entropy of 1 kilo mole of air relative to pure oxygen and nitrogen, all at the same temperature and pressure

Q.3) Attempt any THREE of the following. **12 Marks**

a) Define system, open system, closed system and isolated system.

b) Calculate ΔU and ΔH in kJ for 1kmol water as it is vaporised at temperature of 373K and constant pressure of 101.3kPa. The specific volume of liquid and vapour at these conditions are 1.04×10^{-3} and 1.675 m^3/ kmol respectively. 1030kJ of heat is added to water for this change.

c) State Clausius inequality. Give the expression for reversible and irreversible process.

d) Calculate the increase in entropy of 3 mol of an ideal gas as it changes from 27^oC at 0.2 atm to $727\ ^oC$ at 2 atm. C_p = 7 cal /mol K

Q.4) Attempt any THREE of the following. **12 Marks**

a) Give the Van der Waals equation for real gases and give the value of constants

b) Calculate the entropy of water vapour at 473 k and 101.3kPa starting from water at 273K. The average heat capacity of water is 4.2kJ /kg K and water vapour is 1.9kJ/kg K. Latent heat of vaporisation is 2257kJ/ kg.

c) One mol of an ideal mono-atomic gas expands reversibly from a volume of 10 litres and temperature 298K to a volume of 20 litres and temperature 250 K.
Assuming Cv = 3/2R. Calculate entropy change for the process.

d) Derive the relation between Kp and Ky.

e) Based on Van't Hoff equation, explain why temperature increase is not desirable for exothermic reaction

Q.5) Attempt any TWO of the following. **12 Marks**

a) Explain Joule-Thomson porous plug experiment.

b) Explain P-H thermodynamic diagram

c) Calculate Kp for ammonia synthesis at a total pressure of 30 atm at 400^oC. Reaction is $N_2 + 3H_2 \leftrightarrow 2NH_3$. Percentage of ammonia at equilibrium is 10%.

Q.6) Attempt any TWO of the following. **12 Marks**

a) Explain P-T diagram for a pure substance.

b) Draw the phase diagram for sulphur system and explain.

c) For the reaction, $2NaHSO_4 \leftrightarrow Na_2S_2O_7 + H_2O$, ΔH at 298 K = 19800cal, ΔG at 298 K = 9000cal. Assuming ΔH to be constant, calculate the dissociation pressure of the reaction at 700K.

Scheme - I

Sample Test Paper - I

Program Name : **Diploma in Chemical Engineering**
Program Code : **CH**
Semester : **Fourth**
Course Title : **Chemical Engineering Thermodynamics**
Marks : **20**

22406

Time: 1 Hour.

Instructions:

(1) All questions are compulsory.

(2) Illustrate your answers with neat sketches wherever necessary.

(3) Figures to the right indicate full marks.

(4) Assume suitable data if necessary.

(5) Preferably, write the answers in sequential order.

Q.1 Attempt any FOUR. **08 Marks**

a) List the type of system based on i) flow of mass and energy across boundary
ii) Composition

b) Define phase.

c) Define degree of freedom.

d) Give the sign convention for work done.

e) Define heat capacity.

f) Give the equation for work done in isothermal process for an ideal gas

Q.2 Attempt any THREE. **12 Marks**

a) Prove that work is a path function.

b) Define thermal equilibrium, chemical equilibrium, mechanical equilibrium and thermodynamic equilibrium.

c) Heat is transferred to 10 kg of air which is initially at 100 KPa and 300K until the temperature reaches 600K.Determine the change in internal energy, change in enthalpy, heat supplied and work done for constant volume process.

d) Explain stable, unstable and metastable equilibrium.

e) Explain the phase diagram for water system

f) Define Gibb's phase rule. Evaluate degree of freedom for i) an aqueous solution of glucose ii) a mixture of $H_{2(gas)}$, $O_{2(gas)}$ and $H_2O_{(gas)}$

Scheme - I

Sample Test Paper - II

Program Name : **Diploma in Chemical Engineering**
Program Code : **CH**
Semester : **Fourth**
Course Title : **Chemical Engineering Thermodynamics**
Marks : **20**

22406

Time: 1 Hour.

Instructions:

(1) All questions are compulsory.

(2) Illustrate your answers with neat sketches wherever necessary.

(3) Figures to the right indicate full marks.

(4) Assume suitable data if necessary.

(5) Preferably, write the answers in sequential order.

Q.1 Attempt any FOUR. **08 Marks**

a) Give the Vander Waals equation for real gases.

b) Define entropy. Give its unit.

c) Give the equation for entropy change during vaporization

d) State third law of thermodynamics.

e) State Lechatelier's principle.

f) Define law of mass action.

Q.2 Attempt any THREE. **12 Marks**

a. One kilo mol of CO_2 occupies a volume of $0.381 m^3$ at 313 K. Compare the pressure given by i) ideal gas equation ii) Vander Waals equation.
Vander Waals constants $a = 0.365\ Nm^4/mol^2$ and $b = 4.28 \times 10^{-5}\ m^3$ / mol.

b. Derive the relation between ΔG and K.

c. Give the statements of second law of thermodynamics.

d. Derive the expression for entropy change for of an ideal gas in terms of temperature and volume.

e. Derive the relation between Kp and Kc.

f. Give the Van't Hoff equation and explain the terms.