Programme: B.Sc. Degree in Chemical Engineering

Session: 2013 – 14
Level: 1
Date: 15 January 2014

Semester: A
Duration: Two Hours
Max Marks: 100

ENCH 203: Chemical Engineering Principles

Candidates should attempt ANY FOUR Full Questions

Please read the Questions carefully

Materials to be Supplied/Allowed:
Question paper (Supplied)
Blank Examination Script (Supplied)
Non-programmable calculator (Allowed)
Q1(a) Mention any five aspects of the Chemical Industry dealt by a Chemical Engineer. [5]

(b) In the following reaction

$$\text{NaCl} + \text{HNO}_3 \rightarrow \text{NaNO}_3 + \text{HCl}$$

(i) Calculate the weight of NaCl required to react with 12 kg of HNO$_3$. [8]

(ii) Calculate the weight of NaCl required to obtain 13.5 kg of NaNO$_3$? [8]

Given: The atomic masses of Na, Cl, H, N and O are 23, 35.5, 1, 14 and 16 g/mol respectively.

(c) Justify the Significance of Differential Balance. [4]

Q2(a) Describe the following with respect to a Thermodynamic System.

(i) Thermodynamic System [4]

(ii) Closed System [4]

(iii) Surrounding [4]

(b) If water at 165 °C and 987 kPa has an internal energy of 742 kJ/kg and a specific volume of 1.138 cm$^3$/g. Calculate its enthalpy? [6]

The water is brought to the vapor state at 298 °C and 1480 kPa where its internal energy is 2783.4 kJ/kg and its specific volume is 171.7 cm$^3$/g. Calculate $\Delta U$ and $\Delta H$ for the process. [7]

Q3(a) What is Mach Number and how is it measured? [4]

(b) How Mach Number can affect Flow of Fluids in the following cases.

(i) Compressible Fluid [4]

(ii) Incompressible Fluid [4]
(c)  
(i) Explain Laminar and Turbulent flow of fluids by Reynolds experiment.  
(ii) Draw suitable figures.  
(iii) How the fluid flow is affected by Reynolds Number?  

Q4(a) Describe the following types of Convection with suitable examples.  
(i) Natural Convection  
(ii) Forced Convection  

(b) Explain the following three modes of Heat Transfer  
(i) Conduction  
(ii) Convection  
(iii) Radiation  

Q5(a) What is Mass Transfer? How it occurs in a mixture containing different species?  

(b) Discuss the following Mass Transfer operations  
(i) Distillation  
(ii) Humidification  
(iii) Liquid – liquid extraction  

(c) Define Wein’s Law and give the relevant Equation.  

Q6(a) Explain the following units of concentration measurement and give their respective equations.  
(i) Molarity  
(ii) Molality  
(iii) Mole fraction  

(b) Explain mixed mechanism of heat transfer by Shell and Tube Heat Exchanger with a suitable diagram.
(c) Suggest an equation to relate the energy radiated by an object to its temperature and name the relevant law. [4]

End of Question Paper