RAJARATA UNIVERSITY OF SRI LANKA

FACULTY OF APPLIED SCIENCES

BSc in Applied Sciences
Third Year - Semester I Examination – July / August 2023

CHE 3206 – CHEMICAL AND PROCESS TECHNOLOGY

Time: Two (02) hours

Answer All Questions

1)
   a) Comment on the growth of the modern chemical industry.

      (08 marks)

   b) Discuss sulfuric acid manufacturing via the contact process, highlighting possible environmental hazards.

      (08 marks)

   c) State the key differences between the Lead chamber process and the Contact process in the production of sulfuric acid.

      (04 marks)

   d) Discuss the industrial uses of sulfuric acid and sodium hydroxide.

      (05 marks)

2)
   a) What is the meaning of "sustainable development"? How do you connect it to green technology? Critically discuss.

      (06 marks)

   b) State principles of green chemistry.

      (06 marks)

   c) Discuss the traditional and green chemical production of adipic acid. Summarize the benefits of the green chemical method of adipic acid production.

      (08 marks)

d) Account on Tetra-Amido Macrocyclic Ligand (TAML). Explain the environmental benefits of using TAML™ catalysts in wastewater treatment.

(05 marks)

3)

a) What is meant by diffusion? Sketch out a schematic diagram of diffusion occurring in heterogeneous catalytic reactions.

(05 marks)

b) Define following terms.
   i)   Non-steady state diffusion
   ii) Substitutional diffusion
   iii) Interstitial diffusion
   iv) Self-diffusion

(06 marks)

c) Mention Fick's first law of diffusion. Identify all the terms. List out the limitations.

(05 marks)

d) Given an 80% by volume ammonia gas diffusing across a 1.00 cm long section of tubing with a diameter of 1.00 cm, where the opposite end of the tubing has a 20% ammonia concentration, at a temperature of 25°C in the atmospheric pressure (P), and the diffusivity of ammonia in air under these conditions is $1.80×10^{-5}$ m^2s^{-1}.

Estimate the rate of diffusion of ammonia through the section of tubing.

$(R = 8.314 \ J \ mol^{-1}K^{-1}, P = 1.013 × 10^5$ Pa, Molecualr mass of $NH_3 = 17.03 \ gmol^{-1})$

(09 marks)

4)

a) Derive the general mole balance equation given below. Identify all the terms.

$$F_{jo} - F_j + \int_0^v r_j dv = \frac{dN_j}{dt}$$

(05 marks)

b) Write a brief account on Continuous flow reactors.

(06 marks)

c) Build up the mole balance equation for Continuous Stirred Tank Reactor (CSTR), Plug Flow Reactor (PFR) and for the Packed Bed Reactor (PBR). State all the assumptions.

(09 marks)

d) Write a short account on catalyst poisoning.

(05 marks)

- End -