INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

End-Autumn Semester Examination 2023-24

Date of Examination:_____ **Session: (FN/AN)**_____ **Duration: 3 Hrs** **Full Marks: 50**

Subject No. : CH30014 Subject: Chemical Process Technology

Department/Center/School: Chemical Engineering Department

Specific charts, graph paper, log book etc., required: Not applicable

Special Instructions (if any): Not applicable

The questions should be answered to the point. Irrelevant answers will not be marked. The answers of each part (A or B) should be written strictly under that part. Answers without the question numbers written will not be checked.

Part A

1. a) What is synthesis gas? [0.5]
   b) Name the process by which synthesis gas can be produced. Write the reaction equations. [0.5+1]
   c) Describe in brief the process of production of synthesis gas with reaction conditions and a block flow diagram. [3+2=5]
   d) How can the process be improved where no external heating of the reactor is required? [2]
   e) Name two chemicals that can be produced from synthesis gas. [1]

2. a) Write the reactions associated with methanol production (write the side reactions along with the main reaction). [1.5]
   b) What are the conditions which favour methanol production? [2]
   c) Write short description of the production of anhydrous ethanol process with a flow diagram of the process. [3+3=6]
   d) Write an important use of ethanol. [0.5]

3. a) Write the urea manufacturing reactions. [1]
   b) What are the processes by which urea solids are prepared? [3]
   c) What is the drawback of once through (one step) urea manufacturing process? [1]

Part B

4. a) Write down the name and chemical formula of the products formed post nitration of propane. What is double decomposition reaction? How can we get rid of coking operation? How to synthesize Cu-Ni bimetallic catalyst supported on alumina (write down the steps)? [1+0.5+0.5+1.5]

P.T.O

5. (a) Write down different reaction steps involved in Finnish process. Write down the advantages of V_2O_5 based catalysts over Pt based catalysts for H_2SO_4 production. Describe the manufacturing of H_2SO_4 by contact process with a conceptual flow diagram (mention the T, P, catalyst, and the composition of inlet and outlet streams). What are the major engineering problems associated with contact process? What are the typical sources of SO_2 to be utilized in contact process? [0.5+1+3.5+0.5+1] 6.5

6. Differentiate between branched chain and gel polymers (write down the chemical reactions). Differentiate between high, intermediate, and low pressure processes for the manufacturing of polyethylene (write down the T, P, and catalyst). How to manufacture styrene butadiene rubber (write down the chemical reaction)? What is ring opening reaction? Write down the reactions involving the interactions between ethylene glycol and methanol. With a conceptual flow diagram describe the manufacturing of polyethylene by low pressure process (mention P, T, catalyst, other operating conditions and the composition of inlet and outlet streams.[1+1.5+1+0.5+0.5+3] 7.5

7. What is plat forming reaction? Write down different reactions involved in plat forming process. Describe plat forming operation with the help of a process flow diagram. What type of feed one should use for hydro cracking operation? Write down different reactions involved in hydro cracking operation. Describe hydrocracking operation with a conceptual flow diagram. How to remove nitrogen, oxygen and sulfur containing impurities from a feed stock? [0.5+1.5+3+1+1.5+3+1] 11.5 (10 + 10)