GUJARAT TECHNOLOGICAL UNIVERSITY

BE-6 SEMESTER – OLD PAPER – S22 TO W25 – QUESTION BANK

Subject Name & Code:

ADVANCE SEPARATION TECHNIQUE (3160507)

Unit 1: Fundamentals of Separation Processes

Repeated Questions:

1. Define separation factor and explain its importance / feasibility based on its value.
    - Q1(a). Define separation factor and its importance. (W24 - Q1a, 03 marks)
    - Q1(a). Define the term "separation factor". Also describe the feasibility of separation based on the different values of separation factor. (S25 - Q1a, 03 marks)
    - Q1(a). Explain Separation factor. (S24 - Q3a, 03 marks)
    - Q1(a). Explain Separation factor. (W22 - Q1a, 03 marks)
2. Differentiate between Equilibrium and Rate governed separation processes.
    - Q4(a). Define: (i) equilibrium governed separation and (ii) rate governed separation. (S22 - Q4a, 03 marks)
    - Q3(a). Explain Equilibrium & rate-governed separation. (W25 - Q3a OR, 03 marks)
    - Q2(a). Differentiate between equilibrium separation processes and rate- governed separation processes with appropriate examples. (S25 - Q2a, 03 marks)
3. Discuss the drawbacks of conventional separation processes and the need for advanced separation processes.
    - Q1(c). Discuss drawbacks of the conventional separation processes. (W22 - Q1c, 07 marks)
    - Q3(a). List out the drawbacks of the conventional separation processes, and the need for advanced separation processes. (S24 - Q3a OR, 03 marks)
    - Q2(c). Discuss the drawbacks of the conventional separation processes and need for advanced separation processes. (S23 - Q2c, 07 marks)

Other Important Questions (Newest to Oldest):

1. Q1(b). Discuss the criteria for selecting an advance separation process over conventional process. (W24 - Q1b, 04 marks)
2. Q1(c). With suitable examples discuss importance of advanced separation processes over conventional separation processes in chemical industry. (S22 - Q1c, 07 marks)
3. Q1(c). Classify membrane separation processes based on driving force and also list the general characteristics. (W24 - Q1c, 07 marks)
4. Q2(c) OR. Explain the Separation factor, equilibrium, and rate governed separation. (S23 - Q2c OR, 07 marks)
5. Q1(c). List out the principal characteristics of novel separation techniques. (W25 - Q1c, 07 marks)

Unit 2: Membrane Separation Processes (RO, NF, UF, MF, Dialysis)

Repeated Questions:

1. List/Explain operating parameters for various membrane processes (RO, NF, UF, MF).
    - Q1(a). Write operating parameters of Ultrafiltration and Microfiltration membranes. (S24 - Q1a, 03 marks)
    - Q2(a). Write operating parameters of Ultrafiltration and Microfiltration membranes. (S23 - Q2a, 03 marks)
    - Q2(a). Write operating parameters of RO and NF membranes. (W22 - Q2a, 03 marks)
2. Explain the working principle and applications of Nanofiltration (NF).
    - Q2(b). Discuss working principle of nanofiltration and its industrial applications. (S22 - Q2b, 07 marks)
    - Q3(a). Explain concept and working of nanofiltration. (S25 - Q4a, 03 marks)
    - Q3(a). Explain concept and working of nanofiltration. (W23 - Q3a OR, 03 marks)
    - Q2(c) OR. Discuss working principle of Nanofiltration membrane & write industrial applications for Nanofiltration membrane. (W22 - Q2c OR, 07 marks)
3. State the advantages of Reverse Osmosis (RO).
    - Q2(b). State four advantages of reverse osmosis. (W25 - Q3b, 04 marks)
    - Q3(b). State four advantages of reverse osmosis. (S22 - Q3b, 04 marks)
4. Describe a Spiral Wound Membrane Module.
    - Q3(c). Describe in brief a spiral wound membrane module. (W25 - Q3c, 07 marks)
    - Q4(a). Describe in brief a spiral wound membrane module. (W23 - Q4a, 03 marks)

Other Important Questions (Newest to Oldest):

1. Q1(a). Mention membrane pore size which is used in RO, MF, UF, and NF individually. (W25 - Q1a, 03 marks)
2. Q1(b). Differentiate the Reverse osmosis and Dialysis. (S24 - Q1b, 04 marks)
3. Q3(a). Define: Membrane fouling. If the pressure drop (ΔP) is 1000 units, the flux (J) is 50 units, what is the hydraulic membrane permeability? (S22 - Q3a, 07 marks)
4. Q5(a) Answer the followings: (i) What is the membrane that selectively allows certain species to pass through called? (ii) What is the value of standard design temperature of reverse osmosis systems? (iii) Calculate the recovery for the following data: Product Flow: $535 m^3/h$ Feed flow: $635 m^3/h$ (S22 - Q5a, 07 marks) [Numerical Question]
5. Q2(b). Discuss working principle of nanofiltration and its industrial applications. (S22 - Q2b, 07 marks)
6. Q3(b). Write advantages and limitations of membrane separation processes over conventional separation processes. (W23 - Q3b, 04 marks)
7. Q5(b). List out different working membrane modules and describe anyone in detail. (S24 - Q1c, 07 marks)
8. Q5(c). Enlist various membrane modules used for membrane separation processes and describe any two of them in detail. (S25 - Q5c OR, 07 marks)
9. Q2(b). Explain in brief working principle of membrane processes. (W22 - Q2b, 04 marks)
10. Q2(c). List out different membrane modules. Discuss anyone in detail. (W22 - Q2c, 07 marks)
11. Q4(a). Write three examples of concentration driven membrane process. (S22 - Q4a OR, 03 marks)
12. Q5(a). Draw a neat sketch of a cross- flow membrane process. (W23 - Q5a, 03 marks)
13. Q3(a). Draw labeled diagram of: (i) dead-end membrane filtration and (ii) cross- flow membrane filtration. (S22 - Q3a OR, 03 marks) [Diagram mentioned]
14. Q1(a). Write two examples of materials used as organic membrane and inorganic membrane. (S22 - Q1a, 03 marks)

Unit 3: Membrane Gas Separation, Pervaporation, Membrane Reactors

Repeated Questions:

1. Explain the concept and working of a Membrane Reactor.
    - Q3(c) OR. Explain the Concept and working of the Membrane Reactor. (S24 - Q2c OR, 07 marks)
    - Q3(c) OR. Explain the concept and working of a membrane reactor. (W25 - Q3c OR, 07 marks)
    - Q3(b). Explain concept and working of membrane reactor. (W23 - Q3b, 04 marks)
    - Q3(c). Explain the Concept & working of the Membrane Reactor. (S23 - Q3c OR, 07 marks)
2. List applications of Membrane Gas Separation.
    - Q2(b). List out four applications of membrane gas separation. (S23 - Q2b, 04 marks)
    - Q1(b). List out applications of membrane gas separation. (S24 - Q2b, 04 marks)
    - Q5(a). List out three industrial applications of membrane gas separation. (S22 - Q5a OR, 03 marks)
    - Q3(b). Discuss applications of membrane gas separation. (W22 - Q3b, 04 marks)
3. Explain the Hybrid Distillation-Pervaporation system.
    - Q2(c). Explain Hybrid distillation-pervaporation system. (S24 - Q2c, 07 marks)
    - Q3(c). Explain Hybrid distillation- pervaporation system. (W22 - Q3c, 07 marks)
    - Q2(c) OR. Describe the principle and its applications of hybrid distillation-pervaporation systems. (W25 - Q2c OR, 07 marks)
4. Explain the principle of Pervaporation.
    - Q3(a). Discuss the principle of pervaporation. (S23 - Q3a OR, 03 marks)
    - Q3(c) OR. Explain principle of pervaporation & list out different membranes used in pervaporation. (W22 - Q3c OR, 07 marks)
    - Q5(c). Explain working principle of pervaporation and enlist its various industrial applications. (S25 - Q5c, 07 marks)

Other Important Questions (Newest to Oldest):

1. Q5(c). Explain in detail about pervaporation separation. (S22 - Q5c, 07 marks)
2. Q4(b). Discuss Gas separation membranes. (S23 - Q3b OR, 04 marks)
3. Q3(a). Briefly describe gas separation using membranes. (W24 - Q3a, 03 marks)
4. Q4(b) OR. Depict production of absolute alcohol by pervaporation process. (W24 - Q4a OR, 07 marks)
5. Q4(b) OR. Describe membrane reactor and its application in gas separation. (W24 - Q4b OR, 07 marks)
6. Q4(b). List out various types of membrane used for membrane reactor. Explain anyone. (W22 - Q4b, 04 marks)
7. Q4(c). Explain principle of designing of gas separator membrane using complete mixing model. (W22 - Q4c, 07 marks)
8. Q4(c). Discuss membrane gas separator principal using complete mixing model. (S22 - Q4c OR, 07 marks)
9. Q2(b). Write short note on dialysis and electrodialysis. (W24 - Q3b, 04 marks)
10. Q1(b). Define: the Separation factor, Permeability. (W25 - Q1b, 04 marks)
11. Q2(e) OR. Explain the working principle of pervaporation and describe hybrid process for the production of absolute alcohol. (W23 - Q2e OR, 07 marks)
12. Q4(a). Classify the membrane process based on driving force. (W23 - Q4a OR, 03 marks)
13. Q4(c). Discuss in details various operating parameters for the evaluation of performance of membrane process. (W23 - Q4c OR, 07 marks)
14. Q5(c). Discuss in detail various engineering problems associated with usage of membranes. (W23 - Q5c, 07 marks)
15. Q5(b). Write short note on Membrane cleaning. (W23 - Q5b OR, 04 marks)

Unit 4: Reactive and Catalytic Distillation

Repeated Questions:

1. Explain the manufacturing of MTBE/ETBE by Reactive Distillation and compare with the conventional process.
    - **MTBE:**
        - Q3(a) OR. Describe the manufacturing process of MTBE by reactive distillation with a neat process flow sheet. (W24 - Q3a OR, 07 marks) [Diagram mentioned]
        - Q5(c). Describe the manufacturing of Methyl Tertiary Butyl Ether (MTBE). (W22 - Q4c, 07 marks)
        - Q5(c). Describe the manufacturing of MTBE by reactive distillation process. (S24 - Q5c OR, 07 marks)
    - **ETBE:**
        - Q4(c). Describe the manufacturing of ETBE by reactive distillation process and compare it with the conventional process. (W25 - Q4c, 07 marks)
        - Q3(c). Describe the manufacturing of ETBE by reactive distillation process and compare it with the conventional process. (S23 - Q4c, 07 marks)
        - Q3(c). Explain the manufacturing of ETBE using reactive distillation. Also explain the effect of various parameters on the performance of reactive distillation unit. (S25 - Q3c, 07 marks)
2. Discuss the advantages and disadvantages of Reactive/Catalytic Distillation.
    - Q4(b). Discuss advantage and disadvantage of reactive distillation. (W22 - Q4b, 04 marks)
    - Q5(a). List the advantages and disadvantages of reactive catalytic distillation. (W25 - Q5a, 03 marks)
    - Q3(c). List out five advantages and five limitations of reactive/catalytic distillation over conventional distillation. (S22 - Q3c OR, 07 marks)
    - Q5(a). List out the Advantages and Disadvantages of Reactive and catalytic distillation. (S24 - Q5a OR, 03 marks)
3. Explain the concept and working of a Short Path Distillation Unit (SPDU).
    - Q5(c). Discuss the concept and working of the Short Path Distillation Unit. (W25 - Q5c, 07 marks)
    - Q4(c) OR. Draw a neat sketch of the Short Path Distillation Unit (SPDU) and discuss the concept and working of SPDU. (S23 - Q4c OR, 07 marks) [Diagram mentioned]
    - Q5(c). Discuss the working mechanism of the Short Path Distillation Unit (SPDU). (S24 - Q5c, 07 marks)
    - Q4(c). Draw a labeled diagram of short path distillation unit (SPDU). (S22 - Q4c, 07 marks) [Diagram mentioned]
4. Discuss BALE and KATMAX packing for reactive/catalytic distillation.
    - Q5(b). Discuss with neat sketch: BALE and KATMAX packing for reactive and catalytic distillation. (W25 - Q5b OR, 07 marks) [Diagram mentioned]
    - Q4(b) OR. Discuss with a neat sketch: BALE and KATMAX packing for reactive and catalytic distillation. (S23 - Q4b OR, 04 marks) [Diagram mentioned]
    - Q5(b). Discuss the BALE and KATMAX packing. (S24 - Q5b OR, 04 marks)
    - Q2(b). Discuss with neat sketch: BALE and KATMAX packing for reactive and catalytic distillation. (W23 - Q2b, 04 marks) [Diagram mentioned]

Other Important Questions (Newest to Oldest):

1. Q3(b). List at least four industrial applications of reactive distillation technology. (S25 - Q3b OR, 04 marks)
2. Q5(a). Discuss with a neat sketch: BALE and KATMAX packing for reactive and catalytic distillation. (S25 - Q5a OR, 03 marks) [Diagram mentioned]
3. Q3(a). Explain the merits of reactive distillation over conventional technology (Reactor followed by distillation column). (S25 - Q3a, 03 marks)

4. Q3(c). Discuss about the various types of contacting devices use in Catalytic Distillation. (W23 - Q3c, 07 marks)
5. Q4(a). Define reactive and catalytic distillation. (W22 - Q4a, 03 marks)
6. Q4(a). Explain the concept of Reactive and Catalytic Distillation. (S23 - Q4a OR, 03 marks)
7. Q5(b). Discuss the concept of Reactive and Catalytic distillation. (S24 - Q5b, 04 marks)
8. Q1(c). Explain the various aspect of reactive and catalytic distillation over the conventional distillation. (W23 - Q1c, 07 marks)

Unit 5: Supercritical Extraction

Repeated Questions:

1. Explain the ROSE (Residuum Oil Supercritical Extraction) process with a flow diagram.
    - Q2(c) OR. Explain ROSE process with a neat flow sheet. (W24 - Q2c OR, 07 marks) [Diagram mentioned]
    - Q4(c) OR. Explain ROSE process with a neat flow diagram. (S25 - Q4c OR, 07 marks) [Diagram mentioned]
    - Q1(c). With the help of a detailed flow diagram explain the ROSE process for deasphalting. (W25 - Q1c, 07 marks) [Diagram mentioned]
    - Q4(c). Discuss the Residuum Oil Supercritical Extraction (ROSE) process in detail. (S24 - Q4c OR, 07 marks)
    - Q2(c). Explain with neat flow sheet Residuum Oil Supercritical Extraction (ROSE) process. (S22 - Q2c, 07 marks) [Diagram mentioned]
2. Explain the decaffeination of coffee using supercritical extraction.
    - Q2(c). Explain the Decaffeination of the Coffee process in detail. (S24 - Q4c, 07 marks)
    - Q4(c). With a flow sheet, explain the working of Kraft process for decaffeination of coffee. (S25 - Q4c, 07 marks) [Diagram mentioned]
    - Q2(c). Explain decaffeination of coffee with a neat diagram. (W24 - Q2c, 07 marks) [Diagram mentioned]
    - Q1(b). Discuss in detail the de-caffination process. (W23 - Q1b, 04 marks)
3. Discuss the properties of Supercritical Fluids / essential properties of a good supercritical solvent.
    - Q1(a). What are the essential properties of a good supercritical solvent? (S23 - Q1a, 03 marks)
    - Q4(b) OR. Discuss in brief the essential properties of a good supercritical solvent. (W23 - Q4b OR, 04 marks)
    - Q1(b). What are unique properties and solubility behaviour of supercritical fluids? (S22 - Q1b, 07 marks)
    - Q4(a). Enlist different properties of supercritical fluids. (W22 - Q3a OR, 03 marks)
4. Justify why CO_2 is the most preferred supercritical fluid solvent.
    - Q4(a) OR. Why CO2 is considered the most preferred as a supercritical fluid solvent? (S24 - Q4a OR, 03 marks)
    - Q1(b). Discuss why CO_2 is used as the most preferred supercritical fluid solvent. (S23 - Q1b, 04 marks)
    - Q1(b). CO_2 is most widely used super critical fluid for extraction-justify. (S22 - Q3b, Part of 07 marks)
    - Q5(a) OR. Discuss the properties of the supercritical fluid solvents and Discuss why CO_2 is used as the most preferred supercritical fluid solvent. (W25 - Q5a OR, 07 marks)

Other Important Questions (Newest to Oldest):

1. Q2(b). Enlist the superior properties and solubility behavior of supercritical fluids compared to conventional solvents. (W24 - Q2b, 04 marks)
2. Q5(c). Discuss commercial applications of supercritical extraction. (W22 - Q5c, 07 marks)
3. Q4(b). Discuss the Advantages of Supercritical fluid over Conventional Unit Operations. (S24 - Q4b, 04 marks)
4. Q4(a). Enlist any three advantages of supercritical extraction. (W22 - Q4a, 03 marks)
5. Q4(b). List out the application of Supercritical Extraction. (S24 - Q4b OR, 04 marks)
6. Q1(a). List the commonly used supercritical solvents. Why CO_2 is preferred? (W24 - Q1a, 03 marks)
7. Q5(c) OR. Discuss the Hydrothermal oxidation. (W25 - Q5c OR, 07 marks)
8. Q5(c). With the help of a detailed flowsheet explain the ROSE process for deasphalting by propane using supercritical extraction. Also list the advantages. (W23 - Q5c OR, 07 marks) [Diagram mentioned]

Unit 6: Chromatographic Separation

Repeated Questions:

1. Explain Thin Layer Chromatography (TLC) and/or Paper Chromatography.
    - Q5(c). Explain thin layer and paper chromatography. (S23 - Q5c, 07 marks)
    - Q5(b) OR. Describe thin layer and paper chromatography with a neat sketch. (W24 - Q5b OR, 07 marks) [Diagram mentioned]
    - Q3(c). Explain the Thin layer and paper chromatography. (S24 - Q3c OR, 07 marks)
    - Q5(b). What is principal and working of thin layer chromatography? (S22 - Q5b, 04 marks)
2. List/Explain the advantages and disadvantages of chromatographic separation.
    - Q5(c). List the advantages and disadvantages of chromatographic separation. (S23 - Q5c OR, 07 marks)
    - Q5(b). List out advantages and disadvantages of chromatographic separation processes. (W22 - Q5b, 04 marks)
    - Q3(b). List the advantages and disadvantages of chromatographic separation. (S24 - Q3b OR, 04 marks)
3. Explain the principle of chromatographic separation.
    - Q4(a). Discuss the Principle of chromatographic separation. (W25 - Q4a, 03 marks)
    - Q5(a). Discuss in brief Principle of chromatographic separation. (W22 - Q5a, 03 marks)

Other Important Questions (Newest to Oldest):

1. Q5(c). Explain principal and working of gel filtration and affinity chromatography. (S22 - Q5c OR, 07 marks)
2. Q5(b). Compare ion exchange chromatography with gel filtration chromatography. (S25 - Q5b, 04 marks)
3. Q5(c). Discuss chromatographic column Ion exchange chromatography. (W22 - Q5c, 07 marks)
4. Q1(c). Explain working of gas chromatography with neat a figure in detail. (S25 - Q1c, 07 marks) [Diagram mentioned]
5. Q5(b). Explain Liquid chromatography. (S23 - Q5b OR, 04 marks)
6. Q4(b). Explain Paper Chromatography. (W25 - Q4b, 04 marks)
7. Q5(a) OR. Discuss principle and operation of ion exchange chromatography. (W24 - Q5a OR, 07 marks)

Unit 7: Electrophoretic Separations

Repeated Questions:

1. Explain the principle of Electrophoresis.
    - Q5(a). Write the principle of the electrophoresis process. (S23 - Q5a, 03 marks)
    - Q5(a). Write principle of electrophoresis process. (W22 - Q5a, 03 marks)
    - Q5(a). Explain the principle of electrophoresis separation. (W24 - Q5a, 03 marks)
    - Q5(a) OR. With a neat diagram explain the principle of electrophoresis separation. (S23 - Q5a OR, 03 marks) [Diagram mentioned]
2. List factors affecting the Electrophoresis process.
    - Q4(b). Enlist different factors affecting the electrophoresis process. (W25 - Q4b, 04 marks)
    - Q3(b). What are the factors affecting the Electrophoresis process? (S24 - Q3b, 04 marks)
    - Q5(b). What are the different factors which affect electrophoresis separation. (W24 - Q5b, 04 marks)
    - Q5(b). Enlist different factors affecting electrophoresis process. (W22 - Q5b, 04 marks)
3. List applications/uses of Electrophoresis.
    - Q4(a). Write the applications of electrophoresis. (W25 - Q4a OR, 03 marks)
    - Q5(b). List out the uses of Electrophoresis. (S23 - Q5b, 04 marks)
    - Q5(c). Give a detailed description of the various applications of electrophoresis separation. (W24 - Q5c, 07 marks)

Other Important Questions (Newest to Oldest):

1. Q5(a). Describe the factors affecting the efficiency of electrophoresis in brief. (S25 - Q5a, 03 marks)
2. Q5(b). Compare gel electrophoresis with paper electrophoresis. (S25 - Q5b OR, 04 marks)
3. Q3(c). Discuss the Paper Electrophoresis. (S24 - Q3c, 07 marks)

Multi-Unit / General Questions

(These questions cover broad topics that span multiple units or are of a general nature.)

Repeated Questions:

1. Enlist/Discuss various membrane materials used for synthesis.
    - Q2(a). Enlist different materials used for membranes synthesis. (S24 - Q2a, 03 marks)
    - Q3(a). Discuss various membrane materials. (S23 - Q3a, 03 marks)
    - Q3(a). Enlist different materials used for membranes synthesis. (W22 - Q3a, 03 marks)
    - Q3(a) OR. Discuss about different materials used for membranes synthesis. (S25 - Q3a OR, 03 marks)

Other Important Questions (Newest to Oldest):

1. Q2(a). Discuss various membrane materials for Reverse Osmosis (RO). (W23 - Q2a, 03 marks)
2. Q3(b). Enlist Synthesis methods of membrane. Explain anyone in brief. (W22 - Q3b OR, 04 marks)
3. Q4(b). Elaborate a thin film composite type membrane with a diagram. (W24 - Q4b, 04 marks) [Diagram mentioned]
4. Q4(a). Write a short note on membrane modules. (W24 - Q4a, 03 marks)
5. Q2(b). State industrial application of membrane distillation. (W23 - Q5b, 04 marks)
6. Q5(a). Write the advantages and disadvantages of pressure swing distillation over extractive distillation. (W23 - Q5a OR, 03 marks)
7. Q2(c). Discuss principle of Pressure Swing Adsorption (PSA) with its commercial applications in detail. (W23 - Q2c, 07 marks)
8. Q3(a). Discuss various applications of Melt Crystallization in brief. (W23 - Q3a, 03 marks)
9. Q4(b). Discuss the phase equilibrium diagram of melt crystallization. (W23 - Q4b, 04 marks)
10. Q4(c). Discuss various separation techniques used in chemical industry and their advantages with example. (W23 - Q4c, 07 marks)
11. Q2(c) OR. Explain with neat flow sheet MTBE manufacturing by catalytic distillation. (S22 - Q2c OR, 07 marks) [Diagram mentioned]
12. Q3(c). Discuss about the different types of packings used in reactive distillation process. (W24 - Q3c, 07 marks)
13. Q4(c). Describe reverse osmosis process and its application in desalination of sea water. (W24 - Q4c, 07 marks)
14. Q1(b). Describe the working of membrane bioreactor in brief. (S25 - Q1b, 04 marks)
15. Q2(c) OR. Describe RO process with a schematic diagram and also explain its application in desalination. (S25 - Q2c OR, 07 marks) [Diagram mentioned]
16. Q3(b). List at least four industrial applications of short path distillation. (S25 - Q3b, 04 marks)
17. Q3(c) OR. Explain design and working of short path distillation unit. Also explain separation of Vitamin-E from crude Vitamin-E acetate with the help of neat process flow diagram using short path distillation. (S25 - Q3c OR, 07 marks) [Diagram mentioned]
18. Q4(b). Classify different types of membrane process based on the driving force. (S25 - Q4b, 04 marks)
19. Q4(b) OR. Explain the different problems associated with membranes and its possible solutions. (S25 - Q4b OR, 04 marks)
20. Q4(a). Compare short-path distillation with molecular distillation. (S25 - Q4a OR, 03 marks)
21. Q5(a). What is molecular distillation? (S24 - Q5a, 03 marks)
22. Q4(a). Compare short-path distillation with molecular distillation. (S23 - Q4a, 03 marks)

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