IFS Chemical Engineering Papers 2006

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Paper-I

Section A

1. Answer any four of the following (10 × 4 = 40)

    a. Answer the following questions

        i. How is friction factor defined and what are the parameters on which it is dependent (5)?

        ii. What are the different types of conveyers available for bulk solid transportation (5)?

    b. Distinguish between Adiabatic Saturation Temperature and Wet Bulb temperature. Explain why both these are same for air-water system (10).

    c. Discuss caking of crystals and its prevention (10).

    d. Distinguish between resistances in series and resistances in parallel through which heat is being conducted under steady-state condition. Explain using electrical analogy (10).

    e. Differentiate among nucleate boiling, pool boiling and subcooled boiling (10).

2. Answer the following questions

    a. How do you use stress-strain relationship to explain the rheological classification of fluids? Explain with examples (10).

    b. Derive the continuity equation. State the assumptions (10).

    c. Answer the following questions

        i. List the advantages and disadvantages of plate and frame filter press (5).

        ii. State the two laws of crushing and write suitable mathematical relationships for the two laws (5).

    d. Answer the following questions

i. Explain the basis for the selection of mixing impellers (5).

ii. Briefly explain the mechanism of fluidization (5).

3. Answer the following questions

a. Answer the following questions

i. Bring out clearly the concept of film transfer coefficient and overall transfer coefficient in mass transfer (5).

ii. Explain briefly the diffusivity of gases and liquids (5).

b. Answer the following questions

i. Discuss the mass transfer resistances in a wetted column (5).

ii. Write briefly on Shank system of leaching (5).

c. With a neat drying rate curve, explain different zones of drying (10).

d. What a1e the limitations of McCa1e-Thiele method? How are these overcome in Ponchon-

Savarit method (10)?

4. Answer the following questions

a. Answer the following questions

i. What is LMTD, and why and where is it used (5)?

ii. Obtain the relationship between individual and overall heat transfer coefficients (5).

b. Answer the following questions

i. State and explain the Stefan-Boltzmann law of radiation (5).

ii. Write a note on absorption of radiation by opaque solids (5).

c. Answer the following questions

i. What is the influence of boiling point elevation on evaporator performance (5)?

ii. Briefly describe a vapour compression evaporator (5).

d. Write the design procedure for a double pipe heat exchanger (10).

Section B

1. Answer any four of the following (10 × 4 = 40)

    a. Explain the principle, of reverse osmosis. What are its limitations and applications (10)?

    b. List out the factors to be considered in the design of vessels (10).

    c. Name the different supports used for process vessels mentioning their advantages and disadvantages (10).

    d. Explain with sketches the working principles, installation and applications of thermocouples for temperature measurement (10).

    e. Explain the working of a PID control system. Draw a pneumatic control circuit for this system and explain the characteristics (10).

2. Answer the following questions

    a. Explain the principle of ultra filtration and list out its industrial applications (10).

    b. Discuss the industrial applications of ion exchange process (10).

    c. Explain any two methods for separating a binary liquid mixture stating the underlying principles (10).

    d. Explain the working of an instrument based on electro dialysis (10).

3. Answer the following questions

    a. Explain the design equations for calculating the thickness of cylindrical and spherical shells. How will you select a standard plate for fabricating a shell (10)?

    b. Write down the stepwise procedure for the design of an elliptical head (10).

    c. Name the different stresses acting on a tall vessel which is to be installed in a seismic zone (10).

    d. Mention any five industrially important alloys of Nickel and Copper. Give their approximate composition and application (10).

4. Answer the following questions

    a. With a neat diagram, describe the radioactive vacuum gauge method for measuring pressrue in a process industry (10).

    b. Sketch the following function and obtain the Laplace transform (10).

    c. Answers the questions below

i. Explain in practical terms, how one tunes a feedback controller for an existing process in a chemical plant (5).

ii. Define phase margin and gain margin, and show how you can compute them from

Bode Plot (5).

d. Develop a transfer function between the pressure drop and the manometer reading h for a mercury manometer. List the assumptions made (10).

Paper-II

Section A

1. Answer any four of the following (in 150 words, maximum)

   a. Discuss about proximate analysis of coal (10).

   b. Discuss about Mollier diagrams (10).

   c. An aqueous solution contains 40% Na_2CO_3 by weight. Express the composition in mole per cent (10).

   d. A natural gas has the following composition, in volumetric per cent: Calculate

      i. Composition in mole per cent.

      ii. Composition in weight per cent (10).

   e. Discuss the mathematical statement of second law of thermodynamics (10).

2. Answer the following questions

   a. Mono-chloroacetic acid (MCA) is manufactured in a semi batch reactor by the action of glacial acetic acid with chlorine gas at 373 K in the presence of PC13 catalyst. MCA thus formed will further react with chlorine to form dichloroacetic acid (DCA). To prevent the formation of DCA, excess acetic acid is used. A small-scale unit, producing 5000 kg/d MCA, requires 4536 kg/d of chlorine gas. Also, 263 kg/d of DCA is separated in the crystallizer to get almost pure MCA product. Find the % conversion, % yield of MCA and selectivity (25).

   b. Discuss about the heat of reaction (15).

3. Answer the following questions

   a. For the reaction $A \rightarrow R$, K = 0.02 min. It is desired to produce 4752 g moles of R per 10 hours a day and 99% of A entering the reactor is to be converted in a batch

reactor. To charge the reactor and heat it to reaction temperature requires 0.26 hours. To discharge the reactor and to prepare it for the next run takes 0.9 hours. Calculate the volume of the reactor required. Pure A with molar density of 8 g mole per liter is charged to the reactor (25).

b. Discuss about phase rule (15).

4. Answer the following questions

a. Discuss ideal solution and its properties (20).

b. Derive an expression for design equation for an ideal batch reactor (20).

Section B

1. Write short notes on any four of the following (in 150 words, maximum)

a. PVC (10)

b. Principles of piping layout (10)

c. Coal chemicals (10)

d. Alternative investments (10)

e. Effects of air pollution (10)

2. Answer the following questions

a. Describe the manufacture of penicillin using fermentation route (20).

b. List the mathematical methods for profitability evaluation and describe any one (20).

3. List various environmental protection laws and give the main features/provisions of any four in brief (40).

4. Answer the following questions

a. Discuss the estimation of capital investment (20).

b. Discuss petroleum refining briefly (20).