KATHMANDU UNIVERSITY
End Semester Examination
July/August, 2024

Marks Scored:

Level : B.E.
Year : III

Course : CHEG 310
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date 05 AUG 2024

SECTION "A"

[20 Q. × 0.5 = 10 marks]

Choose and encircle in the most appropriate option from each set of choices

1. Agitation has induced motion of a material in a
   a. A circulatory pattern inside a container.
   b. An axial pattern inside a container.
   c. A helical pattern inside a container.
   d. A cross-flow pattern inside a container.

2. For a fully baffled standard tank with an 6 straight blades turbine, the following flow regimes hold for $1 < Re < 10$
   a. Near the turbine: turbulent flow, other zones: almost static.
   b. Near the turbine: laminar flow, other zones: almost dynamic.
   c. Near the turbine: laminar flow, other zones: almost static.
   d. Near the turbine: turbulent flow, other zones: almost dynamic.

3. Expression for the Reynolds number for an agitator is
   a. $N_{Re}=\frac{nD_a^2\rho}{\mu}$ b. $N_{Re}=\frac{nD_a^3\rho}{\mu}$ c. $N_{Re}=\frac{nD_a^5\rho}{\mu}$ d. $N_{Re}=\frac{nD_a^6\rho}{\mu}$

4. Full form of "**TEMA**"
   a. Association for Tubular Exchanger Manufacturers
   b. Tubular Exchanger Manufacturers Association
   c. Alliance of Tubular Exchanger Manufacturers.
   d. Tube and Exchanger Manufacturers Association

5. Condensers are used to
   a. Liquefy vapors by removing their latent heats.
   b. Liquefy vapors by removing their sensible heats.
   c. Liquefy vapors by removing heat equal to the heat of vaporization.
   d. Liquefy vapors by removing heat of radiation.

6. In a shell and tube heat exchanger, at which point does the mass velocity reach a local maximum?
   a. When the fluid passes a row of baffles. b. When the fluid passes a row of tubes.
   c. When the fluid passes across the tubes. d. When the fluid passes parallel tubes.

7. When is a plate-type heat exchanger typically used?
   a. When the heat transfer between fluids is low or moderate.
   b. When high pressure is required.
   c. When minimal heat transfer area is needed.
   d. When a compact design and high heat transfer efficiency are desired.

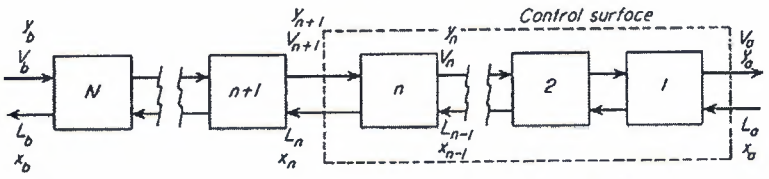
8. Free water in a solid is defined as
   a. Total water content in solid
   b. Total equilibrium water content in solid
   c. Sum of total water and equilibrium water in solid
   d. Difference of total water and equilibrium water in solid

9. Drying of wet solids is inherently
   a. A mechanical process
   b. A thermal process
   c. Both mechanical and thermal process
   d. Initially a mechanical then a thermal process

10. Which of the following statements is true about the drying time and conditions in a drying process?
   a. The drying time is always a few seconds.
   b. Solids always remain at a constant temperature for the entire drying cycle.
   c. The temperature of the heating medium remains constant throughout the drying process.
   d. In a continuous dryer, each particle or element of the solid goes through a cycle similar to that in a batch dryer.

11. Which of the following statements is true regarding the leaching process compared to ordinary filtration washing?
   a. Leaching typically removes less soluble material than ordinary filtration washing.
   b. The properties of solids remain unchanged during the leaching process.
   c. Leaching equipment is vastly different from the washing section of various filters.
   d. Coarse, hard, or granular feed solids may disintegrate into pulp or mush when their soluble material is removed during leaching.

12.



In countercurrent leaching process, material balance for the **total solution** in the cascade is

a. $V_{n+1}+L_a=V_aL_n$ b. $V_{n+1}-L_a=V_aL_n$ c. $V_{n+1}*L_a=V_aL_n$ d. $\frac{V_{n+1}}{L_a}=V_aL_n$

Where, L: Flow of retained liquid in the solid, V: Flow of the overflow solution.

13. Which of the following correctly describes the crushing?

a. Crushing is a wet process where size reduction occurs on all particles.
b. Crushing is a dry process, used for fine grinding.
c. Crushing preferentially reduces the size of large fragments and is typically a dry process.
d. Crushing is a dry process, used for intermediate grinding.

14. Which of the following statements about comminution of the ROM (Run-of-Mine) ore is correct?

a. Comminution is typically done in dry conditions, regardless of the moisture content of the solids.
b. An ore with a moisture content greater than 4% by weight will not cause any difficulties during the comminution process.
c. The reduction ratio (RR) is calculated by dividing the average diameter of the product by the average diameter of the feed.
d. Energy requirement increases with the reduction ratio (RR).

15. The operating speed of ball mill should be ---------- the critical speed.

a. less than b. more than c. at least equal to d. initially less then more than

16. The work index in Bond's law for crushing of solids has the following dimensions?

a. No-units (dimensionless) b. $^{kWh}/_{ton}$

c. $^{kW}/_{ton}$ d. $^{kWm^{1/2}}/_{ton}$

17. In a Gyratory crusher the size reduction is affected primarily by:

a. Compression b. Impact c. Attrition d. Cutting action

18. What is the term for the process of separating solids from a suspension by passing it through a porous filtering medium?

a. Decantation b. Filtration c. Centrifugation d. Distillation

19. What is the primary function of clarifying filters?

a. To remove large amounts of solids to produce a clean gas or sparkling clear liquids.
b. To produce a clear gas or sparkling clear liquids by trapping particles inside the filter medium or on its external surface.
c. To separate liquids from gases through fine meshes.
d. To filter out large particles using a screen with smaller pores.

20. At very low r.p.m the power required for agitation is proportional to

a. D b. D^2 c. D^3 d. D^5

Where D is the diameter of impeller

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SECTION "B"
[40 marks]

Attempt *ANY FOUR* questions.

1. a. Describe the various types of agitators. What are flow patterns in agitators? [5]

   b. A flat-blade turbine with six blades is installed centrally in a vertical tank. The tank is 6 ft in diameter; the turbine is 2 ft in diameter and is positioned 2 ft from the bottom of the tank. The turbine blades are 5 in. wide. The tank is filled to a depth of 6 ft with a solution of 50 % caustic soda, at 150 °F, which has a viscosity of 12 cP and a density of 93.5 lb/ft^3. The turbine is operated at 90 r/min. Calculate the power required to operate the mixer when [5]
   (a) Tank is baffled, (b) Tank is unbaffled
   Given:
   N_{Re} = 69,600, Np = 5.8 (For baffled tank)
   N_{Re} = 69600, Np = 1.7 (For un-baffled tank)
   a = 1.0 and b = 40.0

2. a. (a. Describe various types of flow in heat exchangers. What are the different types of extended surface in heat transfer? Discuss the term fin efficiency. [2+2+1]

   b. A tubular exchanger 35 in. ID contains eight hundred and twenty-eight ¾ in. OD tubes 12 ft long on a 1-in. square pitch. Standard 25 percent baffles are spaced in 12 in. apart. Liquid benzene at an average bulk temperature 60 °F is being heated in the shell side of exchanger at a rate of 100,000 lb/h. If the outside surfaces of the tubes are at 140 °F, estimate the heat transfer coefficient of the benzene. [5]
   Given,
   $$\frac{h_0 D_0}{k_0} = 0.2 \left(\frac{D_0 G_e}{\mu}\right)^{0.6} \left(\frac{C_p \mu}{k}\right)^{0.33} \left(\frac{\mu}{\mu_w}\right)^{0.14}$$
   For a 25 % baffle f = 0.1955, μ at 60 °F = 0.70 cP, μ at 140 °F = 0.38 cP
   c_p = 0.41 Btu/lb-°F, k = 0.092 Btu/fth-°F

3. a. Explain the process and equipment used in leaching by percolation through stationary solid beds. Discuss the setup, operation, and any special features that are typically employed in this method. [5]

   b. What are the drying mechanisms? Please explain batch and continuous dryers. [2+3]

4. a. Please explain the followings: [5]
   (i) Cystal geometry, (ii) Supersaturation, (iii) Nucleation

   b. What do you mean by filtration? Discuss various filtration mechanism. [5]

P.T.O.

5 Discuss the followings: [2+2+2+2+2]

a. Enthalpy balance
b. Counter-current leaching plant
c. Reynolds number and power number
d. Shell and baffles
e. Bond's and Kick's law