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Question Paper Code: R3903

B.E./B.Tech. DEGREE EXAMINATION, NOV 2024

Third Semester

Chemical Engineering

R21UCH303 FLUID FLOW OPERATIONS

(Regulation R2021)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The hydrostatic pressure increases with: CO1-U
(a) Decrease in depth (b) Increase in temperature
(c) Increase in depth (d) Decrease in density
2. Which of the following is an example of a non-Newtonian fluid? CO1-U
(a) Water (b) Air (c) Ketchup (d) Mercury
3. Which of the following represents the major energy losses in a pipe? CO1-U
(a) Friction losses (b) Elevation changes
(c) Flow obstructions (d) Temperature differences
4. For an incompressible fluid, Bernoulli's equation states that: CO1-U
(a) Pressure increases with velocity (b) Total mechanical energy remains constant
(c) Velocity decreases with elevation (d) Kinetic energy is negligible
5. The Buckingham Pi theorem is used to: CO1-U
(a) Analyze fluid flow (b) Create dimensionless numbers
(c) Derive equations of motion (d) Analyze fluid flow
6. What is the dimension of the Reynolds number? CO1 -U
(a) $M^0 L^1 T^0$ (b) $M^0 L^0 T^0$ (c) $M^1 L^0 T^0$ (d) $M^0 L^2 T^{-1}$

7. Slurry transport involves: CO1-U
- (a) Only liquid flow (b) Solid-gas mixtures
- (c) Solid-liquid mixtures (d) Liquid-gas mixtures
8. The applications of fluidization include: CO1-U
- (a) Chemical reactions (b) Gas-solid reactions
- (c) Separation processes (d) All of the above
9. Compressors are used primarily for: CO1-U
- (a) Increasing fluid flow rate (b) Transporting solid particles
- (c) Increasing the pressure of gases (d) Mixing liquids
10. The main purpose of fans is to: CO1-U
- (a) Circulate liquids (b) Increase fluid velocity
- (c) Move large volumes of air (d) Compress gases

PART – B (5 x 2= 10 Marks)

11. Differentiate between absolute pressure and gauge pressure. CO1-U
12. Define boundary layer thickness and its importance. CO1-U
13. What are the limitations of dimensional analysis? CO1-U
14. List out the characteristics of a packed bed in fluidization. CO1-U
15. What is the role of pumps in fluid transportation? Give one example. CO1-U

PART – C (5 x 16= 80 Marks)

16. (a) (i) Classify the various methods and instruments used for pressure measurement. CO1 App (16)
- (ii) Explain the principles behind each method with a neat sketch.
- (b) i) Examine the key properties of fluids and their significance in engineering applications. (6) CO1 App (16)
- ii) A U-tube manometer filled with mercury is connected between two points in a pipeline. If the manometer reading is 26 mm of Hg, calculate the pressure difference between the points when (a) water is flowing through the pipe and (b) air at atmospheric pressure and 20°C is flowing in the pipe.
- Density of mercury = 13.6 gm/cc Density of water = 1 gm/cc
Molecular weight of air = 28.8. (10)

17. (a) Explain the Reynolds experiment and its purpose in fluid mechanics. Describe the setup used in the experiment and the methodology for determining the flow regime. Include relevant equations and parameters involved. CO2 App (16)
- (b) Compare and contrast the Venturi meter and the orifice meter in terms of their working principles, design features, advantages, disadvantages, and typical applications. Include relevant equations and diagrams to support your analysis. CO2 App (16)
18. (a) Elaborate on the Buckingham Pi Theorem. Discuss its implications and provide an example where this theorem is applied to a practical engineering problem. CO3 Ana (16)
- (b) Explain how dimensional analysis is used in scale-up studies. Discuss its significance in the transition from laboratory experiments to industrial-scale applications, providing specific examples. CO3 Ana (16)
19. (a) Explain the concept of continuous fluidization and its advantages over batch processes. Discuss its applications in slurry and pneumatic transport systems. CO4 U (16)
- (b) Discuss and elaborate on at least three major industrial applications of fluidization. CO4 U (16)
20. (a) Describe pump sizing and its importance in pump selection. Discuss the role of NPSH in pump sizing. Explain how to calculate and evaluate $NPSH_a$ and $NPSH_r$ to prevent cavitation. CO5 U (16)
- (b) Describe the working principle of gear, diaphragm, and piston pumps. CO5 U (16)

