momentum transfer - CHE-2123
End Sem - Exam - Dec 2023
Total 2 50 marks

Type: DES

Q1. A Petroleum refinery gets its crude oil of a viscosity of 3 cP and specific gravity of 0.8 from a tank through a 15 cm diameter pipe. The oil is delivered into a 15 m diameter cylindrical storage tank. The delivery nozzle is situated at an elevation of 5 m. The storage tank is maintained at a pressure of 2.0 bar gauge. When pumping takes place, the level of the oil in the tank rises at 5cm per minute. Estimate the horsepower of the pump employed. (4)

Q2. Define the universal velocity distribution equation for turbulent flow through a circular pipe. State all the assumptions (4)

Q3. Explain i) Entrance length ii) Drag and drag coefficient (2)

Q4. Derive Ergun's equation for fluid flow through the packed bed. State all the assumptions clearly (4)

Q5. Explain the hydrodynamic behavior of a fluidized bed. Elaborate on the types of fluidization (3)

Q6. Define Mach number. H_2 gas flows at a velocity of 50 m/s under a pressure of 1.3 bar absolute. If the temperature of the gas is 25° C, at what Mach number does the flow take place? Assume n=1 for H_2 gas (3)

Q7. Define and write the significance of specific volume, mass density, and specific gravity. Also, calculate the specific weight, density, and specific gravity of one liter of liquid which weighs 7N (3)

Q8. Explain the rate of deformation of a fluid element and derive the expression when the element is moving on the inclined plane with a neat and clean diagram (3)

Q 9. Explain U-tube differential manometer with a neat and clean diagram. How are they used for the measurement of pressure? The right limb of a simple U-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of a specific gravity of 0.9 is flowing. The center of the pipe is 12 cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference in mercury level in the two limbs is 20 cm (4)

Q10. Derive an expression for the discharge through a venturi-meter with a neat and clean diagram. An orifice meter with an orifice diameter of 15 cm is inserted in a pipe of 30 cm diameter. The pressure difference by a mercury oil differential manometer on the two sides of the orifice meter gives a reading of 50 cm of mercury. Determine the rate of flow of oil of specific gravity 0.9 when the coefficient of discharge of the orifice meter is 0.64 (4)

Q11. Find the expression for the discharge over a rectangular notch. Determine the height of a rectangular weir of length 6 m to be built across a rectangular channel. The maximum depth of water on the upstream side of the weir is 1.8 m and the discharge is 2000 litres/s. Take Cd = 0.6 and neglect end contractions (3)

Q12. Derive the expression for the hydrostatic law with a neat and clean diagram. Also, distinguish between centre of gravity and center of buoyancy with suitable example (3)

Q13. Explain the characteristics of the pumps with a neat and clean diagram. Estimate the number of pumps required to take water from a deep well under a total head of 89 meters. All the pumps are identical and are running at 800 rpm. The specific speed of each pump is given as 25 while the rated capacity of each pump is 0.16 m^3/s (3)

Q14. What is the suction head, delivery head, and manometric head of the centrifugal pump? A centrifugal pump delivers water against a net head of 14.50 meters and a design speed of 1000 rpm. The vanes are curved back to an angle of 30 degrees with the periphery. The impeller diameter is 300 mm, and the outlet width is 50 mm. Determine the discharge of the pump if manometric efficiency is 95% (4)

Q15. State the selection criteria of repeated variables in Buckingham's' pi theorem. Derive based on dimensionless analysis suitable parameters to present the thrust developed by a propeller. Assume that the thrust P depends upon the angular velocity ω, speed of advance V, diameter D, dynamic viscosity μ, mass density ρ, and elasticity of the fluid medium which can be dented by the speed of sound in the medium C (3)