



Name :

Roll No. :

Invigilator's Signature :

CS/B.TECH(BT)/SEM-4/CHE-414/2011

2011

TRANSFER OPERATIONS - I

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

$$10 \times 1 = 10$$

- i) Reynolds Number is the ratio of
 - a) Viscous force to gravity force
 - b) Inertia force to viscous force
 - c) Viscous force to inertia force
 - d) Inertia force to gravity force.
- ii) Stoke's Law is valid, when Reynold's no. is less than
 - a) 2
 - b) 100
 - c) 700
 - d) 2100.



- iii) $f = 16/N_{Re}$ is valid for
- a) Turbulent flow
 - b) Laminar flow through a circular pipe
 - c) Laminar flow through a open channel
 - d) None of these.
- iv) Head developed by a centrifugal pump depends on its
- a) Speed
 - b) Impeller diameter
 - c) Both (a) & (b)
 - d) Nether (a) nor (b).
- v) The simple Pitot tube measures the pressure.
- a) static
 - b) dynamic
 - c) total
 - d) none of these.
- vi) For the same flow rate of a fluid the pressure drop is the least for
- a) Venturimeter
 - b) Orifice meter
 - c) Flow-nozzle
 - d) ΔP is same for all.



- vii) Prandtl number is given
- a) $C_p \mu / D$
 - b) hD / K
 - c) $C_p \mu / K$
 - d) μ / hC_p .
- viii) Blood is an example of
- a) Newtonian fluid
 - b) Bingham plastic
 - c) Pseudoplastic fluid
 - d) Dilatant fluid.
- ix) For compressible sludge, the specific cake resistance
- a) remains unaffected with the change in the pressure drop across the cake
 - b) increases with increase in pressure drop across the cake
 - c) decreases with increase in pressure drop across the cake
 - d) increases linearly with increase in the pressure drop across the cake.
- x) Devices with separate particles of differing densities are known as
- a) Sorting classifiers
 - b) Thickners
 - c) Cyclones
 - d) Filters.



- xi) In screen analysis, the notation 60/72 means
- passing through 60 mesh retained on 72 mesh
 - passing through 72 mesh retained on 60 mesh
 - 60 gm fines and 72 gm coarse
 - 72 gm fines and 60 gm coarse.
- xii) for gray bodies
- $\epsilon = 1$
 - $\epsilon = 0$
 - $\epsilon < 1$
 - $\epsilon > 1$.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

- State Buckingham *Pi*-theorem.
 - Check the dimensional homogeneity of the following equations :
 - $Q = C_d a \sqrt{2gH}$
 - $V = C\sqrt{mi}$

Where m = hydraulic mean depth
 i = longitudinal slope of the channel. $2 + 3$
- What are the different types of frictional loss occurring in a pipe carrying a fluid ? Define skin friction factor and state how it is related with shear stress on the fluid. $2 + 3$



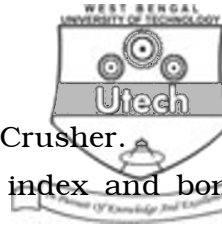
4. Explain the working principle of an orifice meter for measuring pipe flow. What factors mainly govern the coefficient of discharge ? 3 + 2
5. What is meant by LMTD ? Derive the equation of LMTD for a counter-current heat exchanger. 2 + 3
6. What is the power required to crush 80 tons/hr of limestone if 80% of the feed passes a two inch screen and 80% product passes a 1/8 inch screen. 5

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Define NPSH and cavitation of the pump. 3
- b) Draw the characteristic curve of centrifugal pump. 4
- c) It is proposed to pump 16000 kg/hr of Benzene at 37.8°C and 1.1 atm absolute pressure from the reboiler of a distillation column to a second distillation unit without cooling the benzene before it enters the pump. If the friction loss in the pipe between the reboiler and the pump is 7 kN/m² and the density of benzene is 865 kg/m³ and its vapour pressure at 37.8°C is 26.2 kN/m² . How far above the pump must the liquid level in the reboiler be maintained to give a NPSH of 2.5 m. Calculate the power required to drive the pump if the pump is to elevate the benzene 10 m, the pressure in the second unit is atmospheric and the friction loss in the discharge line is 35 kN/m² . The velocity in the pump discharge line is 3 m/s. 8



8. a) Explain the working principle of Jaul Crusher. 4
 b) Derive an expression between work index and bond's constant. 4
 c) Discuss the working principle of crushing rolls. 7
9. a) State Fourier's law. Derive the equation for heat flow through a cylinder. 2 + 6
 b) Crude oil flows at the rate of 1000 kg/hr through the inside pipe of a double pipe heat exchangers and is heated from 30°C to 90°C. The heat is supplied by kerosene initially at 200°C flowing through annular space. If the temperature of approach (minimum temperature difference) is 10°C, determine the heat transfer area for co-current flow and kerosene flow rate.
 C_p for crude oil = 0.5 kcal/kg°C
 C_p for kerosene = 0.6 kcal/kg°C
 $U_o = 400$ kcal/hr.mr² .°C. 7
10. a) Explain the concept of driving potential as applied to heat transfer problem. 3
 b) Determine the temperature gradient and the temperature difference between two sides of a 50 mm thick brass wall ($K = 70$ W/mK) if the rate of heat flow through this wall is 70 W/m² . 4
 c) The door of a cold storage plant is made from two 6 mm thick glass sheets separated by a uniform air gap of 2 mm. The temperature of the air inside the room is – 20°C and ambient air temperature is 3°C. Assuming the heat transfer coefficient between glass and air to be 23.26 W/m² K. Determine the rate of heat leaking into the room per unit area of the door; neglect convection effect in the air gap.
 ($K_{\text{glass}} = 0.75$ W/mK and $K_{\text{air}} = 0.02$ w/mK). 8



11. a) Explain the operation of a fluidized bed. Give the industrial application of fluidization. 6 + 2

b) A water softener consists of a vertical tube of 50 mm diameter and packed to a height of 0.5m with ion-exchange resin particles. The particles may be considered spherical with a diameter of 1.25 mm. Water flows over the bed because of gravity as well as a pressure difference at a rate of 300 ml/s. The bed has a porosity of 0.30. Calculate the pressure gradient. 7

12. Write short notes on any *three* of the following : 3 × 5

- a) Critical speed of a ball mill.
 - b) Differential and cumulative screen analysis.
 - c) Difference between Orifice meter and Venturimeter.
 - d) Continuous filtration process.
 - e) Free settling and hindered settling.
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