Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (BT)/SEM-4/CHE-414/2010

2010

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) Power Law behaviour of Newtonian Fluid is for

   a) $n = 1$ b) $n = 0$

   c) $n < 1$ d) $n > 1$.

   ii) Turbulent flow of Newtonian fluid in a circular tube

   a) $N_{Re} < 1400$

   b) $N_{Re} > 1400$

   c) $N_{Re} < 2100$

   d) $N_{Re} > 4000$.

iii) For laminar flow in a pipe Fanning friction factor (f) is

a) $\frac{24}{N_{Re}}$ b) $\frac{32}{N_{Re}}$

c) $\frac{16}{N_{Re}}$ d) $\frac{4}{N_{Re}}$.

iv) An ideal fluid is one which

a) is very viscous

b) is frictionless and incompressible

c) has negligible surface tension

d) obeys Newton's law of viscosity.

v) The velocity profile for laminar flow through a closed conduit is

a) Logarithmic b) Parabolic

c) Hyperbolic d) Linear.

vi) Power required by a centrifugal pump is proportional to

a) $N^2 D^3$ b) ND^2

c) $N^2 D$ d) $N^3 D^5$.

(D = diameter, N = rpm)

vii) Nusselt number is

a) $C_P \mu / D$ b) hD/k

c) $C_P \mu / k$ d) μ / hC_P.

viii) $C_p\mu/K$ is termed as

a) Grashoff number b) Nusselt number

c) Prandtl number d) Stanton number.

ix) For a multiple shell and tube heat exchanger, the LMTD correction factor is always

a) 1 b) > 1

c) < 1 d) between 1 & 2.

x) The operating speed of a ball mill should be ..... the critical speed.

a) less than b) much more than

c) at least equal to d) none of these.

xi) Which of the following crushing laws is most accurately applicable to the fine grinding of materials ?

a) Bond's crushing law b) Kick's law

c) Rittinger's law d) None of these.

xii) For heating air by saturated steam, the following heat exchanger is suggested

a) double pipe heat exchanger

b) shell and tube heat exchanger

c) extended surface heat exchanger

d) plate type heat exchanger.

GROUP – B
(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Derive the relationship between the pressure drop and the manometer reading for a *U*-tube manometer.

3. Write down the Bernoulli's equation and state the significance of each term. 2 + 3

4. Define free settling, hindered settling, terminal velocity, sphericity and minimum fluidization velocity.

5. Calculate the LMTD of the following heat exchanger :

6. a) Derive a relation between overall heat transfer co-efficient and individual heat transfer co-efficient.

   b) Define fouling factor. 3 + 2

GROUP – C

(Long Answer Type Questions)

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

7. a) Derive an expression for terminal-settling velocity of a spherical particle in a fluid medium under stokes law region. 7

b) An hydrocarbon oil (molecular weight 220, density = 1·6 gm/cc, viscosity = 5 cP), is being pumped from the storage tank at ground floor to the top of the absorption column of height 10 m at the rate of 2000 kg/min through a 5 cm ID smooth polythene pipe. Assume an efficiency of 60%, calculate the power (kW) of the pumped employed. The loss due to valve and expansion may be taken as 1·5 (kgf) (m)/kg.

Take Fanning friction factor (f) = 16/Re for laminar flow = 0·08 $(Re)^{-0.25}$ for turbulent flow. 7 + 8

8. a) Derive the equation for conductive heat flow through a hollow sphere. 7

b) A steam pipe line 150/160 mm in dia is covered with a layer of insulating material of thickness 50 mm. The thermal conductivity of the pipe is 50 W/m K and that of the insulating material is 0·04 W/mK. The temperature inside the pipe line is 100° C and that of the outside surface of the insulation is 40° C. Calculate the heat loss per 1 m length of the pipe line. 8

9. a) State the following : 3 × 2

   i) Rittinger's law

   ii) Kick's law

   iii) Bond's law.

   b) What is meant by angle of nip in crushing rolls ? 2

   c) In crushing a certain ore, the feed is such that 80% is less than 50·8 mm in size and the product size is such that 80% is less than 6·35 mm. The power required is 89·5 kW. What will be the power required using the same feed so that 80% is less than 3·18 mm ? 7

10. a) Explain the operation of a fluidized bed. Give the industrial applications of fluidization. 6 + 2

   b) A water softener consists of a vertical tube of 50 mm diameter and packed to a height of 0·5 m 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

11. a) State the operating principle of ball mill. Derive the relationship between the critical speed of a ball mill with radius of balls & ball mills. 6

b) Describe the operating principle of Rotary drum vacuum filter with a neat sketch. 4

c) Derive the expression between Work index and Bond's constant. 5