

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 × 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

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|----------------------|
| 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.

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GROUP – B
(Short Answer Type Questions)

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

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



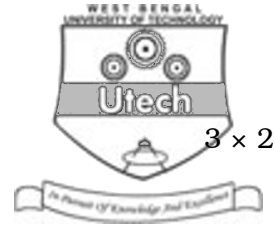
GROUP – C

(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

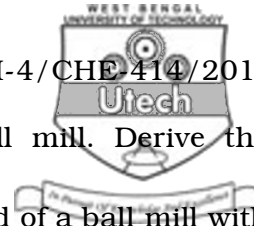
iii) Bond's law.

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
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