Name : …………………………………………………………

Roll No. : …………………………………………………………

Invigilator's Signature : …………………………………………

CS/B.Tech (CT)/SEM-3/CHE(CT)-301/2009-10
2009
UNIT OPERATION – 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 the following : $10 \times 1 = 10$

    i)   Potential flow is characterized by

        a)   no friction

        b)   no eddies

        c)   neither friction nor eddies

        d)   both friction and eddies.

    ii)   The inclined manometer is used for measuring

        a)   small pressure

        b)   large pressure

        c)   small pressure difference

        d)   large pressure difference.
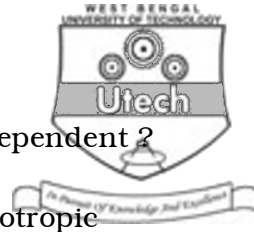
iii) Which of the following fluids is time dependent ?

    a)   Pseudo plastic   b)   Thixotropic

    c)   Newtonian   d)   Dilatant.

iv) Which of the following valves permits flow in one direction only ?

    a)   Globe valve   b)   Gate valve

    c)   Check valve   d)   None of these.

v) Diaphragm pump is used for handling

    a)   low pressure

    b)   high pressure

    c)   toxic or corrosive substance

    d)   none of these.

vi) Black body is a substance, whose absorptivity is

    a)   zero   b)   half

    c)   unity   d)   none of these.

vii) Prandtl no. is given by

    a) $\dfrac{k}{c_p \mu}$ b) $\dfrac{\rho c_p}{k}$

    c) $\dfrac{L}{\rho c_p}$ d)   none of these.

viii) Fouling factor in a heat exchanger

   a) provide additional resistance to heat flow

   b) is a dimensionless factor

   c) conversion factor for individual heat transfer co-efficient

   d) none of these.

ix) The expression for conductive heat transfer through a hollow cylinder is $\langle t_i > t_0 \,;\, \gamma_0 > \gamma_i \rangle$

   a) $q = \dfrac{2\pi\, Lk\,(t_i - t_0)}{ln\,\gamma_i/\gamma_0}$

   b) $q = \dfrac{2\pi\, Lk\,(t_0 - t_i)}{ln\,\gamma_i/\gamma_0}$

   c) $q = \dfrac{2\pi\, Lk\,(t_i - t_0)}{ln\,\gamma_0/\gamma_i}$

   d) $q = \dfrac{2\pi\, Lk\,(t_0 - t_i)}{ln\,\gamma_0/\gamma_i}$.

x) Centrifugal pump is suitable for

   a) developing very high pressure difference

   b) transportation of gases

   c) moving high viscosity liquids

   d) none of these.

GROUP – B
(Short Answer Type Questions)

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

2. Discuss the behaviour of Newtonian and non-Newtonian fluids in the light of shear stress *vs.* velocity gradient diagram.

3. Derive the expression for steady state heat transfer by conduction through a thick hollow sphere. (thickness of the wall is 10% of dia.)

4. Prove that the emissivity of a body being at temperature equilibrium with its surroundings becomes equal to its absorptivity.

5. What do you know about the characteristics curves for a centrifugal pump ? What are the disadvantages of a centrifugal pump ?

6. Describe with the help of a neat diagram the operation of a 1-2 heat exchanger.

GROUP – C

(Long Answer Type Questions)

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

7.   1·5 kg/s of 98% sulphuric acid is to be pumped through a 30 mm dia. pipe, 30 m long, to a tank 15 metre higher than its reservoir. Calculate the power required for the pump.

[Viscosity of the acid, μ = 0·025 Ns/m^2; sp. gr. of the acid = 1·84; friction factor f = 0·011]

8.   a)   A furnace wall is constructed of a brick (thickness : 20 cm) with thermal conductivity of 0·14 W/m° C backed by a layer of another brick (thickness : 40 cm) of thermal conductivity 1·4 W/m° C . The temperatures are 750° C and 75° C at innerface and outerface of the wall respectively. Which of the bricks would behave as refractory one ? Calculate the heat loss per unit area of the wall and also the temperature of the interface between two bricks.
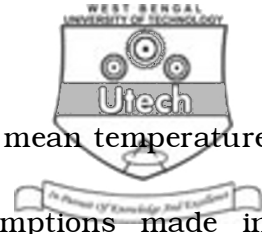
b) Derive the expression for logarithmic mean temperature difference clearly stating the assumptions made in different steps. 8 + 7

9. With the help of a diagram describe the features and working principle of a venturimeter. Discuss the advantages and disadvantages of it in comparison with orificemeter.

10. a) Define opaque body. What do you mean by total radiating power ?

b) Derive the expression for overall heat transfer co-efficient based on outside area of pipe in case of convective heat transfer. Take into account the effect of fouling factors. 1 + 3 + 11

11. Write short notes on any *four* of the following :

a) Nominal diameter and schedule no. of a pipe

b) Drag co-efficient

c) Gear pump

d) Equivalent diameter

e) Net positive suction head

f) Friction factor for laminar flow.

12. Draw Shankey diagram and note the percentage of heat-loss/absorbed at different parts of it.