Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.TECH (CT-OLD)/SEM-3/CHE (CT)-301/2011-12
2011
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 × 1 = 10

    i)   Gear pump is used for transporting

         a)   gas

         b)   high pressure air

         c)   toxic or corrosive liquid

         d)   oil.

    ii) Ordinary centrifugal pump is used for handling fluids of

         a)   high pressure

         b)   high viscosity

         c)   character resembling air

         d)   character resembling water.

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iii) An orifice meter is preferred to venturi meter because

   a)   frictional loss is low

   b)   it requires less space

   c)   both (a) & (b) are correct

   d)   none of these.

iv) In shear stress *vs.* velocity gradient plot, the straight line not passing through the origin represents

   a)   Newtonian fluid

   b)   Bingham plastics

   c)   Pseudoplastic fluid

   d)   Dilatant fluid.

v) Globe valve is used for

   a)   allowing flow in one direction only

   b)   accurate control of flow

   c)   opening or shutting down the flow

   d)   none of these.

vi) Expression for logarithmic mean radius is

   a) $r_o - r_i / 2 \cdot 303 \log (r_i / r_o)$

   b) $r_o + r_i / \ln (r_o / r_i)$

   c) $r_o - r_i / \ln (r_o / r_i)$

   d) $r_o - r_i / \ln r_o r_i$.

vii) Shell & Tube heat exchanger is better than Double-pipe exchanger because

   a) it takes less amount of space

   b) for same amount of heat transfer, surface material requirement is same

   c) maintenance is easier

   d) none of these.

viii) Thermal efficiencies of counter-current and parallel-current exchangers are equal when

   a) one of the fluids is highly viscous

   b) the exchanger is used as condenser

   c) the average temperature difference is large

   d) the fluids are immiscible.

ix)   The overall heat transfer co-efficient, when two fluids are separated by a metal wall, largely depends upon the layer

   a)   which offers most resistance to heat flow

   b)   which offers least resistance to heat flow

   c)   of metal wall

   d)   which has the least thickness.

x)   Prandtl No. is

   a) $DV\rho/\mu$

   b) $C_\rho\ \mu/k$

   c) $h D/k$

   d)   none of these.

GROUP – B

(Short Answer Type Questions)

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

2.   What are the advantages and disadvantages of a centrifugal pump ?

3.   With the help of a neat sketch, describe the operation of a 1 - 2 shell & tube type heat exchanger.

4.   Derive the expression for logarithmic mean temperature difference for the entire area of a heat exchanger.
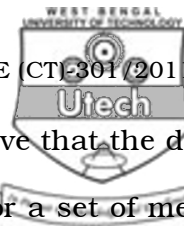
5. Why is a rotameter called an areameter ? Prove that the drag force on the float always remains constant for a set of meter and a fluid.

6. Prove that the energy received by radiation per unit area of the receiving surface is inversely proportional to the square of the distance between the surfaces.

GROUP – C

(Long Answer Type Questions)

Answer any *three* questions.   3 × 15 = 45

7. a) Water enters from a 2 inch dia. pipe to a 3 inch dia. pipe. While flowing through the 2 inch dia. pipe, it has a Reynolds No. of 6000. What will be its Reynolds No. while flowing through 3 inch dia pipe ?

   b) Find the drop in pressure due to friction in a pipe 300 m long and 100 mm diameter, when water is flowing at the rate of 0·05 m ^{3} /sec. The pipe is of glazed porcelain and having friction factor f = 0·0033.

6 + 9
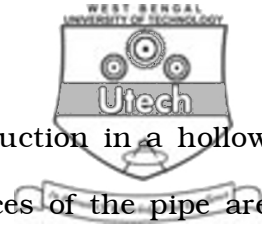
8. a) Consider the steady state heat conduction in a hollow cylinder. The inner and outer surfaces of the pipe are maintained at uniform and constant temperatures. Heat flows radially from the inner to outer surface. Deduce the expression for the rate of conduction.

   b) The inner surface of a nickel-steel cylinder (k = 1900 W/m°C) of i.d. 1 cm and o.d. 7 cm is maintained at a constant temperature of 100°C, while the outer surface is held at 50°C. Calculate the heat loss per metre length of the pipe. $8 + 7$

9. Draw and label different parts of a centrifugal pump. How does a diaphragm pump function ? What is the purpose of a multi-stage centrifugal pump ? What do you mean by Net Positive Suction Head and Cavitation ? $6 + 3 + 2 + 4$

10. Define emissive power, emissivity and gray body. What do you mean by Angle of Vision ?

Deduce the expression

$q_{12} = \sigma \left(T_1^4 - T_2^4 \right) / \left(1/_1 \right) + \left(1/_2 \right) - 1$. All notations have their usual meaning. $6 + 2 + 7$
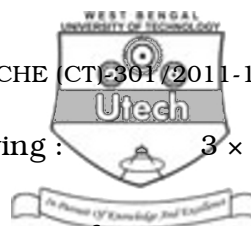
11. Write short notes on any *three* of the following : 3 × 5

    a) Kinetic energy correction factor and friction factor

    b) Equivalent diameter

    c) Boundary layer

    d) Orifice meter

    e) Hydraulic radius.