Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH/CT(OLD)/SEM-3/CHE(CT)-301/2012-13

2012

UNIT OPERATION - 1

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 from the following : $10 \times 1 = 10$

i) Reynolds number is

a) hD/k b) $C_p \mu / k$

c) $D\bar{V} \rho/\mu$ d) none of these.

ii) Differential manometer is used for measuring

a) very small pressure

b) very large pressure

c) very large pressure difference

d) very small pressure difference.

iii) Check valves are used for

a) allowing flow in one direction only

b) accurate control of flow

c) shutting down or opening the flow

d) none of these.

iv) Diaphragm pump is used for handling
   a) oil
   b) low pressure liquid
   c) high pressure liquid
   d) toxic or corrosive liquids.

v) Hydraulic radius is used in case of
   a) circular cross-section
   b) non-circular cross-section
   c) annular space
   d) both (b) and (c).

vi) Double pipe heat exchanger is preferred over shell and tube exchanger when
   a) the fluids passing through the exchanger are corrosive
   b) one of the fluids is viscous in nature
   c) overall heat transfer co-efficient is low
   d) heat transfer area requirement is low.

vii) Which of the following fluids is time dependent.
   a) thixotropic b) Newtonian
   c) dilatants d) pseudoplastics.

viii) The radiation falling on an opaque solid is
   a) fully reflected back
   b) fully absorbed on a thin surface layer
   c) mainly absorbed on a thin surface layer
   d) fully transmitted to the core of the body.

ix) Thermal efficiencies of counter-current and parallel current heat exchangers become equal when

a) the average temperature gradient is small

b) there is little amount of dissipation of heat to the surroundings

c) the heat exchangers are used as condensers

d) one of the fluids is highly viscous.

x) An orifice meter is preferred over venturimeter because

a) it requires less space

b) frictional loss is low

c) the former can handle only high viscous liquid

d) none of these.

GROUP – B

(Short Answer Type Questions)

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

2. Describe the principle of a rotameter with a neat sketch.

3. What do you mean by Net Positire Suction Head (NPSH) ? What is cavitation and how can you prevent it ?

4. What are the advantages and disadvantages of centrifugal pump ?

5. Derive the expression for steady state heat transfer by conduction through a hollow cylinder.

6. Draw and label different parts of single pass tubular condenser along with the temperature profile throughout the length of the condenser.

GROUP – C

(Long Answer Type Questions)

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

7. 4000 kg/hr. of sulfuric acid is to be transported through a 25 mm dia. pipe, 25 m long, to a tank at 12 m height.
   Calculate the power requirement of the pump.
   Data given :
   Viscosity of acid = 25×10^{-3} kg. m^{-1} . s^{-1} ; Sp.gr. of acid = 1·84, friction factor, $f = 16/N_{Re}$ for streamline flow
   $f = 0{\cdot}0014 + 0{\cdot}125/(N_{Re})^{0{\cdot}32}$
   for turbulent flow.

8. How can you differentiate between laminar and turbulent flow ? Why there is a need to incorporate kinetic energy correction factor in Bernoulli's equation for frictionless flow ? Draw the shear *vs.* velocity gradient diagram for Bingham plastic and psendo-plastic fluids. How do you define wall drag and form drag ? What is drag co-efficient ?
   3 + 2 + 3 + 3 + 4

9. a) Derive an expression for overall heat transfer co-efficient based on outside area of a pipe incorporating the effects of metal wall, scale and dirt factor.
   b) Derive the expression for logarithmic mean temperature difference clearly stating the assumptions made in different steps. 8 + 7

10. Define reflectivity, absorptivity and transmissivity. Prove that the energy received per unit area of the receiving surface is inversely proportional to the square of the distance between the surfaces. Deduce the expression
    $$q_{12} = \sigma \left(T_1^4 - T_2^4 \right) / \left(1/\in_1 \right) + \left(1/\in_2 \right) - 1.$$
    All notations have their usual meaning.

11. Write short notes on any *three* of the following : 3 × 5
    a) Nominal diameter of pipe and schedule No.
    b) Kirchhoff's law of radiation
    c) Characteristic curve of centrifugal pump
    d) Compound resistance in series in conductive heat transfer
    e) Hydraulic radius and equivalent diameter.