TRANSFER OPERATION - I
(BIOT 2202)

Time Allotted : 3 hrs   **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
__any 5 (five)__ from Group B to E, taking __at least one__ from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

    (i)   Which among the following is an assumption of Hagen-Poiseuille equation?
            (a) Fluid is nonviscous   (b) Fluid is laminar
            (c) Fluid is turbulent   (d) Fluid is compressible.

    (ii)
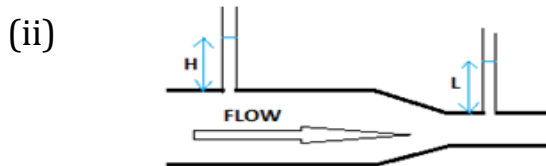
            What will be the relation between H & L?
            (a) H = L   (b) H > L
            (c) H < L   (d) Depends on the horizontal distance between the two tubes.

    (iii)   When is the fluid called laminar?
            (a) Low viscosity
            (b) The density of the fluid is high
            (c) Reynolds number is greater than 2000
            (d) Reynolds number is less than 2000.

    (iv)   Which of the following equation must be perfunctorily satisfied while dealing with fluid flow problems?
            (a) Newton's third law   (b) Law of conservation of momentum
            (c) Continuity equation   (d) Newton's second law.

    (v)   If a liquid enters a pipe of diameter d with a velocity v, what will it's velocity at the exit if the diameter reduces to 0.5d?
            (a) v   (b) 0.5v   (c) 2v   (d) 4v.

    (vi)   Rate of filtration depends on
            (a) pressure drop   (b) viscosity of filtrate
            (c) cake resistance   (d) all the above.

(vii) Counter-current flow heat exchanger is preferred for
   (a) rapid initial cooling   (b) uniform cooling
   (c) gradual cooling   (d) none of the above.

(viii) Ruth equation is used to describe
   (a) heat flow by conduction   (b) heat flow by radiation
   (c) constant pressure filtration   (d) settling of solids

(ix) Which of the following crushing laws is most accurately applicable to the grinding of stones?
   (a) Bond's Law   (b) Kick's Law
   (c) Rittinger's Law   (d) None of these.

(x) A blinded screen means
   (a) a solid plugged with solid particles   (b) a screen folded at two ends
   (c) a vibrating screen   (d) a dismantled screen.

Group- B

2. (a) Mathematically prove that law of conservation of energy is applicable in the case of fluid flowing through a pipe.   [(CO2)(Analyse/IOCQ)]
   (b) Define flow behaviour and flow consistency index for power low fluid.
        [(CO1)(Remember/LOCQ)]
   9 + 3 = 12

3. Air (ρ = 1.22 Kg/m^3, μ = 1.9 × 10^{-5} pa.s) is flowing in a fixed bed of a diameter 0.5 m and height 2.5 m. The bed is packed with spherical particles of diameter 10 mm. The void fraction is 0.38. The air mass flow rate is 0.5 kg/s. Calculate the pressure drop across the bed of particles.   [(CO2)(Calculate/IOCQ)]
   12

Group - C

4. It is planned to install a steel pipe with an ID 20 cm to transfer 1000 kg/min molasses having viscosity 500 cP and density 1.6 gm/cc. The line is to be 1000 m long and delivery end is to be 5 m higher than the intake. (i) Calculate pressure drop due to friction (Kg/Cm^2). (ii) If the overall efficiency of pump is 80%, what is the power required by the pump?   [(CO2)(Calculate/HOCQ)]
   12

5. (a) What is NPSH? Write the equations to calculate NPSH required for suction lift system and suction head system.   [(CO3)(Remember/LOCQ)]
   (b) What should be the range of values of coefficient of discharge for venturimeter and why?   [(CO3)(Understand/LOCQ)]
   (3 + 4) + 5 = 12

Group - D

6. (a) Derive an equation for heat flow through a hollow cylinder.
   [(CO4)(Remember/LOCQ)]
   (b) A small oxidized horizontal metal tube with an OD of 0.0254 m and being 0.61 m long with a surface temperature at 588 K is in a very large furnace enclosure with fire-brick walls and the surrounding air at 1088 K. The emissivity of the metal tube is 0.6 and 0.46 at 588 K. Calculate the heat transfer to the tube by radiation. [(CO4)(Analyze/IOCQ)]
   5 + 7 = 12

7 Write short notes on (any 3): **(3 × 4) = 12**
   (i) Cavitation
   (ii) Ball mill
   (iii) Packed bed
   (iv) Centrifugal pump
   (v) Gyrating screen
   (vi) Jaw crusher. [(CO5)(Remember/LOCQ)]

Group - E

8. The following data were obtained in a constant pressure filtration unit for filtration of a yeast suspension.
   Characteristics of the filter are as follows:
   $A = 0.28$ m^2, $C = 1920$ kg/m^3, $\mu = 2.9 \times 10^{-3}$ kg/m.s, $\alpha = 4$ m/kg.
   (i) Determine the pressure drop across the filter.
   (ii) Determine the filter medium resistance.

Time (min)	4	20	48	76	120
V (l of filtrate)	115	365	680	850	1130

[(CO6)(Evaluate/IOCQ)]
12

9. (a) State Bond's law. Derive a relationship between Bond's constant and work index. [(CO5)(Remember/LOCQ)]
   (b) What is the power required to crush 100 tons/h of limestone if 80% of the feed passes a 2 in screen and 80% of the product a 1/8 in screen? Work index of limestone is 12.74. [(CO6)(Analyse/IOCQ)]
   (2 + 4) + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	34.37	53.13	12.5

Course Outcome (CO):

After completion of this course, the students will be able to:
1. Understand thy physical properties of fluid, flow behavior and their consequence on fluid flow.
2. Apply the basic laws and equations to analyze fluid dynamics and solve numerical problems related to them.
3. Understand the importance of fluid flow measurement by various devices in industries.
4. Analyze and calculate various parameters involved in heat transfer by conduction, convection and thermal radiation.
5. Develop and design various equipment's associated with heat transfer and evaluate heat exchanger performance.
6. Develop the knowledge of principles of comminution, mechanical separation aspects, working of equipments used in mechanical operation and calculate various parameters for energy requirement related to size reduction of solid

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question