TRANSFER OPERATIONS-I (SEMESTER - 4)

CS/B.TECH (BT-NEW)/SEM-4/CHE-414/09
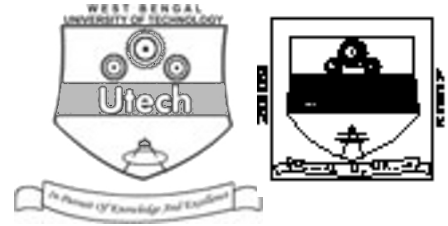
1. ....
   Signature of Invigilator

2. ....
   Signature of the Officer-in-Charge

Reg. No.

Roll No. of the Candidate

Time : 3 Hours]   [Full Marks : 70

INSTRUCTIONS TO THE CANDIDATES :

1. This Booklet is a Question-cum-Answer Booklet. The Booklet consists of **32 pages**. The questions of this concerned subject commence from Page No. 3.

2. a) In **Group – A**, Questions are of Multiple Choice type. You have to write the correct choice in the box provided **against each question**.

   b) For **Groups – B** & **C** you have to answer the questions in the space provided marked 'Answer Sheet'. Questions of **Group – B** are Short answer type. Questions of **Group – C** are Long answer type. Write on both sides of the paper.

3. **Fill in your Roll No. in the box** provided as in your Admit Card before answering the questions.

4. Read the instructions given inside carefully before answering.

5. You should not forget to write the corresponding question numbers while answering.

6. Do not write your name or put any special mark in the booklet that may disclose your identity, which will render you liable to disqualification. Any candidate found copying will be subject to Disciplinary Action under the relevant rules.

7. **Use of Mobile Phone and Programmable Calculator is totally prohibited in the examination hall.**

8. You should return the booklet to the invigilator at the end of the examination and should not take any page of this booklet with you outside the examination hall, **which will lead to disqualification**.

9. Rough work, if necessary is to be done in this booklet only and cross it through.

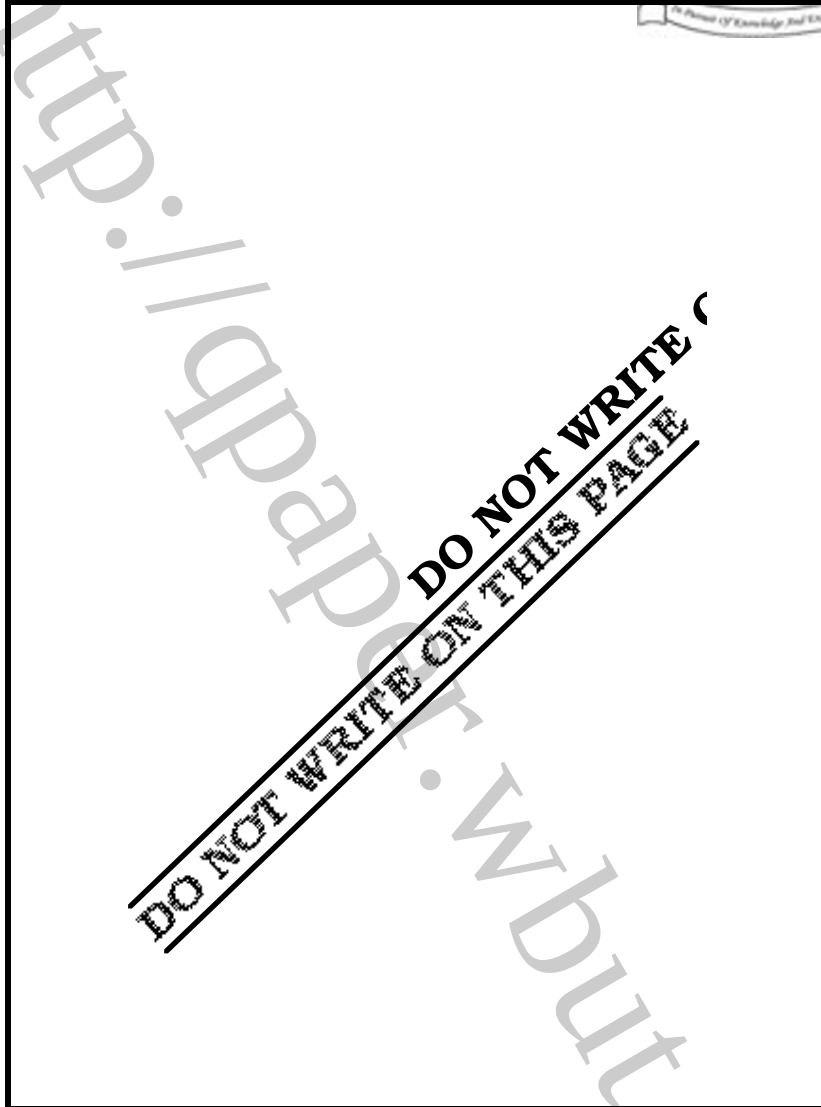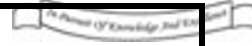### No additional sheets are to be used and no loose paper will be provided

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FOR OFFICE USE / EVALUATION ONLY
Marks Obtained

Question Number				Group – A						Group – B		Group – C		Total Marks	Examiner's Signature
Marks Obtained															

....
Head-Examiner/Co-Ordinator/Scrutineer

4531 (10/06)

ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009
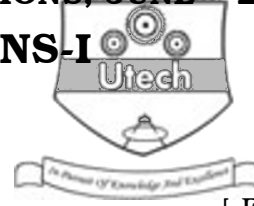
TRANSFER OPERATIONS-I

SEMESTER - 4

Time : 3 Hours]   [Full Marks : 70

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 pseudoplastic is for

   a) $n = 1$ b) $n = 0$

   c) $n < 1$ d) $n > 1$.

   ii)   An example of Newtonian fluid is

   a)   non-colloidal solution   b)   Sewage sludge

   c)   Rubber latex   d)   Quicksand.

   iii)   A stremline is

   a)   always the path of a particle

   b)   a line drawn in the flow region such that the tangent drawn at any point on the line indicates the direction of velocity

   c)   a line drawn in the flow region such that there is mass flow across the line

   d)   not fixed in steady flow.

   iv)   For laminar flow in a pipe, the value of momentum correction factor (β) is

   a) $\dfrac{3}{4}$ b) $\dfrac{4}{3}$

   c)   0   d)   1.

v) In the steady laminar flow of a Newtonian fluid at constant pressure through the cylindrical pipe, the velocity varies as the

    a) pipe diameter

    b) square root of the pipe diameter

    c) square of the pipe diameter

    d) cube of the pipe diameter.

vi) Prandtl number is the

    a) ratio of kinematic viscosity to thermal diffusivity

    b) ratio of thermal diffusivity to kinematic viscosity

    c) product of thermal diffusivity and kinematic viscosity

    d) ratio of absolute viscosity to thermal conductivity.

vii) The unit of Stefan-Boltzmann constant is

    a) $W / (m^2 .K)$ b) $W / (m^2 . K^4)$

    c) W/m^2 d) $W/(m.K^4)$.

viii) Fouling factor (R_f) is defined as

    a) $R_f = U_{clean} - U_{dirty}$ b) $R_f = 1/U_{dirty} - 1/U_{clean}$

    c) $R_f = 1/U_{clean} - 1/U_{dirty}$ d) $R_f = 1/ (U_{clean} U_{dirty})^{1/2}$.

ix) For compressible sludge, the specific cake resistance

    a) remains unaffected with the change in the pressure drop across the cake

    b) increases with increase in pressure drop across the cake

    c) decreases with increase in pressure drop across the cake

    d) increases linearly with increase in the pressure drop across the cake.

x) Devices which separate particles of differing densities are known as

    a) Sorting classifiers   b) Thickeners

    c) Cyclones   d) filters.

xi) In screen analysis, the notation 60/72 means

    a) passing through 60 mesh retained on 72 mesh

    b) passing through 72 mesh retained on 60 mesh

    c) 60 gm fines and 72 gm coarse

    d) 72 gm fines and 60 gm coarse.

xii) The flow number, N_Q, is defined by

    a) ND^3 / Q b) Q / ND^3

    c) $P / N^3 D^5 \rho$ d) $N^3 D^5 \rho / P$

where Q = Volumetric flow rate through the impeller

    N = Rotational speed of impeller

    D = Diameter of impeller

    P = Power

    ρ = Density of fluid.

GROUP – B

(Short Answer Type Questions)

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

2. State the operating principle of Ball mill. Derive the relation between critical speed of a ball mill with radius of balls and ball mill.   2 + 3

3. Draw and explain the characteristic curves for centrifugal pump. What is priming of pump ?   3 + 2

4. A flat furnace hall is constructed of 150 mm layer of Sil-o-cel brick with thermal conductivity of 0·138 W/m°C. The temperature of the inner face of the wall is 700°C and that of the outer surface is 70°C. What is the heat loss from 1 m^2 of the wall ?   5

5. Derive the Hagen-Poiseuille equation.   5

6. What is meant by LMTD ? Derive the equation for LMTD for a countercurrent heat exchanger.   1 + 4

GROUP – C

(Long Answer Type Questions)

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

7. a) Differentiate between reciprocating pump and centrifugal pump.

   b) Derive the expression for terminal-settling velocity of a spherical particle in a fluid medium under Stokes law region.

   c) Calculate the velocity gradient at distances 0 mm, 100 mm and 150 mm from the boundary if the velocity profile is a parabola with vertex 150 mm from the boundary where the velocity is 1 m/s. Also calculate the shear stresses at these points if the fluid has a viscosity of 0·804 N-S/m^2.   2 + 8 + 5

8. a) Define thixotropic and rheopectic fluids with examples.

   b) What is the difference between kinematic viscosity and eddy diffusivity of momentum ?

   c) A sharp edged orifice with an aperture of 20 mm diameter is inserted in a 50 mm ID pipeline carrying a raw material from the neighbouring factory. What charges are to be paid per day to the factory for the chemical received, if the material costs Rs. 2 per kg.

   Given,

   Average viscosity of raw material = 0·7 cP.

   Average density of fluid = 1·3 gm/c.c.

   Manometer connected across the orifice reads 10 cm of Hg.

   Orifice coefficient = 0·61.

   d) Define minimum fluidization velocity. Draw the representative free hand graph of Pressure drop *vs*. velocity and bed height *vs*. velocity of liquid in a fluidized bed reactor.   4 + 2 + 6 + 3

9. a) It is planned to install a steel pipe with an inside diameter of 20 cm to transfer 1000 kg/min molasses having viscosity of 500 cP and a density of 1·6 gm/c.c. The line is to be 1000 m long and the delivery end is to be 5 m higher than the intake.
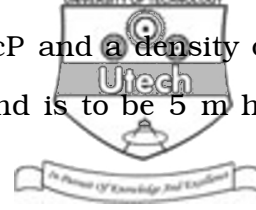
Calculate

i) pressure drop due to friction expressed as kg/cm^2 .

ii) if the overall efficiency of the pump is 60%, what will be the pumpower required, in kW ?

b) What are the causes of energy loss in centrifugal pump ?

c) Define skin friction, form friction, free turbulence and wall turbulence. 8 + 3 + 4

10. a) A certain crushing roll 1 m in diameter is set so that the crushing surfaces are 12·5 mm apart and the angle of nip is 31°. What is the maximum size of particle that should be fed to the roll ? If the actual capacity is 12% of theoretical, calculate the throughput in kg/s when running at 2·0 Hz, if the working face of the roll is 0·4 m long and the feed weighs 2500 kg/m^3 .

b) Derive the expression between work index and Bonds constant.

c) Explain in detail the different zones appearing in a batch sedimentation process. Mention the critical settling point. 8 + 3 + 4

11. a) Define NPSH and cavitation.

b) A pump draws a solution of specific growth 1·84 from a storage tank through 75 mm pipe. The efficiency of the pump is 60%. The velocity in the suction line is 0·914 m/s. The pump discharges through a 50 mm pipe to an overhead tank. The end of the dischrge pipe is 15·2 m above the level of the solution in the feed tank, friction losses in the entire piping system are 29·9 J/kg. What pressure must the pump developed ? What is the power delivered to the fluid by the pump ? 5 + 10

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END