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RN-8045

B. E. - II (Sem. III) (Chem.) Examination

May / June – 2010

Fluid Flow Operations

(As per GTU Syllabus)

Time : **3** Hours] [Total Marks : **100**

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ **B. E. - 2 (Sem. 3) (Chem.)**

Name of the Subject :

☛ **Fluid Flow Operations**

☛ Subject Code No. : **8 0 4 5** ☛ Section No. (1, 2,.....) : **1&2**

Seat No. :

Student's Signature

(2) Answer to each section must be written in **separate** answer book.

(3) Figures to the right indicate full marks.

(4) Assume the data whenever necessary.

(5) Draw neat sketch wherever necessary.

SECTION - I

1 (a) Answer the following : **1×10=10**

(i) Define static fluid.

(ii) Write down barometric equation.

(iii) What is the meaning of thivotropic fluids?

(iv) Write down the physical significance of Reynold's number.

(v) Write down the basic momentum balance equation.

(vi) Write the Bernoulli's equation in tps units.

(vii) Fanning friction factor is used for _____ flow.

(viii) What is roughness parameter?

(ix) When the pressure ratio in the throat is reduced to its critical value, the flow rate is _____.

(x) Define Mach number.

(b) Derive the Navier-Stokes equation for flow of Newtonian fluid in x-direction for which density is constant.

2 Answer any **two** : **2×8=16**

(a) In the orifice meter, a flat disk with a central opening of diameter D_o is set across a pipe of diameter D_1 and the pressure drop ΔP across the opening is measured. It is postulated that ΔP is a function of the average fluid velocity in the pipe $\bar{V}$, the density of the third ρ, the fluid viscosity μ and the diameters of the pipe and the opening, D and D_o, respectively. Thus $\Delta P = \phi(\bar{V}, \rho, \mu, D, D_o)$ Find an acceptable set of dimensionless groups which relate these various factors.

(b) Derive the equation for continuous gravity decanter.

(c) The sulphuric acid of density 1650 kg/m^3 and viscosity 8.6 MPa.s is to be pumped for 800 m along through a 50 mm i.d. pipe at a rate of 3 kg/s and then raised vertically 15 m by the pump. If the pump is electrically driven and has an efficiency of 50%, what power will be required ?

3 Answer any **two** : **2×7=14**

(a) Write down the Newton's law of viscosity and explain about Newtonian and Non-Newtonian fluids.

(b) Derive the equation for the liquid layer flowing on a free surface.

(c) Write down the necessary assumptions for compressible flow and derive the mechanical energy balance equation.

SECTION - II

4 (a) Answer the following : **5×2=10**

(i) Define Form drug and Wall drug.

(ii) What is NPSH (net positive suction head) for centrifugal pump?

(iii) Difference between buoyancy force and drug force in terms of direction of flow.

(iv) List out different types of pipe fittings.

(v) Distinguish between free settling and hindered settling.

(b) Water at 20°C is pumped at the rate of 1.0 kg/s from a storage tank through 100 m of a pipe of internal diameter 30 mm. The pipeline consists of two fully open globe valves and three 90° elbows. Water is discharged into an overhead tank through spray nozzles. The discharge is at a height of 2000 cm above the level of water in the storage tank. The required pressure at the nozzle entrance is 300 kPa gauge. Calculate the theoretical power requirement for the pump equivalent lengths in terms of pipe diameters : **8**

Fully open globe valve = 300 D

90° elbow = 30D

$f = 0.078\ (N_{Re})^{0.25}$

Viscosity of water = 0.975 mPas.

5 Attempt any **two** : **8×2=16**

(a) Explain briefly principle, construction and working of centrifugal pump with neat and clean sketch.

(b) Sulphuric acid of specific gravity 1.3 is flowing through a pipe 5 cm i.d. A thin tipped orifice of 1 cm diameter is fitted in the pipe and the differential pressure shown by mercury manometer is 10 cm. Assuming that the leads to the manometer are fitted with acid, calculate the weight of acid flowing per hour. Assume the value of C_o as 0.61.

(c) A bed of ion-exchange beads 8 ft deep is to be back washed with water to remove dirt. The principles have a density of 1.24 g/cm^3 and an average size of 1.1 mm, what is the minimum fluidization velocity using water at 20°C, and what velocity is required to expand the bed by 25% ? The beads are assumed to be spherical ($\phi_S = 1$) and E_M is taken as 0.40.

6 Attempt any **two** : **8×2=16**

(a) Discuss about blowers and compressors.

(b) Briefly describe about types of fluidization and its application.

(c) Derive the Kozeny-Carman equation for flow through packed bed at $N_{Re(p)}$ upto about 1.0.