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**Total number of printed pages - 03**

**B.TECH**
**PCE3I101**

# 3rd Semester Regular Examination 2016 - 17
# FLUID FLOW & FLOW MEASUREMENT
## BRANCH : Chemical
## Time : 3 Hours
## Max Marks : 100
## Question Code : Y487

**Answer Part-A which is compulsory and any four from Part-B**

***The figures in the right-hand margin indicate marks.***
***Assume suitable notations and any missing data wherever necessary.***
***Answer all parts of a question at a place.***

**Part – A (Answer all the questions)**

**1. Answer the following questions : 2 x 10**

**(a)** Bentonite clay suspensions belong to which category of fluids ?
- i. Pseudoplastic
- ii. Thixotropic
- iii. Dilatant
- iv. Rheopectic

**(b)** SI units of viscosity and kinematic viscosity are:
- i. kg.m/s and $m^2$/s
- ii. kg/m.s and $m^2$.s
- iii. kg/m.s and $m^2$/s
- iv. kg.m/s and $m^2$.s

**(c)** For pseudoplastic and dilatant fluids, the value of flow behavior index (n') are:
- i. n' < 1 and n' < 1
- ii. n' < 1 and n' > 1
- iii. n' > 1 and n' > 1
- iv. n' > 1 and n' < 1

**(d)** Flow within an eddy is:
- i. laminar
- ii. turbulent
- iii. coutte
- iv. all of these

**(e)** The hydraulic radius is especially useful in which type of flow ?
- i. laminar
- ii. turbulent
- iii. viscous
- iv. none of these

**(f)** For laminar flow of Newtonian fluids, the values of kinetic energy correction factor and momentum correction factor are:
- i. 1 and 1/3
- ii. 2 and 2/3

iii. 2/3 and 4/3
iv. 2 and 4/3

**(g)** For steel pipe, the friction factor becomes independent of the Reynolds number for Reynolds numbers greater than _____.
i. $10^4$
ii. $10^5$
iii. $10^6$
iv. $10^7$

**(h)** For a disk, the drag coefficient is _____ at Reynolds numbers above 2000.
i. < 1
ii. = 1
iii. > 1
iv. none of these

**(i)** Kozney-Carman equation is applicable for flow through beds at particle Reynolds numbers upto about _____.
i. $10^0$
ii. $10^1$
iii. $10^2$
iv. $10^3$

**(j)** The drag coefficient in hindered settling is _____ that in free settling.
i. less than
ii. equal to
iii. greater than
iv. none of these

**2. Answer the following questions :** **2 x 10**

**(a)** What are dimensionally homogeneous equations ?
**(b)** Write the Barometric equation and write one of its example.
**(c)** Mention two characteristics of potential flow.
**(d)** What do you understand by viscous dissipation ?
**(e)** What is isotropic turbulence ?
**(f)** What are skin friction and form friction ?
**(g)** What is roughness parameter ? How it is related to friction factor ?
**(h)** What do you understand by expansion loss coefficient ?
**(i)** Differentiate between wall drag and form drag.
**(j)** How the pumps work ?

## Part – B (Answer any four questions)

**3. (a)** A steady stream of liquid in turbulent flow is heated by passing it through a long, straight, heated pipe. The temperature of the pipe is assumed to be greater by a constant amount than the average temperature of the liquid. Using the dimensional analysis, find a relationship that can be used to predict the rate of heat transfer from the wall of the liquid. The general form of this problem may be written as :

$$\frac{Q}{A} = f\left(D, V, \rho, \mu, c_p, k, \Delta T\right)$$

where, Q/A = heat flow per unit area, $f$ = function of, D = inside diameter of pipe, V = average velocity of liquid inside pipe, $\rho$ and $\mu$ = density and viscosity of liquid, $c_p$ = specific heat of liquid, k = thermal conductivity of liquid, and $\Delta T$ = temperature difference between wall and liquid. **10**

**(b)** With a neat diagram, derive the equation to be used to measure the pressure difference using a simple U-tube manometer. **05**

**4. (a)** With a neat diagram prove that in laminar flow of Newtonian fluids in a pipe the average velocity is one-half the maximum velocity. **10**

**(b)** Discuss briefly the friction loss from sudden contraction of cross-section with a neat diagram. **05**

**5. (a)** A pump draws a solution of specific gravity of 1.84 from a storage tank of large cross-section through a pipe having an inside diameter of 0.08 m. The average fluid velocity in the suction line is 3 m/s. The pump discharge through a pipe of inside diameter 0.065 m. The end of the discharge line is 35 m above the level of the solution in the feed tank. Friction losses in the entire system are 4.7 m of the solution. What pressure must the pump develop in $kg/cm^2$ ?Assuming overall efficiency of 60 %, calculate the energy requirement in kWh ? **10**

**(b)** Mention the assumptions for the study of flow of compressible fluids and also mention the basic relations to be used. **05**

**6. (a)** For flow through beds of solids, derive the pressure drop equation. **10**

**(b)** Draw and explain the plot of pressure drop and bed height vs. superficial velocity for a bed of solids. **05**

**7. (a)** Discuss the particulate fluidization. **10**

**(b)** Mention the applications of fluidization. **05**

**8. (a)** Discuss the construction and working of a centrifugal pump with a neat diagram. **10**

**(b)** What do you understand by cavitation and NPSH. **05**

**9. (a)** Discuss the construction and working of a venturimeter with a neat diagram. **10**

**(b)** A pitot tube having a coefficient of 0.95 is inserted in the central line of a long smooth pipe of 250 mm diameter in which crude oil of density 0.9 $gm/cm^3$ and viscosity 16.3 cP is flowing. Calculate the maximum velocity of oil in the pipe if the differential pressure in the manometer is 5 cm of water. **05**

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