Printed Pages : 4

ME-302

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : **140305**

Roll No.

# B. Tech.

## (SEM. III) (ODD SEM.) THEORY EXAMINATION, 2014-15

## FLUID MECHANICS

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

**1** Attempt any **four** parts : **5×4=20**

a) Define the following and give one practical example for each :

I. Turbulent Flow

II. Uniform Flow.

b) Obtain an expression for continuity equation for a three dimensional flow

c) The two dimensional stream function for flow is $\Psi = 9 + 6x - 4y + 7xy$. Find the velocity potential.

d) Find an expression for the drag force on smooth sphere of diameter D, moving with a uniform velocity V in a fluid of density $\rho$ and dynamic viscosity $\mu$.

e) State Buckingham's Pi theorem. Write step by step procedure for solving problem using Buckingham's Pi theorem.

f) Sketch the stream lines represented by $\Psi = xy$. Also find out the velocity and its direction at point (2, 3)

**2** Attempt any **two** parts : **10×2=20**

a) Find the density of a metallic body which floats at the interface of mercury of specific gravity 13.6 and water such that 40 % of its volume is submerged in mercury and 60 % in water.

b) Describe the construction of pressure transducer with neat sketch.

c) Define the following fluid properties

I. Density

II. Weight Density

III. Specific Volume

IV. Specific Gravity of a fluid.

**3** Attempt any **two** parts : **10×2=20**

a) I. Explain doublet and define the strength of the doublet

II. Distinguish between a source and sink

b) Kerosene flows through the Venturimeter shown in FIG 1 with flow rates between 0.005 $m^3/s$ and 0.050 $m^3/s$. Determine the range in pressure difference, needed to measure these flow rates. (Specific Gravity of Kerosene = 0.85)

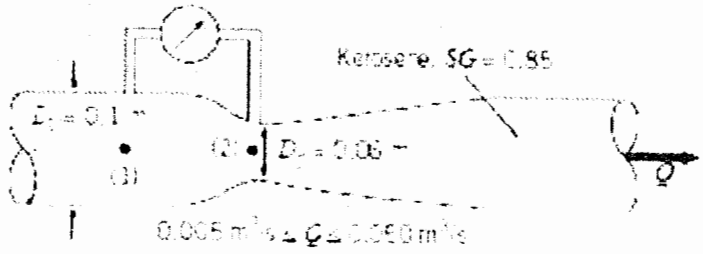


**FIG 1**



c) The fluid dynamic characteristics of an airplane flying 240 mph at 10,000 ft (3048 m) are to be investigated with the aid of a 1 : 20 scale model. If the model tests are to be performed in a wind tunnel using standard air, what is the required air velocity in the wind tunnel? Is this a realistic velocity?

**4** Attempt any **two** parts : **10×2=20**

a) Derive an expression for the loss of head due to

I. Sudden enlargement

II. Sudden Contraction.

b) Water at 20°C is to be pumped from a reservoir ($Z_A$ = 5 m) to another reservoir at a higher elevation ($Z_B$ = 13 m) through two 36 m long pipes connected in parallel, as shown in FIG 2. The pipes are made of commercial steel, and the diameters of the two pipes are 4 and 8 cm. Water is to be pumped by a 70 percent efficient motor–pump combination that draws 8 kW of electric power during operation. The minor losses and the head loss in pipes that connect the parallel pipes to the two reservoirs are considered to be negligible. Determine the total flow rate between the reservoirs and the flow rate through each of the parallel pipes.

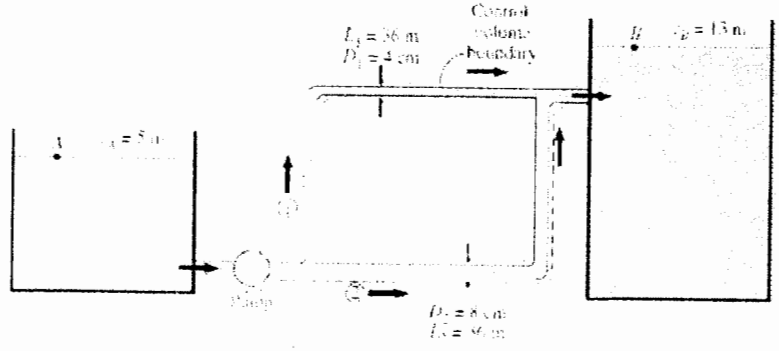

**FIG 2**

c) I. Explain the phenomenon of water hammer.

II. State and prove Stokes' law

5 Attempt any **two** parts : **10×2=20**

a) An 0.80 m diameter, 1.2 m high garbage can is found in the morning tipped over due to high winds during the night. Assuming the average density of the garbage inside to be 150 kg/m$^3$ and taking the air density to be 1.25 kg/m$^3$, estimate the wind velocity during the night when the can was tipped over. Take the drag coefficient of the can to be 0.7.

b) If the circulation developed on an airfoil is equal to $\pi$ CU Sin $\alpha$, prove that the coefficient of lift for airfoil is given by $C_L = 2\pi$ Sin $\alpha$, where $\alpha$ = angle of attack.

c) I. How and why is the stagnation enthalpy $h_0$ defined? How does it differ from ordinary (static) enthalpy?

II. Determine the stagnation temperature and stagnation pressure of air that is flowing at 44 kPa, 245.9 K, and 470 m/s.