Total No. of printed pages = 4

CT-403/FM/4th Sem/2013/M

FLUID MECHANICS

Full Marks – 70

Pass Marks – 28

The figures in the margin indicate full marks for the questions.

Answer question No. 5 and any *three* from the rest.

1. Answer any *two* : 10

(a) What is viscosity.

Calculate the dynamic viscosity of an oil, which is used for. Lubrication between a square plate of size 0·8m × 0·8m and an inclined plane with angle of inclination 30° as shown in Fig 1. The weight of the square plate is 300 N and it slides down the inclined plane with a uniform velocity of 0·3 m/s. The thickness of the oil film is 1·5 mm.

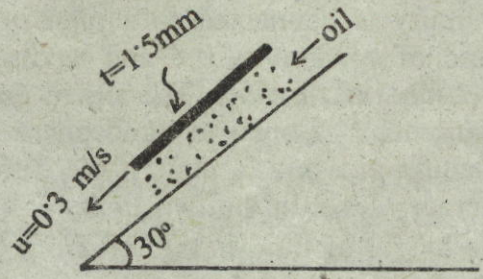

Fig. 1

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(b) (i) What is surface tension ? 5

Prove that the relationship between surface tension and pressure inside a droplet of liquid in excess of outside pressure is given by $P = \frac{4\sigma}{d}$

(ii) What is capillarity ?

Derive an expression for capillary rise. 5

(c) Calculate the capillary effect in mm in a glass tube of 4 mm diameter, when immersed in (i) water (ii) mercury. The temperature of the liquid is 20°C and the values of surface tension of water and mercury at 20°C in contact with air are 0·073575 N/m and 0·51 N/m respectively The angle of contact for water is zero that for mercury 1·30°. Take density of water at 20°C as equal to 998 kg/m^3. 10

2. (a) Define Pascal's law. 8

A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of sp. gravity 0·8 and having vacuum pressure is flowing. The other end of the manometer is open to atmosphere. Find the vacuum pressure in pipe, if the difference of mercury level in the two limbs is 40 cm and the height of fluid in the left from the centre of pipe is 15 cm below.

(b) (i) A 30 cm diameter pipe, conveying water, branches into two pipes of diameters 20 cm and 15 cm respectively. If the average velocity in the 30 cm diameter pipe is 2·5 m/s, find the discharge in this pipe. Also determine the velocity in 15 cm pipe if the average velocity in 20 cm dia pipe is 2 m/s. 8

(ii) State and derive the continuity equation. 4

3. (a) What is venturimeter? 10
Derive an expression for rate of flow through a venturimeter.

(b) An orifice meter with orifice diameter 10 cm is inserted in a pipe of 20 cm diameter. The pressure gauges fitted upstream and downstream of the orifice meter gives readings of 19·62 N/cm^2 and 9·81 N/cm^2 respectively. Coefficient of discharge for the meter is given as 0·6. Find the discharge of water through pipe. 10

4. (a) A circular tank of diameter 1·25m contains water upto a height of 5m. An orifice of 50 mm diameter is provided at its bottom. If $C_d = 0·62$, find the height of water above the orifice after 1·5 minutes. 10

(b) Find the discharge through a rectangular orifice 3·0m wide and 2m deep fitted to a water tank. The water level in the tank is 4m above the top edge of the orifice. Take $C_d = 0{\cdot}62$. 5

(c) Find the discharge through a totally drowned orifice 1·5m and 1m deep, if the difference of water levels on both the sides of the orifice be 2·5m. Take $C_d = 0{\cdot}62$. 5

5. Answer any *one* :

(a) (i) Find the bed slope of a trapezoidal channel of bed width 6m, depth of water 3m and side slope of 3 horizontal to 4 vertical, when the discharge through the channel is 30 m^3/sec. Take Chezy's constant, C = 70. 5

(ii) A rectangular channel carries water at the rate of 400 l/sec when bed slope is 1 in 2000. Find the most economical dimension of the channel is C = 50. 5

(b) Write a short note on energy losses in a pipe. 10