3E2015

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3E2015

B. Tech. (Sem. III) (Main & Back) Examination, January - 2013
Civil Engg.
3CE5 Fluid Mechanics

Time : **3** Hours] [Total Marks : **80**
[Min. Passing Marks : **24**

Attempt any ***five*** *questions, selecting* ***one*** *question from each unit. All questions carry* ***equal*** *marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.*
Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination.
(Mentioned in form No. 205)

1. NIL 2. NIL

UNIT - I

1 (a) Give the classification of fluids and Regimes of flow based on density and viscosity. Also give rheological classification of fluids. 8

(b) The velocity variation in a pipe flow is expressed as :

$$\frac{u}{U} = 1 - \left(\frac{r}{R}\right)^2$$

Where 'U' is the velocity at centre line, and 'r' and 'R' are the radial distances for the point and the wall respectively.

Determine the shear stress 'τ' and $'\left(\frac{r}{R}\right)'$ ratios of 0.0, 0.2, 0.5, 0.8 and 1.0. Given that $U = 10\, m/s$ and $\mu = 2$ centipoise. The pipe is 1m in diameter. Also calculate the drag force/m length of pipe. 8

OR

1 (a) A U-tube is made up of two capillaries of diameters 1.0 mm and 1.5 mm respectively. The U-tube is kept vertically and partially filled with water of surface tension 0.0075 kg/m and zero contact angle. Calculate the difference in the level of the meniscii caused by the capillarity.

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(b) During the flow of a fluid following the law

$$\tau = \mu \left(\frac{du}{dy} \right)^{1.3}$$

it is observed that the velocity distribution within the fluid film is given by -

$$\left(\frac{u}{U_{\max}} \right) = 2\left(\frac{y}{h} \right) - (y/h)^3 / 3$$

where h is the film thickness and $U_{\max}$ is the max^{m} velocity.

The viscosity is $0.5\, N - S/m^2$.

(i) Calculate the shear stress at the solid surface when. U_{max} = 0.2 m/s and h = 1 cm

(ii) Estimate the viscosity of a Newtonian fluid to induce the same shear stress for the same velocity propile and same maximum velocity.

8

UNIT - II

2 (a) Draw neat sketch of Bourdon's pressure gauge and explain its working.

6

(b) A hollow cylinder open at both ends has internal dia. of 30 cm, wall thickness of 15 cm and a length of 90 cm. If it weighs 625 N, find whether the cylinder would be stable while floating in water with its axis vertical.

10

OR

2 (a) Explain the terms meta-centre and meta-centric height. Derive an expression for the meta-centric height of a floating body.

8

(b) The gates of a lock are 5m wide and 5m high, and when closed, include an angle of 120°. Each gate has two hinges, one placed at the top and the other at the bottom of the gate. If the water levels are 4.5 m and 3 m on the upstream and downstream sides respectively. Determine the magnitude of the forces on the hinges due to water pressure.

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UNIT - III

3 (a) Derive the continuity equation for an incompressible fluid flow.

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(b) Determine the circulation 'Γ' around a rectangle defined by $x=1, y=1, x=5$ and $y=4$ for the velocity field $u=2x+3y$ and $v=-2y$. Also calculate viscosity 'w_z'.

8

OR

3 (a) Derive Euler's equation of motion along a stream line for an ideal fluid flow stating assumptions. Explain how this is integrated to get Bernoullis equation along a streamline.

8

(b) The velocity components in a 2-D flowfield for an incompressible fluid are expressed as

$$u = \frac{y^3}{3} + 2x - x^2 y \quad \text{and} \quad v = xy^2 - 2y - \frac{x^3}{3}$$

(i) Show that these functions represent possible case of an irrotational flow.

(ii) Obtain expression for stream function 'ψ' and velocity potential 'ϕ'.

8

UNIT - IV

4 (a) Define an orifice - meter. Prove that the discharge through an orifice-meter is given by

$$Q = Cd \cdot \frac{a_0 a_1}{\sqrt{a_1^2 - a_0^2}} \sqrt{2gh}$$

where a_1 = area of pipe in which orifice-meter is filled

a_0 = area of orifice

(b) A fireman must reach a window 40 m above the ground with a water jet, from a nozzle 3 cm diameter discharging 30 kg/s. Assuming the nozzle height of 2m, determine the greatest distance from the building where fireman can stand and still reach the jet into window.

8

OR

4 (a) What is Cippolleti weir ? Prove that the discharge through Cippoletti weir is given by

$$Q = \frac{2}{3} Cd\, L \sqrt{2g}\, H^{3/2}$$

Where L = length of weir and H is head of water over weir.

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(b) Find the force exerted by the nozzle on the fireman for the configuration and data in fig. Q. 4(b) below

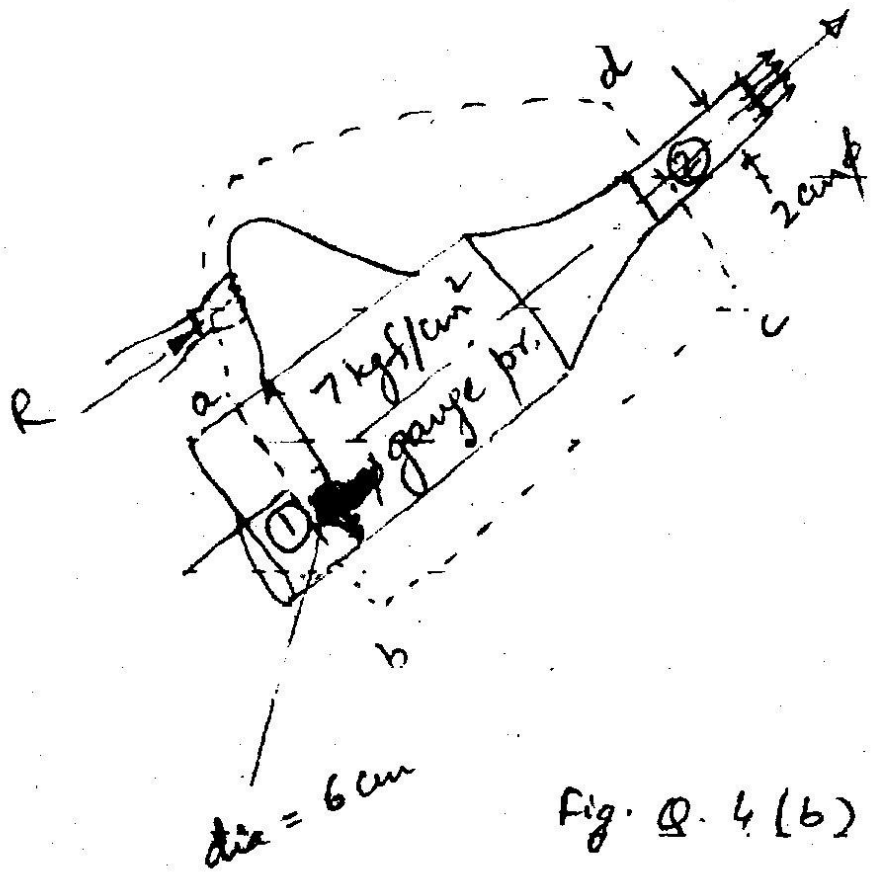

Fig. Q. 4(b)

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UNIT - V

5 (a) Derive Darcy - Weisbach formula for determining friction loss in pipe flow.

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(b) A pipe of diameter 250 mm and length 4 km is used for the transmission of power by water. The total head at the inlet of the pipe is 500 m. Find the maximum power available at the outlet of pipe, if the value of $f = 0.008$. Here 'f' is the coefficient of friction.

8

OR

5 (a) Write short notes on :

(i) Boundary layer separation and control

(ii) Power transmission through pipe and condition for maximum transmission of power.

4+4=8

(b) In a parallel pipe connection as shown in fig. Q. 5(b) below, the total flow from M to N is 0.5 m^3/s. What should be the diameter of a single pipe of shortest length for the same capacity. Here (1), (2) and (3) are the pipes and their respective lengths are 1000 m, 800 m and 900 m. Also their diameters are 0.3 m, 0.3 m and 0.4 m respectively.

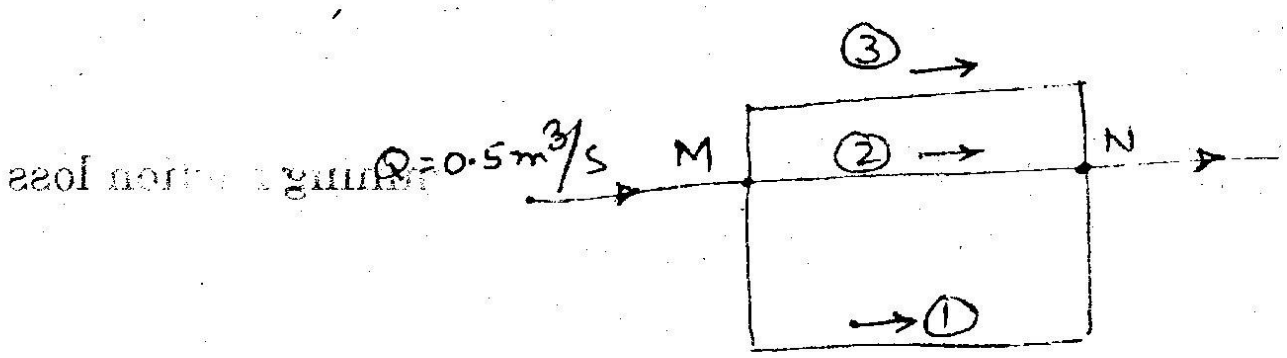

Fig. Q 5(b)

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