B. E. (with Credits)-Regular-Semester 2012-Civil Engineering Sem III

CL303 - Fluid Mechanics-I

P. Pages : 3 **GUG/W/16/3675**

Time : Three Hours * 3 5 9 5 * Max. Marks : 80

Notes : 1. All questions carry equal marks.
2. Answer all questions.
3. Due credit will be given to neatness and adequate dimensions.
4. Assume suitable data wherever necessary.
5. Illustrate your answers wherever necessary with the help of neat sketches.
6. Use of non programmable calculator is allowed.

1. a) A rectangular plate of size 25cm x 50cm & weighing 25kg & slides down a 30º inclined surface at a uniform velocity of 2 m/sec. If the uniform 2mm gap between the plate & inclined surface is filled with oil Determine the viscosity of the oil. **8**

b) State & prove Hydrostatic law. **4**

c) Convert a pressure head of 100m of water to (i) head of kerosene of specific gravity 0.81. ii) Head of carbon tetrachloride of specific gravity 1.6. **4**

OR

2. a) A pressure gauge consist of 2 cylindrical bulb B & C each of 10 cm^2 c/s area. Which are connected by a u-tube with vertical limbs each of $0.25cm^2$ c/s area. A red liquid of Sp. gravity 0.9 is filled into C and clear water is filled into B. The surface of separation being in the limb attached to C. Find the displacement of the surface of separation when the pressure on the surface in C is greater than that in B by an amount equal to 1cm head of water. **8**

b) Show that the relationship between surface tension and pressure inside a droplet of liquid given by $\Delta p = \frac{2\sigma}{r}$. **8**

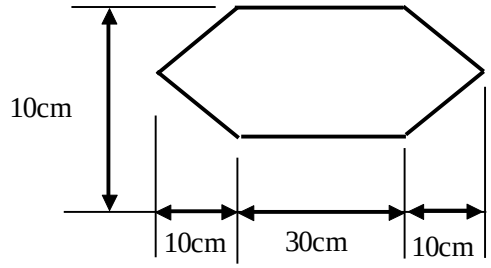
3. a) A $3.6m \times 1.5m$ wide rectangular gate. MN is vertical and hinged at a pt 0.15m below the centre of gravity of the gate. The total depth of water is 6m. What horizontal force must be exerted at the bottom of the gate to keep the gate close. **8**

b) Show that the metacentric height of a floating body is given by. **8**
$GM = \frac{I}{\forall} - BG$.

OR

4. a) A circular plate 2.5m dia. is immersed in water. It's greatest and least depth below the free surface being 3m & 1m resp. Find the total pressure on face of the plate & position of centre of pressure. **8**

b) Figure shows horizontal section at water level of a ship of 8000kN displacement. It's centre of gravity is 300mm below the water surface. Find the meta-centric height for rolling about x-x axis & pitching about y-y axis. Assume that centre of buoyancy at ship is 2.50m below the water surface. **8**



5. a) A fluid flow is given by $\vec{V} = xy^2\,\hat{i} - 2yz^2\,\hat{j} - \left(zy^2 - 2\frac{z^3}{3}\right)\hat{k}$ Prove that it is a case of possible steady incompressible fluid flow. Calculate the velocity & acceleration at the point (1, 2, 3). **8**

b) Differentiate between. **8**

i) Stream function & velocity potential function.

ii) Stream line and streak line.

iii) Rotational flow and irrotational flow.

iv) Compressible and incompressible fluid.

OR

6. a) Derive an expression for continuity for three-dimensional flow & reduce it for steady incompressible two dimensional flow. **8**

b) The stream function for a two dimensional flow is given by $\psi = 2xy$, Calculate the velocity at point P (2, 3). Find the velocity potential function β. **8**

7. a) Find the discharge of water flowing through a pipe 30cm diameter placed in an inclined position where a venturimeter is inserted; having a throat diameter of 15cm. The difference of pressure between the main & throat is measured by a liquid of specific gravity 0.6 in an inverted U-tube which gives a reading of 30cm. The loss of head between the main and throat is 0.2 time the kinetic head of the pipe. **8**

b) A pipe of 20cm diameter conveying $0.20\,m^3/sec$ of water has a right angle bend in a horizontal plane. Find the resultant force exerted on the bend if the pressure at inlet & outlet of the bend are $22.563\,N/cm^2$ & $21.582\,N/cm^2$ resp. **8**

OR

8. a) A circular tank of diameter 1.5m contains water upto a height of 4m. An orifice of 40mm diameter is provided at its bottom. If C_d = 0.62 Find the height of water above the orifice after 10 min. **8**

b) A sharp crested rectangular weir of 1m height extends across a rectangular channel of 3m width. If the head of water over the weir is 0.45m calculate the discharge. Consider velocity of approach & assume C_d = 0.623. **8**

9. a) The discharge Q over a V-shaped notch is known to depend on the angle θ of the notch, the head H of the water surface the velocity of approach V_0 & the acceleration due to gravity of. Determine the dimensionless form of the discharge equation. **8**

b) State Buckingham's π- theorem ? What do you mean by repeating variable ? How are the repeating variable. Selected for dimensional analysis ? **8**

OR

10. a) Water is flowing through a pipe of diameter 30cm at a velocity of 4 m/s. Find the velocity of oil flowing in another pipe of diameter 10cm. If the condition of dynamic similarity is satisfied between the two pipe. The vescocity of water and oil is given as 0.01 poise & 0.025 poise. The specific gravity of act = 0.8 **8**

b) What are model laws. Explain Reynolds model law. **8**

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