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Degree / Branch: BE / Mechanical Engineering **Semester /Year: III / II**

Sub Code / Name: CE3391 / Fluid Mechanics and Machinery

Question Bank (2Mark & 16 Mark)

UNIT I - STEAM NOZZLES

1. Define density or mass density.

Density of a fluid is defined as the ratio of the mass of a fluid to its volume. Density, ρ = mass/volume (Kg/m3) ρwater = 1000 Kg/m3.

2. Define specific weight or weight density.

Specific weight or weight density of a fluid is defined as the ratio between the weight of a fluid to its volume. Specific weight, v = weight/volume (N/m3) v = ρg v water = 9810 N/m3.

3. Define specific volume.

Specific volume of a fluid is defined as the volume of fluid occupied by an unit wt or unit mass of a fluid. Specific volume vs = volume/ wt = 1/ v = 1/ρg ----- for liquids Specific volume vs = volume/ mass = 1/ρ ----- for gases.

4 .Define dynamic viscosity.

Viscosity is defined as the property of fluid which offers resistance to the movement of one layer of fluid over another adjacent layer of the fluid. du ζ = μ --------- dy μ – dynamic viscosity or viscosity or coefficient of viscosity (N-s/m2

5. Define Kinematic viscosity.

It is defined as the ratio between the dynamic viscosity and density of fluid. v = μ/ρ (m2 /s) 1 m2 /s = 10000 Stokes (or) 1 stoke = 10-4 m 2

6. Types of fluids.

Ideal fluid, Real fluid, Newtonian fluid, Non-Newtonian fluid, Ideal Plastic fluid.

7. Define Compressibility.

It is defined as the ratio of volumetric strain to compressive stress.

8. Define Surface Tension.

Surface tension is defined as the tensile force acting on the surface of the liquid in contact with a gas or on the surface between two immiscible liquids such that the contact surface behaves like a membrane under tension. Surface Tension, σ = Force/Length (N/m) σwater = 0.0725 N/m, σMercury = 0.52 N/m

9. Define Capillarity.

Capillarity is defined as a phenomenon of rise or fall of a liquid surface in a small tube relative to the adjacent general level of liquid when the tube is held vertically in the liquid. The rise of liquid surface is known as capillary rise while the fall of liquid surface is known as capillary depression.

10. Define Vapour Pressure.

When vaporization takes place, the molecules start accumulating over the free liquid surface exerting pressure on the liquid surface. This pressure is known as Vapour pressure of the liquid.

11. Define Control Volume.

A control volume may be defined as an identified volume fixed in space. The boundaries around the control volume are referred to as control surfaces. An open system is also referred to as a control volume.

12. Define forced vertex flow?

Give example? It is defined as that type of vertex flow in which some external torque is required to rotate the fluid mass. Example. 1.A vertical cylinder containing liquid which is rotated about its central axis with a constant angular velocity. 2.Flow of liquid inside the impeller of a centrifugal pump.

13. Define compressible flow?

Compressible flow is that type of flow in which the density of the fluid changes from point to point.(eg)Flow of gasses through orifice nozzle and gas turbine.

14. Define incompressible flow?

Incompressible flow is that type of flow in which the density is constant for the fluid flow.(eg)Subsonic aerodynamics.

15. Define rotational flow?

Rotational flow is that type of flow in which in which the fluid particle flowing along streamlines, also rotate about their own axis.

16 MARKS

1. Find the Kinematic viscosity of an oil having density 981 kg/m. The shear stress at a point in oil is 0.2452 N/m2 and velocity gradient at that point is 0.2 /sec.

2. .Calculate the capillary effect in millimeters a glass tube of 4mm diameter, when immersed in (a) water (b) mercury. The temperature of the liquid is 200 C and the values of the surface tension of water and mercury at 200 C in contact with air are 0.073575 and 0.51 N/m respectively. The angle of contact for water is zero that for mercury 1300 . Take specific weight of water as 9790 N / m3.

3. A cylinder of 0.6 m3 in volume contains air at 500C and 0.3 N/ mm2 absolute pressure. The air is compressed to 0.3 m3 . Find (i) pressure inside the cylinder

assuming isothermal process (ii) pressure and temperature assuming adiabatic process. Take K = 1.4

4. If the velocity profile of a fluid over a plate is a parabolic with the vertex 202 cm from the plate, where the velocity is 120 cm/sec. Calculate the velocity gradients and shear stress at a distance of 0,10 and 20 cm from the plate, if the viscosity of the fluid is 8.5 poise.

5. A 15 cm diameter vertical cylinder rotates concentrically inside another cylinder of diameter 15.10 cm. Both cylinders are 25 cm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. If a torque of 12.0 Nm is required to rotate the inner cylinder at 100 rpm determine the viscosity of the fluid.

6. The dynamic viscosity of oil, used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4 m and rotates at 190 rpm. Calculate the power lost in the bearing for a sleeve length of 90 mm. The thickness of the oil film is 1.5 mm.

7. The diameters of a small piston and a large piston of a hydraulic jack at3cm and 10 cm respectively. A force of 80 N is applied on the small piston Find the load lifted by the large piston when: a. The pistons are at the same level b. Small piston in 40 cm above the large piston. The density of the liquid in the jack in given as 1000 kg/m3

8. If the velocity distribution over a plate is given by $2\ 3\ 2\ \ y- y =u$ in which U is the velocity in m/s at a distance y meter above the plate, determine the shear stress at y = 0 and y = 0.15 m. Take dynamic viscosity of fluid as 8.63 poise.

9. Two horizontal plates are placed 1.25 cm apart. The space between them being filled with oil of viscosity 14 poises. Calculate the shear stress in oil if upper plate is moved with a velocity of 2.5 m/s.

10. Find out the minimum size of glass tube that can be used to measure water level if the capillary rise in the tube is to be restricted to 2mm. Consider surface tension of water in contact with air as 0.073575 N/m.

11. A U-Tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs U. U tube is 10 cm and the free surface of mercury is in level with over the centre of the pipe. If the pressure of water in pipe line is reduced to 9810 N/m2 , Calculate the new difference in the level of mercury. Sketch the arrangement in both case.

12. A vertical sluice gate is used to cover an opening in a dam. The opening is 2m wide and 1.2m high. On the upstream of the gate, the liquid of sp. Gr 1.45, lies upto a height of 1.5m above the top of the gate, whereas on the downstream side the water is available upto a height touching the top of the gate. Find the resultant force acting on the gate and position of centre of pressure. Find also the force acting horizontally at the top of the gate and posiotn of centre of pressure. Find also the force acting horizontally at the top of the gate which is capable of opening it. Assume the gate is hinged at the bottom.

13. Water flows through a pipe AB 1.2m diameter at 3 m/s and then passes through a pipe BC 1.5 m diameter at C, the pipe branches. Branch CD is 0.8m in diameter and carries one third of the flow in AB. The flow velocity in branch CE is 2.5 m/s. find the volume rate of flow in AB, the velocity in BC, the velocity in CD and the diameter of CE

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line is reduced to 9810 N/m2 , Calculate the new difference in the level of mercury. Sketch the arrangement in both cases.

15. A differential manometer is connected at the two points A and B of two pipes a shown in figure. The pipe A contains a liquid of sp. Gr = 1.5 while pipe b contains a liquid of sp . gr = 0.9 . The pressures at A and B are 1 kgf / cm2 respectively. Find the difference in mercury level in the differential manometer.

16. A vertical sluice gate is used to cover an opening in a dam. The opening is 2m wide and 1.2m high. On the upstream of the gate, the liquid of sp. Gr 1.45, lies upto a height of 1.5m above the top of the gate, whereas on the downstream side the water is available upto a height touching the top of the gate. Find the resultant force acting on the gate and position of centre of pressure. Find also the force acting horizontally at the top of the gate and posiotn of centre of pressure. Find also the force acting horizontally at the STUDENTSFOCUS.COM top of the gate which is capable of opening it. Assume the gate is hinged at the bottom.

17. A solid cylinder of diameter 4.0 m has a height of 3m. Find the meta – centric height of the cylinder when it is floating in water with its axis vertical. The sp gr of the cylinder – 0.6.