FLUID MECHANICS AND MACHINERY –

UNIT-I

FLUID FLOW PROPERTIES AND FLOW CHARACTERISTICS

2 MARKS – UNIVERSITY Questions and Answers

1. Distinguish between ideal and Real Fluids. (April 2003)

Real Fluid	Ideal Fluid:
1. Compressible	1. Obeys Newton's Law of viscosity.
2. Viscous in nature	
3. Some resistance is always offered by the fluid when it is in motion.	
4. Shear stress always exists in such fluids	

2. Why are some fluids classified as newtonian fluids Give some example to newtonian fluids. (NOV 2002)

In newtonian fluids, a linear relationship exists between the magnitude of shear stress and the resulting rate of deformation.

Example: water Kerosene

3. Distinguish between mass density and specific weight (Dec 2006)

Mass density	Specific weight
1. $\frac{m}{v}$ Mass per unit Volume	1. $\frac{W}{V}$ Weight per unit volume.
2. Unit is Kg/	2. Unit is N/m^3.
3. It does not vary Place to Place	3. It varies from Place to place because of acceleration due to Gravity

3. what is Specific gravity? How is it related to density? (April 2008)

$$S = \frac{\text{Density of liquid}}{\text{Density of standard liquid. ex. water}}$$

It Can be defined as the ratio of mass density of fluid to mass density of standard fluid.

4. Define the term Pressure, what are its units? (Dec 2005)

$$P = \frac{F}{A}$$

It may be called as intensity of Pressure. If F is the total force exerted over an area A. The Pressure at any point is given mathematically as $P = F/A$.

Unit of Pressure is in SI N/m^2 or pascal.

5. State pascal's Law (Dec 2005 & Dec 2008)

The normal stress acting at a point in a fluid is independent of the orientation of the surface on which it acts.

6. what is mean by stagnation Pressure? (Dec 2008)

The Pressure at which velocity of fluid particles is Zero is called stagnation Pressure.

1-(8)

(7) what is the difference between gauge Pressure and absolute Pressure. (Dec 2007)

Gauge Pressure (P_g)

It is the Pressure recorded by the Pressure gauge when the Pressure gauge read 'Zero' Pressure at atmospheric Level, they actually measure the difference between fluid and atmospheric Pressure

Absolute Pressure (P_{abs})

The Pressure measured from the absolute Zero Pressure is called absolute Pressure

$$P_{abs} = P_{atm} + P_g$$

$$P_{abs} = P_{atm} - P_{vac}$$

(8) Define Compressibility and viscosity of a fluid (NOV 2003 & April 2005)

Ratio of the change in Pressure to the rate of change of volume due to the change in Pressure.

$$\text{Bulk modulus } K = \frac{\text{change in Pressure}}{\text{change in volume per unit volume}}$$

Viscosity is the Property of a liquid which determines the amount of resistance to a shearing Stress. It can also be defined as the Property of a fluid due to which it offers resistance to the movement of one layer of fluid over adjacent layer.

Unit is $\frac{N-S}{m^2}$ (or) $\frac{kg}{m-s}$.

(9) State the Newton's Law of Viscosity. (April 2004)

According to Newton's Law of Viscosity, the Shear force F acting between two Layers of fluid is Proportional to the difference in their velocities du and area A of the plate and inversely Proportional to the distance between them.

(10) What is Viscosity ? What is the Cause of it in liquids and in gases ? (Dec 05, Dec 07, April 08)

Viscosity increases with increase in temperature in case of gases whereas it decreases in case of liquid.

(11) What is the effect of temperature on viscosity of water and that of air? (Nov 2004)

When the temperature of water increases, the viscosity will decrease but it will increases with increase in temperature of air

(12) Define Capillarity Apr. 2004, Dec 2005, Dec 2006

Capillary is a phenomenon of rise or fall of liquid surface relative to the adjacent General level of liquid. This phenomenon is due to the Combined effect of Cohesion and adhesion of liquid particles. The rise of liquid level is known as Capillary rise where as the fall of liquid Surface is known as capillary depression.

1(5)

13. Explain the effect of property of Capillarity. (Nov 2004)

This phenomenon is due to the combined effect of cohesion and adhesion of liquid particles. So, the surface will act around the circumference of tube.

14. Express 3m of water head in Cm of mercury and Pressure in kpa. (April 2003)

$h = 3m$

Weight of water $9810\ N/m^3$

Pressure $p = w.h.$

$= 9810 \times 3$

$= 29430\ N/m^2 = 29.43\ KN/m^2$

$P = 29.43\ kpa$

15. What is meant by Continuum? (Dec 2008)

All Substance are made up of molecules Molecules inside the Substances are in Constant motion and collide with eanh other. In gases, molecules are not closely spaced. So, the study of motion of individual molecule is described with the help of statistical methods. But in liquids, the molecules are closely spaced which create strong intermolecular cohesive forces. Thus, the liquid behaves as a continuous mass.

Therefore, we are not interested in the motion of individual molecules, but in the overall motion of the fluid. And, therefore, we consider the fluid as a continuous medium, called continuum, i.e there is a continuous distribution of matter with no empty space.

16. State the equation of continuity to three dimensional in compressible flow (Dec 2005)

$$\frac{\partial}{\partial x}(\rho u) + \frac{\partial}{\partial y}(\rho v) + \frac{\partial}{\partial z}(\rho w) = 0$$

17. State Bernoulli's Theorem as applicable to fluid flow. (Nov 2003, April 2004, Dec 2007)

Bernoulli's equation states that an ideal incompressible fluid when the flow is steady and continuous, the sum of pressure energy kinetic energy and potential energy is constant along the streamline.

$$\frac{P}{w} + \frac{v^2}{2g} + z = \text{Constant}$$

$\frac{P}{w}$ = Pressure energy

$\frac{v^2}{2g}$ = Kinetic energy

z = Potential energy

18. What are the three major assumptions made in the derivation of the Bernoullis equation (April/2008)

a) The liquid is ideal and incompressible
b) The flow is steady and Continous
c) The velocity is uniform over the Cross Section and is equal to mean velocity.
d) The only forces acting on the fluids are the gravity force and the Pressure force
e) All the frictional losses are negligible.

19. Mention any three applications of Bernoullis theorem (Dec 2006)

1. Venturimeter 2. Orifricemeter 3. pitot tube.

20. What do you understand by impulse momentum equation.

Impulse momentum equation states that the impulse of force acting on a fluid mass in a short interval of time is equal to the change of momentum in the direction of force.

21. What is Cavitation ? What Causes it? (Dec 2013)

It is defined as the phenomenon of formation of vapour bubbles of a flowing liquid in a region.

where the Pressure of the liquid falls below its vapour pressure and the sudden collapsing of these vapour bubbles in a region of high pressure. It erode the pump and ~~Pump~~ Turbine parts

(22) Differentiate between kinematic viscosity of liquids and gases with respect to pressure (Dec 2013) 1-8

In case of liquids, kinematic viscosity decreases with increase in temperature.

In case of gases it increases with increase in temperature

(23) Define Newton's Law of viscosity (Dec 2012) Same as (9) Repeated.

(23) A soap bubble is formed when the inside Pressure is 5 N/m2 above the atmospheric Pressure. If Surface tension in the soap bubble is 0.0125 N/m, find the diameter of the bubble formed. (may 2010)

Solution

$$P = \frac{8\sigma}{d}$$

$$5 = \frac{8 \times 0.0125}{d}$$

$$d = 0.02m$$

$$d = 20mm$$

(24) The Converging pipe with inlet and outlet diameters of 200mm and 150mm Carries the oil whose specific gravity is 0.8 The velocity of oil at the entry is 2.5 m/s, find the velocity at the exit of the pipe and oil flow rate in kg/sec (April 2010)

Discharge $Q = A_1V_1 = \frac{\pi}{4}(0.2)^2 \times 2.5 = 0.0785 \frac{m^3}{sec}$

According to Continuity Eqn $A_1V_1 = A_2V_2 \Rightarrow \frac{\pi}{4}(0.2)^2 \times 2.5 = \frac{\pi}{4}(0.15)^2 \times V_2$

$V_2 = 4.44 m/s$

(25) Suppose the small air bubbles in a glass of tap water may be on the order of 50 μm in diameter. What is the pressure inside these bubbles (Dec 2010)

$\sigma = 0.073$ N/m

Pressure inside a water droplet $p = \frac{4\sigma}{d} = \frac{4 \times 0.073}{50 \times 10^{-6}}$

$p = 5840$ N/m²

(26) Why is it necessary in winter to use lighter oil for automobile than in Summer? To what property does the term lighter refer?

Oil will congeal in the winter by making the engine and transmission system shift during winter. This will lead to consume more power from battery.

It will be difficult to start the car with less battery power.

The use of lighter will remain more fluid than heavy oil during winter.

The term lighter refers to specific gravity of oil which indirectly relates with density.

The lighter oil has the specific gravity less than winter.