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QUESTION BANK (DESCRIPTIVE)

Subject with Code: FM&FM (18CE0152) **Course & Branch**: B.Tech - ME

Year & Sem: II-B.Tech & I-Sem **Regulation:** R18

UNIT –I

FLUID PROPERTIES AND FLUID STATICS

1. a) Define and mention units for the following fluid properties: Density, specific weight, specific volume and specific gravity of a fluid. [L1] [5M]

   b) Calculate the specific weight, mass density and specific gravity one litre of a liquid and which weight is 7 N. [L4] [5M]

2. a) Differentiate kinematic viscosity and dynamic viscosity. Give their dimensions. [L1] [5M]

   b) A plate 0.025mm at a distance from a fixed plate moves at 60 cm/sec and requires a force of 2 N/m^2. Determine the dynamic and kinematic viscosity between the plates. [L4] [5M]

3. a) Define surface tension. Derive the relationship between surface tension and pressure inside a droplet of liquid in excess of outside pressure [L3] [5M]

   b) The surface tension of water in contact air at 20^0 C is 0.072 N/m. The pressure inside of water droplet of water is to be 0.02 N/cm^2 greater than the outside pressure. Calculate the diameter of the droplet of water. [L4] [5M]

4. a) Explain the terms of compressibility and bulk modulus. [L2] [6M]

   b) Determine the bulk modulus & compressibility of elasticity of a liquid. If the pressure of liquid is increased from 70 N/cm^2 to 180 N/cm^2. The volume of liquid decreases 0.15%. [L4] [4M]

5. a) Explain the phenomenon of capillarity. Obtain an expression for capillary rise of a liquid. [L2] [5M]

   b) Calculate the capillary raise in a glass tube of 2.5mm diameter when immersed vertically water & mercury. Take surface tension is 0.0725 N/m for water and 0.52 N/m for mercury. The specific gravity of mercury is given 13.6 and angle of contact is 130^0. [L4] [5M]

6. a) State Pascal's law. What do you understand the terms Absolute, Gauge, atmospheric & vacuum pressure? [L1] [5M]

   b) What is the gauge pressure at a point 3m below the free surface of a liquid having a density 1.53×10^3 kg/m^3, if the atmospheric pressure is equivalent to 750 mm of mercury, the Specific gravity of mercury is 13.6 and density of water = 1000 kg/m^3? [L4] [5M]

7. a) List out different types of manometers. Explain differential manometers with neat sketches. [L2] [5M]

   b) A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of specific gravity is 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 40cm and the height of fluid in the left from the center of pipe is 15cm below. [L4] [5M]

8. a) What do you mean by single column manometer? How are they used for the measurement of pressure? [L1] [5M]

   b) An inverted U – tube manometer is connected to two horizontal pipes A and B through which water is flowing. The vertical distance between the axes of these pipes is 30cm. When an oil of specific gravity 0.8 is used as a gauge fluid, the vertical heights of water columns in the two limbs of the inverted manometer (when measured from the respective center lines of the pipes) are found to be same and equal to 35 cm. Determine the difference of pressure between the pipes. [L4] [5M]

9. Explain briefly the working principle of Bourdon's pressure gauge with neat sketch. [L2] [10M]

10. a) What do you understand by "Total Pressure" and "Centre of pressure"? [L1] [5M]

    b) A rectangular plane surface 3 m wide and 4 m deep. It lies in vertical plane in water. Determine the total pressure force and position of center of pressure, when the upper edge is 2 m below the free surface. [L4] [5M]

UNIT –II

FLUID KINEMATICS AND FLUID DYNAMICS

1. a) Define the terms: Stream line, streak line, path line, stream tube and control volume. [L1] [5M]

   b) Explain different types of flow. [L2] [5M]

2. a) Define local acceleration, convective acceleration and tangential acceleration. [L2] [5M]

   b) The velocity vector in a fluid flow is $V= 4x^3i-10x^2yj+2tk$, find the velocity and acceleration of a fluid particle at (2, 1, 3) at time t=1. [L5] [5M]

3. a) Obtain an expression for continuity equation for three - dimensional flow. [L2] [5M]

   b) 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 the pipe. Also determine the velocity in 15 cm pipe if the average velocity in 20 cm diameter pipe is 2 m/s. [L4] [5M]

4. a) Define the following terms: Velocity potential function, stream function, equipotential line and flow net. [L2] [5M]

   b) If for a two – dimensional potential flow, the velocity potential is given by $\text{Ø} = x(2y-1)$. Determine the velocity at the point P (4, 5). Also determine the value of stream function Ψ at the point P. [L4] [5M]

5. a) Derive Bernoulli's equation and state assumptions. [L2] [5M]

   b) Water is flowing through a pipe has diameter 300 mm and 200 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 24.525 N/cm^2 and the pressure at the upper end is 9.81 N/cm^2. Determine the difference in datum head if the rate of flow through pipe is 40 lit/s. [L4] [5M]

6. a) Derive Euler's equation of motion. [L5] [5M]

   b) Derive momentum equation and impulse momentum equation. [L5] [5M]

7. A vertical wall is of 8 m height. A jet of water is coming out from a nozzle with a velocity of 20 m/s. The nozzle is situated at a distance of 20 m from the vertical wall. Find the angle of projection of the nozzle to the horizontal so that the jet of water just clears the top of the wall. [L4] [10M]

8. A 300 mm diameter pipe carries water under a head of 20 m with a velocity of 3.5 m/s. if the axis of the pipe turns through 45°, find the magnitude and direction of the resultant force at the bend.
   a) Define hydraulic gradient line and energy gradient line.
   b) Explain about energy correction factor and momentum correction factor. [L2] [10M]

9. a) Define free vortex flow and forced vortex flow. [L1] [5M]

b) Derive equation of motion for forced vortex flow. [L4] [5M]

10. The following case represents the two velocity components. i) $u= x^2+y^2+z^2$, $v= xy^2-yz^2+xy$ and ii) $v=2y^2$, $w=2xyz$ Determine the third velocity component such that they satisfy the continuity equation. [L4] [10M]

UNIT –III
ANALYSIS OF PIPE FLOW & FLOW MEASURMENT

1. Derive the expression for head loss in pipes due to friction by using Darcy-Weisbach equation. [L1][10M]
2. Derive the expression for flow through pipes in series and parallel. [L1] [10M]
3. The difference in water surface levels in two tanks, which are connected by three pipes in series of lengths 300 m, 170 m, 210 m and of diameters 300 mm, 200 mm, 400 mm respectively, is 12 m. Determine the rate of flow of water if co-efficient of friction are 0.005, 0.0052 and0.0048 respectively, considering :(1) minor losses also (2) neglecting minor losses. [L1] [10M]
4. a) A horizontal venture meter with 30cm diameter inlet and 10cm throat is used for measuring the flow of water through a pipeline. If pressure in pipe is 1.5kpa and the vacuum pressure at the throat is 40cm of mercury, calculate the rate of flow. It may be presumed that 5% of differential head is lost between the pipe main and the throat section. Also make calculations for the discharge co-efficient take specific weight of water = 10kN/m^3. [L1] [5M]

   b) In a 100mm diameter horizontal pipe a venture meter of 0.5 contraction ratio has been fixed. The head of water on the meter when there is no flow in 3m (gauge). Find the rate of flow for which the throat pressure will be 2m of water is 0.97 take atmospheric pressure head = 10.3m of water. [L1] [5M]
5. a) The following data relate to an orifice meter, Diameter of the pipe = 240mm, Diameter of the orifice = 120mm, Specific gravity of oil = 0.88, Reading of differential manometer = 400mm of mercury, Coefficient of discharge of the meter = 0.65. Determine the rate of flow of oil. [L1] [5M]

   b) An orifice meter with orifice diameter 10cm is inserted in a pipe of 20cm diameter. The pressure gauges fitted upstream and downstream of 19.62N/cm^2 and 9.81N/cm^2. Respectively co-efficient of discharge for the meter is given as 0.6. Find the discharge of water through pipe. [L1] [5M]
6. a) Explain pitot tube and pitot static tube. [L2] [5M]

   b) A sub-marine move horizontally on a sea and has its axis 15m below the surface of water. A pitot tube properly placed just in front of a sub-marine and along its axis is connected to two limbs of a u – tube containing mercury. The difference of mercury level is found to be 170mm, find the speed of the sub-marine knowing that the specific gravity of mercury is 13.6 and that of sea water is 1.026 with respect of fresh water. [L1] [5M]
7. Explain the principle of orifice meter and derive the equation to find the rate of flow of water through a pipe using the same. [L2] [10M]
8. A pipe line of 0.6 m diameter is 1.5 km long. To increase the discharge, another line of same diameter is introduced parallel to the first in the second half of the length. Neglecting minor losses, find the increase in discharge if 4f = 0.04. The head at inlet is 300 mm. [L1] [10M]
9. An external cylindrical mouth piece of diameter 150 mm is discharging water under a constant head of 6 m. Determine the discharge and absolute pressure head of water at vena – contracta. Take $\mathbf{C_d=0.855}$ and $\mathbf{C_c}$ for vena contracta = 0.62 and atmospheric pressure head = 10.3 of water. [L1] [10M]
10. a) What is the difference between Pitot tube and Pitot - static tube? [L2] [2M]

b) Briefly explain the Reynolds experiment. [L1] [3M]

c) Derive the expression for Reynolds number (R_e) [L1] [5M]

UNIT –IV

DIMENSIONAL ANALYSIS AND SIMILITUDE

1. a) Write a short note on dimensional homogeneity. [L1] [5M]

   b) Describe Rayleigh's method. [L1] [5M]

2. a) Describe briefly Buckingham's pi- theorem. [L1] [5M]

   b) The time period (t) of a pendulum depends upon the length (l) of the pendulum and acceleration due to gravity (g). Derive expression for time period. [L1] [5M]

3. What is similitude and describe the types of similarities [L1] [10M]

4. a) Write a short note on model laws. [L1] [5M]

   b) State and derive Reynolds's model law [L1] [5M]

5. a) A pipe of diameter 1.5 m is required to transport an oil of sp.gr 0.90 and viscosity 3×10^{-2} poise at the rate of 3000 liters /s. Tests were conducted on a 15 cm diameter pipe using water at 20° C. Find the velocity and the rate of flow in the model. Viscosity of water at 20° C is equal to 0.01 poise. [L4] [5M]

   b) Water is flowing through a pipe of diameter 30 cm at a velocity of 4 m/s. Find the velocity of oil flowing in another pipe of diameter 10 cm, if the condition of dynamic similarity is satisfied between the two pipes. The viscosity of water and oil is given as 0.01 poise and 0.025 poise. Take sp.gr. of oil =0.8 [L4] [5M]

6. Describe Froude model law and scale ratios briefly. [L2] [10M]

7. a) In 1 in 40 model of a spill way, the velocity and discharge are 2 m/s and 2.5 m^3/s. Find the Corresponding velocity and discharge in the prototype. [L4] [5M]

   b) In a model test of a spill way the discharge and velocity of flow over the model were 2 m^3/s and 1.5 m/s respectively. Calculate the velocity and discharge over the prototype which is 36 Times the model size. [L4] [5M]

8. Write a note on a) Euler's model law b) Weber model law c) model law [L1] [10M]

9. Describe briefly Buckingham's pi- theorem. [L2] [10M]

10. a) The time period (t) of a pendulum depends upon the length (l) of the pendulum and acceleration due to gravity (g). Derive expression for time period. [L3] [5M]

    b) The pressure drop in an aeroplane model of size 1/ 10 of its prototype is 180 N/ cm^2. The Model is tested in water find the corresponding pressure drop in the prototype. Take density of air =1.24 kg / m^3. The viscosity of water is 0.01 poise, while the viscosity of air is 0.00018 Poise. [L4] [5M]

UNIT –V

TURBINES AND CENTRIFUGAL PUMPS

1. Describe briefly definitions of heads and efficiencies of a turbine [L1] [10M]
2. a) What is Pelton turbine? Discuss the parts of Pelton turbine. [L1, L2] [5M]

   b) Derive the expression for velocity triangles and work done for Pelton wheel [L3] [5M]
3. A Pelton wheel is to be designed for the following specifications: Shaft power =11,772 KW; Head=380 m; Speed =750 r.p.m ; Overall efficiency = 86 % ; Jet Diameter is not exceeding one – sixth of the wheel diameter. Determine: a) The wheel diameter b) The number of jets required c) Diameter of the jet; Take K_{v1}=0.98, K_{u1}=0.45. [L4] [10M]
4. A Pelton wheel is to be designed for a head of 60 m when running at 200r.p.m. The Pelton wheel develops 95.6475kW shaft power. The velocity of the buckets =0.45times the velocity of the jet, overall efficiency =0.85 and co-efficient of the velocity is equal to 0.98. [L4] [10M]
5. A Francis turbine with an overall efficiency of 75 % is required to produce 148.25 kW power. It is working under a head of 7.62m. The peripheral velocity $=0.26\sqrt{2gh}$ and the radial velocity of flow at inlet is $0.96\sqrt{2gh}$. The wheel runs at 150 r.p.m. and the hydraulic losses in the turbine are 22% of the available energy. Assuming radial discharge, determine: a) The guide blade angle b) The wheel vane angle at inlet c) Diameter of the wheel at inlet d) Width of the wheel at inlet. [L4] [10M]
6. a) Write a note on work done by the centrifugal pump (impeller) on water. [L1] [5M]

   b) Describe briefly definition of heads and efficiencies of a centrifugal pump. [L2] [5M]
7. A centrifugal pump delivers water against a net head of 14.5m and a design speed of 1000 r.p.m. The vanes of curved back to an angle of 30° with the periphery. The impeller diameter is 300mm and outlet width is 50mm. Determine the discharge of the pump if manometric efficiency is 95%. [L4] [10M]
8. a) Write a note on net positive suction head (NPSH). [L1] [5M]

   b) What is cavitation and what is the effect of cavitation in centrifugal pumps. [L1, L2] [5M]
9. a) Derive the expression for specific speed. [L3] [5M]

   b) Write a note on minimum starting speed. [L1] [5M]
10. Describe briefly about pumps in series and pumps in parallel. [L2] [10M]

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