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QUESTION BANK (DESCRIPTIVE)

Subject with Code : FM & HM (16CE112) **Course & Branch: B.Tech - ME**

Year & Sem: II-B.Tech & I-Sem **Regulation**: R16

UNIT –I

FLUID PROPERTIES AND FLUID STATICS

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

b) What is the gauge pressure at a point 3m below the free surface of a liquid having a density 1.53 x 10^3 kg/m^3.If the atmospheric pressure is equivalent to 750mm of mercury? The Specific gravity of mercury is 13.6 and density of water = 1000 kg/m^3. (5M)

2. Define Manometer. Briefly explain the types of Manometers in detail? (10M)

3. a) A U-tube manometer is used to measure the pressure of water in a pipe line, which is excess of atmospheric pressure. The right limb of manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line ,if the difference in the level of mercury in the limbs of U-tube is 10 cm and the free surface of mercury is in level with the Centre of pipe . If pressure of water in pipe line is reduced to 9810 N/m^2 , Calculate the new difference in the level of mercury .Sketch the arrangements in both cases. (5M)

b) A hydraulic pipe has a ram of 30 cm diameter and a plunger of 4.5 cm diameter. Find the weight lifted by the hydraulic press when the force applied at the plunger is 500N? (5M)

4. a) An inverted U – tube manometer is connected to two horizontal pipes A and B though 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 centre lines of the pipes) are found to be same and equal to 35 cm. Determine the difference of pressure between the pipes. (5M)

b) 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 r.p.m, determine the viscosity of the fluid. (5M)

5. a) Define Hydro static law and derive the condition for pressure head. (5M)

b) Derive the condition for capillary rise and capillary fall with neat sketch. (5M)

6. a) Derive expressions for the total pressure and centre of pressure for an inclined plane surface submerge in the liquid. (5M)

b) A rectangular plane surface 3 m wide and 4 m deep lies in water in such a way that its plane makes an angle of 30^0 with the free surface of water. Determine the total pressure force and position of centre of pressure, when the upper edge is 2 m below the free surface. (5M)

7.a) Explain how you would find the resultant pressure on a curved surface immersed in the liquid. (5M)

b) Define centre of pressure and derive an expression for centre of pressure for a vertically submerged surface. (5M)

8. a) How does viscosity of a fluid vary with temperature?

b)What are different types of Mechanical Pressure Gauges ? Explain briefly about Bourdon's Pressure Gauge ?

9. Explain the terms & Give their Dimensions . (10M)

(i) Dynamic Viscosity & Kinematic Viscosity

(ii) Density & Specific Weight

(iii) Specific Volume & Specific Gravity

(iv) Surface Tension & Capillarity

(v) Vapour Pressure & Compressibilty

10. a) Distinguish between ideal fluids and real fluids with neat sketches. (5M)

b.) Explain the Conditions of Surface tension on Liquid droplet, Hollow bubble & Liquid Jet. (5M)

UNIT –II

FLUID KINEMATICS AND FLUID DYNAMICS

1. a) Define stream line, streak line and path line, stream tube and control volume? (5M)

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

2. Obtain an expression for continuity equation for a one & three - dimensional flow. (10M)

3. a) The velocity potential function is given by Ø = 5(x2 – y2). Calculate the velocity components at the point (4, 5). (5M)

   b) A stream function is given by ψ = 5x – 6y. Calculate the velocity components and also magnitude and direction of the resultant velocity at any point. (5M)

4. a) If for a two – dimensional potential flow, the velocity potential is given by Ø = x(2y – 1). Determine the velocity at the point P (4, 5). Determine also the value of stream function Ψ at the point P. (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. (5M)

5. a) What is Euler's equation of motion? How do you obtain Bernoulli's equation from it? Name the different forces present in a fluid flow (5M)

   b) State Bernoulli's theorem for steady flow of an incompressible fluid. Derive the expression for Bernoulli's theorem from first principle and state the assumption made for such a derivation. (5M)

6. a) Water is flowing through a pipe of 5 cm diameter under a pressure of 29.43N/cm^2 (gauge) and with mean velocity of 2.0 m/s. Find the total head or total energy per unit weight of the water at a cross section which is 5 m above the datum line. (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. (5M)

7. a) Write a short notes on velocity and acceleration function and also define local and convective acceleration (5M)

   b) The following case represent the two velocity components, determine the third velocity component such the they satisfy the continuity equation (5M)

i) $u= x^2+y^2+z^2$, $v= xy^2-yz^2+xy$ and ii) $v=2y^2$, $w=2xyz$

8. a) What is the relation between stream function and velocity potential function? (5M)

b) Write a short notes on the following i) Equipotential line ii) Line of constant stream function iii) Flow net (5M)

9. a) Define hydraulic gradient line and total energy line. (5M)

b) Explain briefly the analysis of free liquid jets. (5M)

10. a) Define compressible and incompressible flows. (10M)

b) Define laminar and turbulent flows.

c) Define uniform and non-uniform flow.

d) Distinguish between rotational and irrotational flow.

e) Distinguish between steady and unsteady flow

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. (10M)

2. a) Derive the expression for flow through pipes in series. (5M)
   b) Derive the expression for flow through parallel pipes (5M)

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 300mm, 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. (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 = $10kN/m^3$. (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. (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
   Co – efficient of discharge of the meter = 0.65

   Determine the rate of flow of oil. (5M)

   b) An orifice meter with orifice diameter 10cm is inserted in a pipe of 20cm diameter. The pressure gauges fitted up stream and down stream 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 (5M)

6. a) Explain pitot tube and pitot static tube (5M)

   b) A sub-marine moves 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 (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. (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. (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. (10M)
10. a) What is the difference between pitot tube and pitot-static tube. (2M)

    b) Briefly explain the Reynolds experiment. (3M)

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

UNIT –IV

DIMENSIONAL ANALYSIS AND SIMILITUDE

1. a) Write a short note on dimensional homogeneity (5M)
   b) Describe Rayleigh's method (5M)
2. a) Describe briefly Buckingham's pi- theorem (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. (5M)
3. What is similitude and describe the types of similarities (10M)
4. a) Write a short note on model laws. (5M)
   b) State and derive Reynolds's model law (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 (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 (5M)
6. Describe Froude model law and scale ratios briefly (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. (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. (5M)
8. Write a note on a) Euler's model law b) Weber model law c)Mach model law (10M)
9. Describe briefly Buckingham's pi- theorem. (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. (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. (5M)

UNIT –V

TURBINES AND CENTRIFUGAL PUMPS

1. Describe briefly definitions of heads and efficiencies of a turbine (10M)
2. a) What is pelton turbine and discuss the parts of pelton turbine (5M)
   b) Derive the expression for velocity triangles and work done for pelton wheel (5M)
3. A pelton wheel is to be designed for the following specifications: (10M)
   Shaft power =11,772 kW ; Head=380 m ; Speed =750 r.p.m ; Overall efficiency = 86 % ; Jet diameter is not exceed 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}=0.985 , K_{u1}=0.45.
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 (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: (10M)
   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
6. a) Write a note on work done by the centrifugal pump(impeller) on water . (5M)
   b) Describe briefly definition of heads and efficiencies of a centrifugal pump. (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% (10M)
8. a) Write a note on net positive suction head (NPSH). (5M)
   b) What is cavitation and what is the effect of cavitation in centrifugal pumps. (5M)
9. a) Derive the expression for specific speed. (5M)
   b) Write a note on minimum starting speed. (5M)
10. Describe briefly the following a) pumps in series b) pumps in parallel (10M)