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QUESTION BANK (DESCRIPTIVE)

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

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

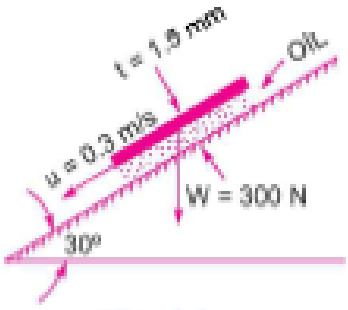
UNIT –I

FLUID PROPERTIES AND FLUID STATICS

1. a) Define and mention units for the following fluid properties: **(6M)**

   Density, specific weight, specific volume and specific gravity of a fluid.

   b) Calculate the dynamic viscosity of an oil, which is used for lubrication between a square plate of size 0.8 m X 0.8 m and an inclined plane with an angle of inclination 30° as shown in below fig. The weight of the square plate is 300 N and it slides down the inclined plane with a uniform velocity of 0.3 m/s. The thickness of oil film is 1.5 mm. **(6M)**



2. a) Explain the phenomenon of capillarity. Obtain an expression for capillary rise of a liquid. **(7M)**

   b) The pressure outside the droplet of water of diameter 0.04 mm is 10.32 N/cm^2. Calculate the pressure within the droplet if surface tension is given as 0.0725 N/m of water. **(5M)**

3. a) State the Newton's law of viscosity. Differentiate kinematic viscosity and dynamic viscosity. Give their dimensions. **(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. **(7M)**

4. a) State and prove hydrostatic law. **(7M)**

   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)**

5. a) State and prove the Pascal's law. **(7M)**

b) Calculate the pressure at a depth of 0.3 m below the surface of the following fluids:
i) water ii) an oil of specific gravity 0.8 and iii) mercury of specific gravity 13.6.
Take density of water as 1000 kg/m^3 **(5M)**

6. What is a manometer? List out different types of manometers. Explain differential manometers with neat sketches. **(12M)**

7. 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 center 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. **(12M)**

8. a) 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. **(7M)**

b) What are the different types of mechanical pressure gauges? Explain briefly about Bourdon's pressure gauge. **(5M)**

9. Derive expressions for both the total pressure and depth of center of pressure for a vertical plane surface submerged in the liquid. **(12M)**

10. a) Explain how you would find the resultant pressure on a curved surface immersed in the liquid. **(6M)**

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 center of pressure, when the upper edge is 2 m below the free surface. **(6M)**

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UNIT –II

FLUID KINEMATICS AND FLUID DYNAMICS

1. a) Define the terms:

   Stream line, streak line, path line, stream tube and control volume. **(6M)**

   b) Explain different types of flow. **(6M)**

2. a) Define local acceleration, convective acceleration and tangential acceleration. **(6M)**

   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. **(6M)**

3. Obtain an expression for continuity equation for three - dimensional flow. **(12M)**

4. a) Define the following terms:

   Velocity potential function, stream function, equipotential line and flow net. **(5M)**

   b) 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). Also determine the value of stream function Ψ at the point P. **(7M)**

5. Derive Bernoulli's equation and state assumptions. **(12M)**

6. a) Define hydraulic gradient line and energy gradient 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. **(7M)**

7. a) Derive momentum equation and impulse momentum equation. **(5M)**

   b) 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. **(7M)**

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. **(12M)**

9. Define free vortex flow and forced vortex flow. Derive equation of motion for forced vortex flow. **(12M)**

10. a) Explain about energy correction factor, momentum correction factor and total gradient line. **(6M)**

    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. **(6M)**

UNIT –III

ANALYSIS OF PIPE FLOW & FLOW MEASURMENT

1. Derive an expression for the loss of head in pipes due to friction by using Darcy - Weisbach equation. **(12M)**
2. Explain the terms: a) Pipes in parallel b) Pipes in series and c) Equivalent pipe **(12M)**
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 and 0.0048 respectively, considering :(1) minor losses also (2) neglecting minor losses. **(12M)**
4. a) Explain pitot tube and pitot static tube. **(7M)**

   b) A sub-marine move horizontally in sea and has its axis 15 m below the surface of water. A pitot tube properly placed just in front of the sub-marine and along its axis is connected to the two limbs of a U – tube containing mercury. The difference of mercury level is found to be 170 mm. 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)**
5. What is a venturimeter? Derive an expression for the discharge through a venturimeter. **(12M)**
6. Define: a) laminar boundary layer b) turbulent boundary layer

   c) laminar sub-layer d) boundary layer thickness **(12M)**
7. a) Write short notes on: a) Moody's chart b) Reynolds Experiment **(6M)**

   b) An orifice meter with orifice diameter 10 cm is inserted in a pipe of 20 cm diameter. The pressure gauges fitted upstream and downstream of the orifice meter gives readings of 19.62 N/cm^2 and 9.81 N/cm^2 respectively. Co-efficient of discharge for the orifice meter is given as 0.6. Find the discharge of water through pipe. **(6M)**
8. Explain the principle of orifice meter and derive the equation to find the rate of flow of water through a pipe using the same. **(12M)**
9. A horizontal venturi meter with 30 cm diameter inlet and 10 cm throat is used for measuring the flow of water through a pipeline. If pressure in pipe is 1.5 kpa 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 = 10 kN/m^3. **(12M)**
10. 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 venacontracta. Take C_d=0.855 and C_c for venacontracta = 0.62 and atmospheric pressure head = 10.3 of water. **(12M)**

UNIT –IV

DIMENSIONAL ANALYSIS AND SIMILITUDE

1. a) Write a short note on dimensional homogeneity. **(6M)**

   b) Describe Rayleigh's method. **(6M)**

2. a) Describe Buckingham's pi- theorem. **(6M)**

   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. **(6M)**

3. What is similitude? Describe the types of similarities. **(12M)**

4. a) Write a short note on model laws. **(6M)**

   b) State and derive Reynolds's model law **(6M)**

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**.**

   (6M)

   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. **(6M)**

6. Describe Froude model law and scale ratios briefly. **(12M)**

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. **(6M)**
   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. **(6M)**

8. Write a note on a) Euler's model law b) Weber model law c) Mach model law **(12M)**

9. Give the formula and dimensions for:

   a) force b) viscosity c) Power d) kinematic viscosity and e) Surface tension **(12M)**

10. a) Explain about dimensional analysis. **(6M)**
    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. **(6M)**

UNIT –V

TURBINES AND CENTRIFUGAL PUMPS

1. Describe briefly definitions of heads and efficiencies of a turbine. **(12M)**
2. Explain the working principle of Pelton wheel turbine with a neat sketch. **(12M)**
3. A Pelton wheel is to be designed for the following specifications: **(12M)**

   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.
4. 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: **(12M)**

   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
5. A Kaplan turbine runner is to be designed to develop 9100 kW. The net available head is 5.6 m. if the speed ratio =2.09, flow ratio = 0.68, overall efficiency = 86 % and the diameter of the boss is 1/3the diameter of the runner. Find the diameter of the runner, its speed and the specific speed of the turbine.

   (12M)
6. Explain the working principle of a centrifugal pump **(12M)**
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%. **(12M)**
8. a) Write a note on net positive suction head (NPSH). **(6M)**

   b) What is cavitation and what is the effect of cavitation in centrifugal pumps. **(6M)**
9. a) Derive the expression for specific speed. **(6M)**

   b) Write a note on minimum starting speed. **(6M)**
10. Describe briefly about pumps in series and pumps in parallel. **(12M)**

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