SWARNANDHRA COLLEGE OF ENGINEERING & TECHNOLOGY

[AUTONOMOUS]

DEPARTMENT OF MECHANICAL ENGINEERING

**FLUID MECHANICS AND HYDRAULIC MACHINERY (R19)**

SEETHARAMPURAM, NARSAPUR-534 280

**UNITWISE QUESTION BANK**

**UNIT-I**

1. Explain about the physical properties of fluid?

2. Derive the expression for the pressure by using simple U-tube manometer?

3. Define kinematic and dynamic viscosities and obtain dimensional relationship between them?

4. A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of specific gravity 0.8 and having vacuum pressure is flowing. The other end of 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 the fluid in the left from the center of pipe is 15cm below.

5. State the Newton’s law of viscosity?

6. Derive the expression for the pressure by using inverted U-tube differential manometer.

7. Calculate the pressure at a height of 7500 m above sea level if the atmospheric pressure is 10.143 Ncm2 and temperature is 15 ̊C at the sea level, assuming (i) air is incompressible, (ii) pressure variation follows isothermal law, and (iii) pressure variation follows adiabatic law. Take the density of air at the sea – level as equal to 1.285 kg/m3. Neglect variation of g with altitude.

8. A 15 cm diameter 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.

9. Calculate the capillary effect in mm in a glass tube of 4 mm diameter, when immersed in (i) water, (ii) mercury. The temperature of the liquid is 20̊C and the values of the surface tension of water and mercury at 20̊C in contact with air are 0.073575 N/m and 0.51 N/m respectively. The angle of contact for water is zero that for mercury 1.30̊. Take density of water at 20̊C as equal to 998 kg/m3.

10. Two plates are placed at a distance of 0.15mm apart. The lower plate is fixed while the upper plate having surface area 1.0 m2 is pulled at 0.3 Nm/s. Find the force and power required to maintain this speed, if the fluid separating them is having viscosity 1.5 poise.

11. An oil film of thickness 1.5 mm is used for lubrication between a square plate of size 0.9m \*0.9m and an inclined plane having an angle of inclination 200. The weight of square plate is 392.4 N and its slides down the plane with a uniform velocity of 0.2 m/s. find the dynamic viscosity of the oil.

**UNIT-II**

1. Derive the Euler’s equation for flow along a stream line?

2. Derive the equations of continuity for laminar flow

3. Classify various types of fluid flow?

4. What is Bernoulli’s theorem? Derive the Bernoulli’s equation for flow along a stream line. State the significance of each term of Bernoulli’s equation?

5. Define stream line, streak line, path line and stream tube?

6. Derive the momentum equation for steady flow?

7. What are the different flow measuring devices and Derive an expression for the measurement of rate of flow by venturimeter.

8. An orifice meter with orifice diameter 10cm is inserted in a pipe of 20cm diameter .The pressure gazes fitted upstream and downstream of orifice meter gives readings of 19.62N/cm2 and 9.81N/cm2 respectively coefficient of discharge of orifice meter is 0.6. Find the discharge of water through the pipe.

9. A horizontal venturimeter with inlet diameter 200 mm and throat diameter 100 mm is employed to measure the flow of water. The reading of the differential manometer connected to the inlet is 180 mm of mercury. If Cd = 0.98, determine the rate of flow.

10. In a three dimensional incompressible fluid flow, the velocity components in x and y directions are u = x2 + Y2 Z3 and v = (XY + YZ + ZX). Use continuity equation to evaluate an expression for the velocity component w in the Z direction.

11. Find the displacement thickness, the momentum thickness and energy thickness for the velocity distribution in the boundary layer given by u / U = y / δ, where u is the velocity at a distance y from the plate and u = U at y = δ, where δ = boundary layer thickness. Also calculate the value of δ\*/θ.

**UNIT-III**

1. Explain Reynold’s experiment with neat sketches.

2. Find the diameter of a pipe of length 2000m when the rate of flow of water through the pipe is 200lit/s and the head loss due to friction is 4m.Take C=50 in chezey’s formulae?

3. Calculate head loss due to friction when pipes are connected in series and parallel?

4. Explain TEL and HGL for closed conduit flow?

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8. The frictional torque T of a disc diameter D rotating at a speed N in a fluid of Viscosity μ and density ρ in a turbulent flow is given by T=D5N2 ρФ(μ/D2 Nρ). Prove this Buckingham’s Π theorem.

9. Explain the dimensional analysis with suitable example.

10. Describe the step by step procedure for determination of dimensionless group by Buckingham Pi Theorem

**UNIT-IV**

1. Explain what you understand by unit speed, unit power and unit discharge of turbine.

2. A Francis turbine running at 400 rpm when head available is 60m.The inner and outer diameters are 50cm and 100cm respectively. The constant velocity of the flow through the runner is10 m/sec and hydraulic efficiency is 80%. Determine the inlet and outlet blade angles of the rotating blades.

3. Describe the working of governing of turbines with a neat sketch.

4. A turbine develops 9000 KW when running at 1000 r.p.m. The head on the turbine is 30 m. If the head on the turbine is reduced to 18 m, determine the speed and the power developed by the turbine.

5. A Pelton wheel is to be designed for a head of 60 m when running at 200 r.p.m. The Pelton wheel develops 95.6475 kW shaft power. The velocity of the buckets = 0.45 times the velocity of the jet, Overall efficiency=0.85 and Co-efficient of velocity is equal to 0.98.

6. Give the classification of turbines and explain them briefly.

7. A jet of water of diameter 10 cm strikes a flat plate normally with a velocity of 15 m/s. The plate is moving with a velocity of 6 m/s in the direction of the jet and away from the jet. Find: i) the force exerted by the jet on the plate. ii) Work done by the jet on the plate per second.

8. Francis turbine designed to develop 160 kw working under a head 10 m and running at 200 rpm. The hydraulic losses in turbine are 15% of available energy. The overall efficiency of turbine is 80%. Assume flow ratio=0.94 and speed ratio=0.25. Calculate: (1) guide blade angle and runner vane angle at inlet and (2) diameter and width at inlet.

9. Kaplan turbine develops 9000 kW under a net head of 7.5 m. Overall efficiency of the wheel is 86% The speed ratio based on outer diameter is 2.2 and the flow ratio is 0.66. Diameter of the boss is 0.35 times the external diameter of the wheel. Determine the diameter of the runner and the specific speed of the runner.

10. A Francis turbine has an inlet diameter of 2.0 m and an outlet diameter of 1 .2m. The width of the blades is constant at 0.2 m. The runner rotates at a speed of 250 rpm with a discharge of 8 m³/s .The vanes are radial at the inlet and the discharge is radially outwards at the outlet. Calculate the angle of guide vane at inlet and blade angle at the outlet.

**UNIT V**

1. Briefly explain what are the different types of heads and Efficiencies associated with pumps?

2. A single acting reciprocating pump, running at 50 rpm, delivers 0.01m3/s of water. The diameter of the piston is 200 mm and stroke length 400mm. determine: i) the theoretical discharge of the pump, ii) co-efficient of discharge, and iii) slip and the percentage of slip of the pump.

3. Draw and discuss the operating characteristics of a centrifugal pump.

4. Describe the working of a reciprocating pump with a neat sketch.

5. Draw a neat sketch explain the working of centrifugal pump.

6. Explain the effect of acceleration in suction and delivery pipes on indicator diagram.

7. Find the power required to drive a centrifugal pump which to drive a centrifugal pump which delivers 0.04 m3 /s of water to a height of 20 m through a 15 cm diameter pipe and 100 m long. The overall efficiency of the pump is 70% and coefficient of friction is 0.15 in the formula hf=4flv2/2gd.

8. A Centrifugal pump having outer diameter equal to 2 times the inner diameter and running at 1200 rpm works against a total head of 75 m. The Velocity of flow through the impeller is constant and equal to 3 m/s. The vanes are set back at an angle of 30º at out let. If the outer diameter of impeller is 600 mm.

9. The following details refer to a centrifugal pump. Outer diameter: 30cm.Eye diameter: 15cm. Blade angle at inlet: 30˚. Blade angle at outlet: 25˚. Speed 1450 rpm. The flow velocity remains constant. The whirl at inlet is zero. Determine the work done per kg. If the manometric efficiency is 82%. Determine the working head. If width at outlet is 2cm, determine the power ή0=76%.

10. In a reciprocating pump the bore is 180mm and stokes is 280mm. Water level is 5m from the pump level. The suction pipe is 110mm diameter and 9m long. The atmospheric pressure head is 10.3m water. Determine the maximum speed not be less than 2.5m head of water. If the suction diameter is increased 125mm and length reduced to 6m, what will be the maximum speed?