Printed Pages : 3

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EAU-063

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 147856

Roll No. | | | | | | | | | | |

B. Tech.

(SEM. VIII) THEORY EXAMINATION, 2014-15

HYDRAULIC & PNEUMATIC SYSTEMS

Time : **3** Hours] [Total Marks : **100**

Note: ***(I) Attempt all questions. Be precise in your answer. Draw neat and clean diagram where ever required. Assume data suitably if necessary.***

1. Attempt any **Four Parts** Of the following: **(5×4 =20)**

a) Define the following fluid properties:
Density, Weight Density, Specific Volume and Specific Gravity of a Fluid

b) Explain the phenomena of surface tension and capillarity rise.

c) Two horizontal plates are placed 1.36 cm apart, the space between them being filled with oil of viscosity 14 poises. Calculate the shear stress in oil if upper plate is moved with a velocity of 2.5 m/s.

d) Define the term Total pressure and centre of pressure.

e) Discuss the relative merits and demerits of venturimeter with respect to orifice meter.

2. Attempt any **Two Parts** Of the following: **(10×2 =20)**

a) A circular plate 2.5 m diameter is immersed in water, its greatest & least depth below the free surface being 3 m & 1 m respectively. Find (a) the total pressure on one face of the plate, & (b) the position of the centre of pressure

b) A pipe 300 m long has a slope of 1 in 100 and tapers from 1.2 m diameter at the high end to 0.6 m diameter at the low end. Quantity of water flowing is 5400 liters per minute. If the pressure at the high end is 68.67 kPa, find the pressure at the low end. Neglect losses

c) A solid sphere of diameter 100 mm moves in water at 5 m/s. It experiences a drag of magnitude 19.62 N. What would be the velocity of 5 M diameter sphere moving in air in order to ensure similarity? What will be the drag experienced by it? State which law governs the similarity.
Take $\rho_{water} = 1000$ kg/m^3; $\rho_{air} = 1.2$ kg/m^3; $\nu_{air} = 13\ \nu_{water}$

3. Attempt any **Two Parts** Of the following: **(10×2 =20**

a) A 1: 10 scale model of a submarine moving far below the surface of water is tested in a water tunnel. If the speed of the prototype is 8 m/s, determine the corresponding velocity of water in the tunnel. Also determine the ratio of the drag for the model & the prototype.
$\nu_{seawater} = 1.121 \times 10^{-6}$ m^2/s ; $\nu_{water} = 1.00 \times 10^{-6}$ m^2/s ; $\rho_{seawater} = 1027$ kg/m^3 ; $\rho_{water} = 1000$ kg/m^3. Would this result be true if the prototype were to move close to the surface? Explain

b) Air flows over a flat plate 1 m long at a velocity of 6 m/s. determine (a) the boundary layer thickness at the end of the plate, (b) shear stress at the middle of the plate, (c) total drag pre unit length on the sides of the plate. Take $\rho = 1.116$ kg/m^3 and $\nu = 0.15 \times 10^{-4}$ m^2/s for air.

c) A jet of water 75 MM diameters having a velocity of 20 M/s, strikes normally a flat smooth plate. Determine the thrust on the plate (a) if the plate is at rest, (b) if the plate is moving in the same direction as the jet with a velocity of 5 M/s. Also find the work done per second on the plate in each case & the efficiency of the jet when the plate is moving.

4. Attempt any **Two Parts** Of the following: **(10×2 =20)**

a) A Pelton wheel has a mean bucket speed of 12 m/s & is supplied with water at a rate of 750 liters per second under a head of 35 m. If the bucket deflects the jet through an angle of 160^0, find the power developed by the turbine & its hydraulic efficiency. Take the coefficient of velocity as 0.98. Neglect friction In the bucket. Also determine the overall efficiency of the turbine if its mechanical efficiency is 80%.

b) A pump operates at a maximum efficiency of 82% and delivers 2.25 m^3/s under a head of 18 m while running at 3600 r.p.m. speed Compute the specific speed of the pump. Also determine the discharge, head & power input to pump at a shaft speed of 2400 rpm. Cite the assumption made, if any.

c) At a sudden enlargement of water main from 240 mm to 480 mm diameter, determine the hydraulic gradient rise by 10 mm. Estimate the rate of flow

5. Attempt any **Two Parts** Of the following: **(10×2 =20**

a) For the over a triangular notch the discharge Q depends on head of water H angle of notch α acceleration due to gravity g mass density, viscosity and surface tension i.e. ρ, μ and σ. Determine the functional relationship for discharge Q; using Buckingham's method of dimensional analysis.

b) Obtain an expression for velocity distribution in turbulent flow for, (1) Smooth Pipe (2) Rough Pipe

c) Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times of average velocity of flow.