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

Paper ID : 2289775 Roll No. | | | | | | | | | |

B. TECH.

Regular Theory Examination (Odd Sem-III), 2016-17

FLUID MECHANICS

Time : 3 Hours *Max. Marks : 100*

SECTION - A

1. Attempt all parts. All parts carry equal marks. Write answer of each part in short. (10×2=20)

a) Define surface Tension.

b) What is Vapour Pressure?

c) Define Control Volume.

d) Define Rotational and irrotational flow?

e) Define Impulse Momentum Equation.

f) What does Haigen-Poiseulle equation refer to? What is Haigen-Poiseulle's formula?

g) What is Kinetic energy correction factor?

h) Define Hydraulic gradient line & Total energy line.

i) Differentiate between Model and Prototype.

j) What is Displacement thickness?

SECTION - B

Note : Attempt any five questions from this section

(5×10=50)

2. What is boundary layer separation? Explain with neat sketches, the necessary conditions for boundary layer separation. What are common methods to control boundary layer separation?

3. Classify different types of fluid flow with example. Derive the continuity equation in Cartesian coordinates.

4. Define the terms: Major energy losses and minor energy losses in pipe. Derive expression for calculating loss of head due to sudden enlargement and sudden contraction.

5. What are differential manometers? A "U" - tube manometer containing mercury of density 13600 kg/m^3 is used to measure the pressure drop along a horizontal pipe. If the fluid in the pipe has a relative density of 0.8 and the manometer reading is 0.6m, what is the pressure difference measured by the manometer?

6. Assuming the drag force, F, exerted on a body is a function of the following:

   Fluid density ρ, Fluid viscosity μ, Diameter d

   Velocity u

   Show the drag force can be expressed as, $F = d^2u^2\rho\Phi(\mathrm{Re})$

   Where Φ is some unknown function and Re is Reynolds number.

7. A horizontal venturimeter with a discharge coefficient of 0.98 is being used to measure the low rate of a liquid of density 1030 kg/m^3. The pipe diameter at entry to the venturi is 75mm and the venturi throat has an area of 1000mm^2. If the flow rate is 0.011 m^3/s determine the height difference recorded on a U-tube manometer connecting the throat to the upstream pipe. Take the relative density of mercury to be 13.6.

8. A circular plate 3 meters in diameter is submerged in water in such a way that the greatest and least depths of the surface, (below water surface) are 2m , and 1m respectively, calculate:

   i) The total pressure on front face of the plate, and

   ii) The position of center of pressure.

9. In a Two-Dimensional flow field for an incompressible fluid the velocity components are:

   $U = y^3/3 + 2x - x^2y$

   $V = xy^2 - 2y - x^3/3$

   Find an expression for the stream function ψ

SECTION - C

Note : Attempt any two questions from this section.

(2×15=30)

10. What are the characteristics of a laminar flow? Derive the expression for the velocity distribution for viscous

flow through a circular pipe. Also sketch the distribution of velocity and shear stress across a section of pipe.

11. Water is flowing in a 300mm pipeline fitted with a 45^0 bend in the vertical plane. The diameter at the outlet of the bend is 150mm. The pipe axis at the inlet is horizontal and the outlet is 1.5m above the inlet. If the flow through the bend is $0.4m^3/s$ and a head - loss of 0.5m occurs in the bend, calculate the magnitude and direction of the resultant force the bend support must withstand. The volume of the bend is $0.075m^3$ and the pressure at the inlet is $300\ kN/m^2$.

12. Using continuity and the Bernoulli equation derive the following expression that can be used to measure flow rate with a Venturi meter.

$$Q_{actual} = C_d A_1 A_2 \sqrt{\frac{2g\left[\frac{p_1 - p_2}{pg} + z_1 - z_2\right]}{A_1^2 - A_2^2}}$$