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

Total No. of Pages: 02

Total No. of Questions: 09

B. Tech. (ME) (Sem.-4th)

FLUID MECHANICS

Subject Code: BTME-403

Paper ID: [A1213]

Time: 3 Hrs. **Max. Marks: 60**

INSTRUCTIONS TO CANDIDATE:

1) ***Section-A is Compulsory.***
2) ***Attempt any Four questions from Section-B.***
3) ***Attempt any Two questions from Section-C.***

SECTION–A

(10x2=20)

Q.1. Write briefly:

(i) "Water is a wetting liquid whereas mercury is a non-wetting liquid" discuss.

(ii) Explain hydrostatic paradox with the help of an example.

(iii) What is meant by stability of submerged and floating bodies and what are the equilibrium conditions of these bodies?

(iv) What are the various methods of describing flow motion?

(v) Differentiate -

(i) Local and convective acceleration

(ii) Normal and tangential acceleration.

(vi) What is a flow net and what are its uses?

(vii) Write Euler's equation of motion in Cartesian coordinates and define the meaning of each term.

(viii) Explain Mach model law.

(ix) What is Moody's diagram and what is its use?

(x) What is a differential manometer and what are its types?

SECTION B

(4x5=20)

Q2: A cubical tank has sides of 1.5 m. It contains water of depth 0.6 m. The upper remaining part is filled with oil of relative density 0.90. Determine the total pressure force and its location on one of the vertical side of the tank.

Q3: A flow is described by the stream function $\Psi = 2\sqrt{3}\, xy$. Locate the point at which the velocity vector has a magnitude of 4 units and makes an angle of 150^0 with the x-axis.

Q4: Derive continuity equation for flow along a stream line.

Q5: Water flows through a 90^0 reducer-bend in the downward direction. The pressure at the inlet (Section 1) is 206 kN/m^2 where the cross-sectional area is 0.01 m^2. The cross-sectional area at the other end (Section 2) is 0.0025 m^2 and the velocity is 15 m/s. Assume the weight of bend and water in it to be 1 kN and section 2 to be 0.40 m below section 1. Further assume that the head loss in the reducer-bend is $h_L = K_b V^2/2g$; where $K_b = 1$ and V is the mean velocity of flow in the bend. Determine the magnitude and direction of the resultant force exerted by the flow on the reducer-bend.

Q6: A horizontal venturimeter with inlet and throat diameters, 300 mm and 100 mm, respectively is used to measure the flow of water. The pressure intensity at the inlet is 130 kN/m^2 while the vacuum pressure head at the throat is 350 mm of mercury. Assuming that 3% of differential pressure head is lost between the inlet and the throat, determine coefficient of discharge and discharge.

SECTION C

(2x10=20)

Q7: A vertical shaft has hemispherical bottom of radius R that rotates inside a bearing of identical shape at its end. An oil of thickness t and viscosity μ is maintained in the bearing. Find an expression for viscous torque when shaft rotates with angular velocity ω.

Q8: Two pipes of diameter 400 mm and 200 mm, each 300 m long. When the pipes are connected in series, discharge is 0.10 m^3/s, find the loss of head. When the pipes are connected in parallel, what would be the loss of head in the system to pass the same discharge? Take coefficient of friction = 0.0075 for each pipe and loss coefficient of contraction = 0.33.

Q9: (a) The time period T of water surface waves is known to depend on the wave length λ, depth of flow D, density of fluid ρ, acceleration due to gravity g and surface tension σ. Obtain the dimensionless form of the functional relationship using π -theorem method.

(b) A small flow meter is designed to measure gas flow in 12.5 mm gas pipeline. For a discharge of 0.004 m^3/s, pressure drop across the meter is expected to be 4.8 kPa. An enlarged geometrically similar model is to be tested in a 300 mm diameter water pipe. Determine discharge and pressure drop in the model. Given: density and viscosity of gas as 12 kg/m^3 and $18x10^{-6}$ Ns/m^2, respectively and that of water as 1000 kg/m^3 and $11/7x10^{-4}$ Ns/m^2.

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