CBCS SCHEME

USN

17ME44

Fourth Semester B.E. Degree Examination, July/August 2021
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. State and prove Pascal's law. **(10 Marks)**

b. The right limb of a simple U tube manometer containing Hg is open to the atmosphere. While the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of pipe is 12cms below the level of Hg in the right limb. Find the pressure of liquid or fluid in the pipe if the difference of Hg level in two limbs is 20cm. **(10 Marks)**

2 a. A caisson for closing the entrance to a dry done is of trapezoidal form 16 m wide at the top and 10m wide at the bottom and 6m deep. Find the total pressure and centre of pressure are the caisson, if the water on the outside is just with the tap and dock is empty. **(10 Marks)**

b. The velocity distribution of flow over a plate is parabolic with vertex 30cms from the plane, where the velocity is 180cm/s. If the viscosity of the fluid of 0.9N-s/m^2 find the velocity gradient and shear stresses at distances of 0.15cms and 30cms from the plane. **(10 Marks)**

3 a. Derive continuity equation in Cartesian coordinates for fluid flow in 3-dimensions. **(10 Marks)**

b. Differentiate between:
i) Study flow and Unsteady flow
ii) Viscous flow and Turbulent flow. **(05 Marks)**

c. Define and explain stream function and velocity potential function. **(05 Marks)**

4 a. State assumption in Bernoulli's equation and derive the relation. **(08 Marks)**

b. Differentiate between venturimeter and orificemeter. **(04 Marks)**

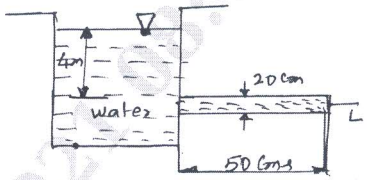
c. A 30cm × 15cm venturimeter is inserted in a vertical pipe line carrying oil of specific gravity 0.85, the flow of oil is upwards. Throat section is 50cm above inlet section of venturimeter. The oil mercury differential manometer gives a reading of 30cm of mercury. Find the rate of oil flow in lts/sec and the pressure difference between inlet and throat section. Assume C_d 0.96. Neglect all losses. **(08 Marks)**

5 a. Derive an expression for loss of head due to sudden enlargement. **(10 Marks)**

b. For laminar flow between the stationary parallel plates. Obtain an expression for velocity distribution. **(10 Marks)**

6 a. Determine the rate of flow of water through a pipe of diameter 20cm and length 50m when one end of the pipe is connected to a tank and other end of the pipe is open to the atmosphere. Consider all minor losses and take f = 0.009 in the formula $h_f = \frac{4fLV^2}{2gd}$, refer the Fig.Q.6(a). **(10 Marks)**

Fig.Q.6(a)



b. Lubricating oil of specific gravity 0.85 and dynamic viscosity 0.1N-s/m^2 is pumped through a 3cm diameter pipe. If the pressure drop per metre length of the pipe is 15kPa. Determine:
i) The mass flow rate of oil kg/min
ii) Shear stress at the pipe wall
iii) Reynolds number of the flow and
iv) The power required per 40m length of the pipe to maintain the flow. **(10 Marks)**

7 a. What is the meaning of Boundary layer separation? What is the effect of pressure gradient on boundary layer separation? **(10 Marks)**

b. Using Rayleigh's method, show that the power 'P' developed by a Hydraulic turbine is given by $P = \rho N^3 D^5 \phi\left[\frac{gH}{N^2D^2}\right]$, where ρ = density of the liquid, N = rotational speed of the turbine in rpm, D = Diameter of the runner, H = Working Head, g = gravitational acceleration. **(10 Marks)**

8 a. The rate of discharge Q of a centrifugal pump is dependent upon density of the fluid 'ρ', pump speed N in rpm, diameter of the impeller 'D', pressure 'P', viscosity of the fluid 'μ'. Using Bucking Ham's π theorem method, show that

$$Q = ND^3\phi\left[\frac{P}{\rho N^3D^5}, \frac{\mu}{\rho ND^2}\right]$$ **(10 Marks)**

b. A kite 0.8m × 0.8m weighing 3.924N assumes an angle of 12° to the horizontal. The string attached to the kite makes an angle of 45° to horizontal. The pull on the string is 24.525N, when the wind is flowing at a speed of 30km/hr. Find the corresponding coefficient of drag and lift. Take density of air = 1.25kg/m^3. **(10 Marks)**

9 a. Explain stagnation properties. Obtain an expression for velocity of sound for adiabatic process. **(10 Marks)**

b. A projectile travels in air of pressure 15N/mm^2 at 10°C at a speed of 1500km/hr. Find the Mach number and Mach angle. Assume γ = 1.4 and R = 287J/kg K. **(05 Marks)**

c. What are the normal and oblique shocks? **(05 Marks)**

10 a. Starting from fundamental, show the velocity of propagation of elastic wave in an isothermal medium is given by $C = \sqrt{RT}$. **(06 Marks)**

b. Define the following terms: i) Mach number ii) Mach cone iii) Zone of action iv) Subsonic flow v) Supersonic flow. **(10 Marks)**

c. Explain the meaning of CFD and its applications. **(04 Marks)**

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