6. (a) Derive an expression for shear stress on the basis of "Prandtl Mixing length theory". In a pipe of 360 mm diameter having turbulent flow, the centre-line velocity is 7 m/s and that at 60 mm from the pipe wall is 6 m/s. Calculate the shear friction velocity. **7.5**

(b) A piping system consists of three pipes arranged in series; the lengths of pipes are 1200 m, 750 m and 450 mm respectively :

(i) Transform the system to an equivalent 450 mm diameter pipe

(ii) Determine an equivalent diameter for the pipe, 2550 m long. **7.5**

Section D

7. (a) Explain the characteristics of laminar and turbulent boundary layers. The velocity distribution in the boundary layer is given by :

$$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) = \left(\frac{y}{\delta}\right)^2,$$

δ being boundary layer thickness. Calculate momentum thickness. **7.5**

Roll No. ..... Total Pages : 06

Sep-21-00025

B. Tech. EXAMINATION, 2021

Semester III (CBCS)

FLUID MECHANICS

ME-302

Time : 2 Hours *Maximum Marks : 60*

The candidates shall limit their answers precisely within 20 pages only (A4 size sheets/assignment sheets), no extra sheet allowed. The candidates should write only on one side of the page and the back side of the page should remain blank. Only blue ball pen is admissible.

Note : Attempt *Four* questions in all, selecting *one* question from any of the Sections A, B, C and D. Q. No. **9** is compulsory.

Section A

1. (a) What is Capillarity ? Derive expression for height of capillarity rise. If a certain liquid has viscosity 4.9×10^{-4} kg(f)-sec/m^2 and kinematic viscosity 3.49×10^{-2} stock, what is its specific gravity ? **7.5**

(b) What is "centre of buoyancy" and "metacentre" ? A metallic cube 30 cm side and weighing 450 N is lowered into a tank containing a two-fluid layer of water and mercury. Determine the position of block at mercury-water interface when it has reached equilibrium. **7.5**

2. (a) Explain briefly the compressibility and Newton's law of viscosity with Newtonian and Non-newtonian fluid. A plate 0.05 mm distant from a fixed plate moves at 1.2 m/sec and requires a force of 2.2 N/m^2 to maintain this speed. Find the viscosity of the fluid between the plates. **7.5**

(b) What is meant by stability of a floating body ? Explain the three states of equilibrium of a floating body in terms of the magnitude and direction of righting couple acting on the body as a result of slight angular displacement. **7.5**

Section B

3. (a) Define briefly the velocity potential and stream function. In a two-dimensional incompressible flow, the fluid velocity components are given by $u = x - 4y$ and $v = -y - 4x$. Show that velocity potential exists and determine its form as well as stream function. **7.5**

(b) Define steady, non-steady, uniform and non-uniform flows. What is pitot tube ? How is it used to measure velocity of flow at any point in a pipe or channel ? **7.5**

4. (a) Define and distinguish among stream line, path line and streak line. Derive Bernoulli's equation from Euler's equation of motion. **7.5**

(b) How are mouthpieces classified ? Find the discharge from a 80 m diameter external mouthpieces, fitted to a side of a large vessel, if the head over the mouthpiece is 6 m. **7.5**

Section C

5. (a) Derive an expression for mean velocity, shear stress and pressure gradient for laminar flow through parallel plates. **7.5**

(b) In a smooth pipe of diameter 0.5 m and length 1000 m water is flowing at the rate of 0.05 m^3/s. Assuming the kinematic viscosity of water as 0.02 stokes, find Head loss due to friction, wall shear stress, centre-line velocity and thicknes of laminar sub-layer. **7.5**

(b) What are dimensionless numbers ? Define Reynold's Froude's and Mach's number with their significance for fluid flow problems. **7.5**

8. (a) In a geometricaly similar model of spillway the discharge per metre length is 0.2 m^3/s. If the scale of the model is 1/36, find the discharge per metre run of the prototype. **7.5**

(b) Why is it necessary to control the growth of boundary layer on most of the bodies ? What methods are used for such a control ? **7.5**

(Compulsory Question)

9. (i) What is the difference between an ideal and a real fluid ?

(ii) 1-dimensional, 2-dimensional and 3-dimensional flow.

(iii) Energy and momentum correction factors

(iv) Sources and sink

(v) Expression of Darcy-Weisbach equation

(vi) Smooth and rough boundary layer

(vii) Drag and lift

(viii) What are scale effects ?

(ix) Streamlines and Bluff bodies

(x) Statement of Law of conservation of mass for continuity equation. **1.5×10=15**