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Name.....

Reg. No.....

THIRD SEMESTER B.TECH. (ENGINEERING) DEGREE [illegible] SCHEME EXAMINATION, NOVEMBER 2015

ME 14 303 – FLUID MECHANICS

Time : Three Hours

Maximum : 100 Marks

Part A

Answer any **eight** *questions.*

1. Explain briefly the following terms :
   (i) Mass density.
   (ii) Specific volume.
   (iii) Specific gravity.
2. A simple U-tube manometer is installed across an orificemeter. The manometer is filled with mercury (sp. gravity = 13.6) and the liquid above the mercury is carbon tetrachloride (sp. gravity = 1.6). The manometer reads 200 mm. What is the pressure difference over the manometer in newtons per square metre?
3. Find the density of a metallic body which floats at the interface of mercury of specific gravity 13.6 and water such that 35 % of its volume is submerged in mercury and 65% in water.
4. Explain kinetic energy and momentum correction factors.
5. Write Bernoulli's equation and list the assumptions made.
6. Define steady, non-steady, uniform and non-uniform flows.
7. A fluid of density 1200 kg/m^3 and viscosity 0.5 poise is flowing at a rate of 5 m^3/min in a circular pipe of cross-section of 1 m^2. Is the flow is laminar or turbulent?
   Calculate the maximum velocity of the fluid in the pipe.
8. Derive an expression for loss of head due to sudden contraction in a pipe.
9. If velocity distribution in laminar boundary layer over a flat plate is assumed to be given by second order polynomial $u = -a + by + cy^2$, determine its form using the necessary boundary conditions.
10. Describe Boundary layer separation.

(8 × 5 = 40 marks)

Part B

Answer **all** *the questions.*

11. (a) A 400 mm diameter shaft is rotating at 200 r.p.m. in a bearing of length 120 mm. If the thickness of oil film is 1.5 mm and the dynamic viscosity of the oil is 0.7 Ns/m^2. Determine :

(i) Torque required to overcome friction in bearing,

(ii) Power utilized in overcoming viscous resistance.

Assume a linear velocity profile.

Or

(b) A circular plate 1.5 m diameter is submerged in water, with its greatest and least depths below the surface being 2 m and 0.75 m respectively. Determine :

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

(ii) The position of the centre of pressure.

12. (a) Derive the continuity equation in Cartesian co-ordinates.

Or

(b) The following data relate to an inclined venturi meter :

Diameter of the pipeline = 400 mm

Inclination of the pipeline with the horizontal = 30°

Throat diameter = 200 mm

The distance between the mouth and throat of the meter = 600 mm

Sp. gravity of oil flowing through the pipeline = 0.7

Sp. gravity of heavy liquid (U-tube) = 13.6

Reading of the differential manometer = 50 mm

The co-efficient of the meter = 0.98

Determine the rate of flow in the pipeline.

13. (a) A two-dimensional flow field is given by $\Phi = 3xy$, determine :

(i) The stream function.

(ii) The velocity at L (2, 6) and M (6, 6) and the pressure difference between the points L and M.

Or

(b) Derive Hagen-Poiseuille equation for laminar flow and state the assumptions made.

14. (a) Derive Von-Karman momentum equation for boundary layer flow.

Or

(b) A streamlined train is 200 m long with a typical cross-section having a perimeter of 9 m above the wheels. If the kinematic viscosity of air at the prevailing temperature is 1.5×10^{-5} m^2/s and density 1.24 kg/m^3, determine the approximate surface drag (drag) of the drain when running at 90 km/h.

(4 × 15 = 60 marks)