B.E./B.TECH. Degree Examination, December 2020

Third Semester

CH18302-FLUID MECHANICS

(Regulation 2018)

Time: Three hours Maximum : 80 Marks

Answer **ALL** questions

PART A - (8 X 2 = 16 marks)

1. In laminar flow, the boundary layer thickness Z_x increases with the distance from leading edge(x) as
   a) Z_x increases with $x^{0.5}$ b) Z_x increases with $x^{0.7}$ c) Z_x increases with $x^{1.5}$ d) Z_x increases with $x^{0.8}$
2. Water in a rotating container forms a parabolic shape due to
   a) Viscous forces b) Gravitational forces c) Centrifugal forces d) Drag force
3. 100 cP is equivalent to
   a) 10^{-1} Pa s b) 10^{-3} Pa s c) 10 Pa s d) 1 Pa s
4. Slip flow is found when
   a) $0.01 < K_n < 0.1$ b) $0.1 < K_n < 10$ c) $K_n > 10$ d) $K_n > 100$ where Kn is the Knudsen number
5. Find the hydraulic radius of a square duct having dimension D = 5 cm
6. Sketch a) Absolute pressure b) Gauge pressure c) Vacuum pressure
7. Find the dimension of Power.
8. Find the Reynold's number of a fluid flowing with a velocity 50 cm/s, where specific gravity if 0.96, viscosity is 8.6 Poise and the diameter of the tube is 50cm.

PART B - (4 X16 = 64 marks)

09. (a) (i) If the velocity distribution over a plate is given by $u = (3/5)\,y - y^2$, in which u is the velocity in metre per second, at a distance y metre above the plate, determine the shear stress at y = 0 and y = 0.25 m. Take dynamic viscosity of fluid to be 10 Poise. **(10)**

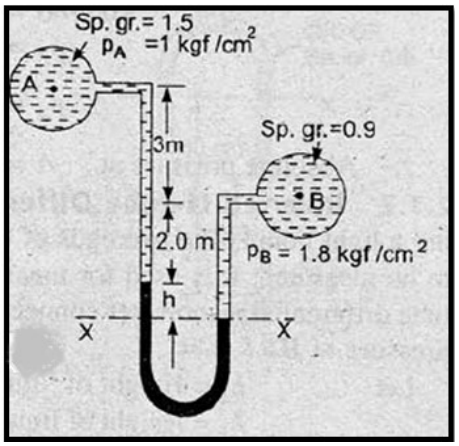
(ii) Calculate the specific weight, density and specific gravity of one litre of a liquid which weighs 7N. **(6)**

(OR)

(b) (i) Elaborate the importance of various flow patterns used to represent the fluid flow. **(8)**

(ii) Sketch the stress-stain plot for various types of fluids with explanation about their characteristics. **(8)**

10 (a) (i) A differential manometer is connected at the two points A and B of two pipes as shown in fig. A contains a liquid of Sp. gr 1.5 while B contains a liquid of Sp. gr 0.9. The pressures at A and B are 1 kgf/cm^2 and 1.8 kgf/cm^2. Find the difference in mercury level. **(10)**



(ii) Water is flowing through a pipe of 5 cm diameter under a pressure of 29.43 N/cm^2 and with mean velocity of 5.0 m/s. Find the total head or total energy per unit weight of the water at cross section, which is 5 m above the datum line. **(6)**

(OR)

(b) (i) Elaborate on Pascals law with the help of suitable derivation **(10)**

(ii) Find the height of mercury column corresponding to 1 atmospheric pressure. What is the height if mercury is replaced with water? **(6)**

11 (a) (i) Air (ρ = 1.22 Kg/m^3, μ= 1.9 X 10 $^{-5}$ Pa.s) is flowing in a fixed bed of a diameter 0.5 m and height 2.5 m. The bed is packed with spherical particles of diameter 10 mm. The void fraction is 0.38. The air mass flow rate is 0.5 kg/s. Calculate the pressure drop across the bed of particles. **(10)**

(ii) Justify the statement- 'Fluidization operations are not always beneficial' **(6)**

(OR)

(b) (i) A sugar syrup is flowing through a pipe of 55 mm diameter at a rate of 66.67 m^3/s. The viscosity of the syrup is 0.15 Ns/m^2 and its density id 1040 kg/m^3. Calculate the frictional loss over a length of 10 metres. **(8)**

(ii) Calculate the critical velocity of water flowing 25mm diameter pipe. Viscosity of water is 0.0008 Ns/m^2. Also calculate the friction factor when Reynold's number is 1500.Take density of water=1000 kg/m^3 **(8)**

12. (a) (i) The inlet and throat diameters of a horizontal venturi meter are 30 cm and 10 cm respectively. The liquid flowing through the meter is water. Pressure intensity at the meter is 13.734 N/cm^2, while the vacuum pressure head at the throat is 37 cm of mercury. Find the rate of flow. Assume that 4% of the differential head is lost between the inlet and throat. Find the value of Cd. **(10)**

(ii) A pitot static tube is used to measure the velocity of air flowing through a duct. The manometer shows a difference in head of 5 cm of water. If the density of air and water are 1.13 kg/m^3 and 1000 kg/m^3 determine the velocity of air. Assume the coefficient of the pitot tube as 0.98. **(6)**

(OR)

(b) (i) Find an expression for the drag force on a smooth sphere of diameter D, moving with a uniform velocity V, in a fluid of density ρ and dynamic viscosity μ. **(10)**

(ii) A pipe of diameter 1.5 m is required to transport an oil of specific gravity 0.90 and viscosity 0.03 poise at the rate of 3000 l/sec. Tests were conducted on a 15 cm diameter pipe using water at 20 deg C. Find the velocity and rate of flow in the model where viscosity of water at 20 deg C is 0.01 poise, take density of water=1000kg/m^3 **(6)**