Question Paper

Exam Date & Time: 22-Nov-2018 (02:00 PM - 05:00 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
THIRD SEMESTER B.Sc. Applied Sciences in Engg.
END - SEMESTER THEORY EXAMINATION NOVEMBER - 2018
TRANSPORT PROCESS - I -FLUID FLOW [IBT 234 - S2]

Marks: 100 **Duration: 180 mins.**

Answer 5 out of 8 questions.

1) A) Determine the atmospheric pressure at a location where the barometric reading is 750mm Hg. Take the density of mercury to be 13600kg/m^3. (5)

B) Explain the following i) Newtonian and non-Newtonian fluids with examples (5)

C) The absolute pressure in water at a depth of 5 m is read to be 145kPa. Determine the local atmospheric pressure and (b) the absolute pressure at a depth of 5m in a liquid whose specific gravity is 0.85 at the same location. (6)

D) Explain the working principle of a barometer (4)

2) A) Water flows through a pipeline. A manometer is used to measure the pressure drop for flow through the pipe. The difference in level was found to be 20cm. If the manometer fluid is CCl_4, find the pressure drop in SI units (ρ_{CCl4} = 1.596g/cm^3). If the manometric fluid is changed to mercury (ρ=13.6g/cc) what will be the difference in level. (5)

B) A Newtonian fluid having viscosity of 1.23poise and density of 0.893 gm/cm^3 is flowing through a straight circular pipe having an inside diameter of 5cm. A pitot tube is installed in the pipeline with its impact tube located at the center of the pipe cross section. At a certain flowrate pitot tube indicates a reading of 8cm mercury. Determine the volumetric flowrate. (5)

C) The diameter of a pipe at section 1 and 2 are 200mm and 300mm respectively. If the velocity of water flowing (5) through the pipe at section 1 is 4m/s find the discharge through the pipe and the velocity at section 2. Assume that the pipe is placed horizontally.

D) Explain the sudden contraction and expansion losses occurring in a pipeline. (5)

3) A) Through a pipe of 2.5cm inner diameter and 250m length, oil of density = 1200kg/m^3 and viscosity=20cP, is made to flow. Find the maximum flow rate that will ensure laminar flow. Also find the pressure drop for this flow. (5)

B) What is the physical significance of Reynolds number? How is it defined for (a) flow in a circular pipe of inner diameter D and (b) flow in a circular duct of cross section a*b. (5)

C) How is the hydrodynamic entry length defined for flow in a pipe? Is the entry length longer in laminar or turbulent flow? (5)

D) Explain why the friction factor is independent of the Reynolds number at very high Reynolds number. (5)

4) A) Water at 15Â°C (ρ=999.1 kg/m^3 and μ= 1.138*10^{-3} kg/m.s) is flowing steadily in a 30m long and 4 cm diameter horizontal pipe made up of stainless steel at a rate of 8 L/s. Determine (a) the pressure drop (b) head loss (c) pumping power requirement to overcome this pressure drop. Assume f= 0.01573. Discuss the answer. (10)

B) Determine the mass flowrate in kg/min, shear stress at the pipe wall, Reynolds number for the flow and the power required per 50m length of the pipe to maintain the flow of oil through a 30mm diameter pipe. The properties of oil are: specific gravity=0.9, viscosity =1 poise. Assume that the pressure drop per meter length of the pipe is 20kN/m^2. (10)

5) A) On a flat plate of 2m(length) X 1m (width) experiments were conducted in a wind tunnel with a wing speed of 50km/h. The plate is kept at such an angle that coefficients of drag and lift are 0.18 and 0.9 respectively. Determine the drag force, lift force, the resultant force and the power exerted by the air stream on the plate. Take density of air = 1.15kg/m^3 (5)

B) In fully developed laminar flow in circular pipe, the velocity (6) at R/2 (midway between the wall surface and the centerline) is measured to be 6m/s. Determine the velocity at the center of the pipe.

C) Prove that the ratio of average velocity and maximum velocity for a laminar flow is equal to 0.5. (4)

D) A pipe of diameter 100mm and length 1000m is used to pump oil of viscosity 0.85Ns/m^2 and specific gravity 0.92 at a rate of 1.2m^3/min. State whether the flow is laminar or turbulent. Determine the friction factor. (5)

6) A) Crude oil is pumped through a 150mm diameter smooth pipe which is subjected to seasonal changes in temperature. At a maximum temperature of 38Â°C, when the kinematic viscosity is 0.28 stokes, a power input of 2.3kW per 300m is required to maintain a flow of 30 lt/sec. What power input would be required to maintain the same rate of flow at the minimum temperature of 0Â°C if the viscosity of oil is then 10 times great? Assume a specific gravity of 0.9 at both temperatures. (5)

B) In a horizontal pipe show that the losses vary directly as the viscosity, length, discharge and vary inversely as the fourth power of diameter. (10)

C) List the features of rotary pumps and centrifugal pumps (5)

7) A) Air flows through a bed of 1.5cm diameter at 30ÂºC and 1 atm at a rate of 70 kg/min. The bed is 126 cm diameter and 260 cm height. The porosity of the bed is 0.35. The viscosity of air is 0.0182 cP and the density is 0.001156 gm/cc. Calculate the pressure drop. (5)

B) Define the terms (i) superficial velocity (ii) interstitial velocity (5)

C) Prove that flowrate is proportional to pressure drop and inversely proportional to the length of the bed as per Kozeny-Carman equation (10)

8) A) Explain the various flow patterns in mixing with a schematic representation (5)

B) Elucidate the variation of pressure drop and bed height with respect to superficial velocity in a packed bed and a fluidized bed. (5)

C) A packed bed consists of spheres of 5mm diameter. These are poured to a depth of 4.5 m such that the bed porosity was 0.41. If air flows through this bed entering at 27ÂºC and 8 atm absolute and leaving at 120ÂºC, calculate the pressure drop across the bed when the flow rate is 530 kg/hr per square meter of empty bed cross section. Assume average viscosity as 0.02 cP and density as 6.3 kg/m^3. (10)

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