VIT
Vellore Institute of Technology

Final Assessment Test – November 2019

Course: CHE1005 - Momentum Transfer

Class NBR(s): 1209 Slot: D2+TD2

Time: Three Hours Max. Marks: 100

KEEPING MOBILE PHONE/SMART WATCH, EVEN IN 'OFF' POSITION, IS EXAM MALPRACTICE

PART – A (4 X 10 = 40 Marks)

Answer ALL Questions

1. A hydraulic lift used for lifting automobiles has a 30 cm diameter ram which slides in a 30.018 cm diameter cylinder, the annular space being filled with oil having a kinematic viscosity of 4.0 cm^2/s and relative density of 0.9. If the rate of travel of the ram is 15 cm/s, find the frictional resistance when 3.3 m of ram is engaged in the cylinder.

2. Obtain an expression for the height of capillary rise for a liquid of surface tension σ and contact angle θ between two parallel vertical plates at a distance B apart.

3. The velocity along the centreline of a nozzle of length L is given by $V = 2t(1-\frac{x}{2L})^2$

   Where V= velocity in m/s, t=time in seconds from commencement of flow, x= distance from the inlet to the nozzle. Find the convective acceleration, local acceleration, and total acceleration when t = 3 second, x = 0.5 m, and L = 0.8 m.

4. Gasoline has a vapour pressure of 5.5×10^4 Pa (abs) and density ρ = 680 kg/m^3 flows through a constriction in a pipe where the diameter is reduced from 20 cm to 10 cm. The pressure in the 20 cm pipe just upstream of the constriction is 50 kPa. If the atmospheric pressure is 75 cm of mercury, calculate the maximum discharge that can be passed through this constriction without cavitation occurring.

PART – B (6 X 10 = 60 Marks)

Answer any SIX Questions

5. The discharge Q over a small rectangular weir is known to depend upon the Head H over the weir, the weir height P, gravity g, width of the weir L and fluid properties density ρ, dynamic viscosity μ and the surface tension σ. Express the relationship between the variables in the dimensionless form.

6. Determine the kinetic energy correction factor for laminar flow in a round pipe.

7. Oil of absolute viscosity 1.5 poise and relative density 0.85 flows through a 30 cm diameter pipe. If the head loss in 300 m length of pipe is 20 m, estimate
   (a) The shear stress at the pipe wall
   (b) Shear stress at a radial distance of 10 cm from the pipe axis.
   (c) The friction factor *f* by assuming the flow to be laminar.

8. Calculate the terminal velocity of the maximum size of sand particles (RD=2.65) that will settle in water according to Stock's law. Calculate its diameter.
   (density of water = 998 kg/m^3 Viscosity = 0.001 Pa.s)

9. A car has a frontal projected area of 1.6 m^2 and travels at 60 km/h. It has a drag coefficient of 0.35 based on frontal area.
   (a) Calculate the power required to overcome wind resistance by the car.
   (b) If the drag coefficient is reduced to 0.30 by streamlining, for the same power extended in overcoming air resistance, what speed of the car is possible? (density of air = 1.2 kg/m^3)

10. Determine the head loss for flow of 200L/s of gasoline (density= 680 kg/m^3, viscosity = 2.92×10^{-4} $N.s/m^2$) through a 30 cm diameter pipe. The pipe is 500 m long and has an equivalent roughness magnitude of 0.2 mm. Express the head loss as equivalent pressure differential.

11. Define the following terms:
    (a) NPSH (b) Cavitation (c) Specific speed (d) Minimum speed

12. A centrifugal pump of impeller diameters of 20 cm on the outer and 10 cm on the inner side is rotating at 1000 rpm. If the discharge pipe is shut off completely, calculate the difference in pressure between the outer and inner periphery. Neglect all losses.

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