53 (FPT 303) FLMC

2017

FLUID MECHANICS

Paper : FPT 303

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. (a) What do you mean by the term viscosity ?   3

   (b) What is kinematic viscosity ?
                                                                                                                            2

   (c) State and explain Pascals Law.
                                                                                                                            2

   (d) What do you understand by absolute, gauge and vacuum pressure ?
                                                                                                                            6

(e) Convert 1 atmospheric pressure in killopascal. 2

(f) Describe the fundamental principles and pressure measurement formula by using differential manometer.

5

2. (a) A differential manometer is used to measure the pressure difference between two points in a pipe carrying water. The manometric liquid is mercury and the points have a $0.3m$ height difference. Calculate the pressure difference when height $(h) = 0.7m$. Given that density of mercury and water are $13.6 \times 10^3 kg/m^3$ and $1000 kg/m^3$. 5

(b) Describe different types of fluid flow.

6

(c) Determine : 4

(i) The gauge pressure and

(ii) the absolute pressure of water at a depth of 9m from the surface. Given that the density of water and acceleration due to gravity are $998.2 kg/m^3$ and $9.81 m/s^2$.

(d) State and explain continuity equation of fluid mechanics. What is vortex flow?

4+1=5

3. (a) How fluid is characterized by the property of viscosity? Cite *one* example of each category of fluid. What is Power Law model? 3+2+1=6

(b) A large iceberg floating in seawater is of cubical shape and it's specific gravity is 0.9 if 20cm proportion of the iceberg is above the sea surface, determine the volume of the iceberg if specific gravity of seawater is 1.025. 4

(c) State and explain Bernoulli's equation with the importance of different heads in frictionless pipe. How it is corrected for friction in pipe and pumping energy? 3+1+1=5

(d) it is planned to install a steel pipeline with an inside diameter of 202mm to transport 3800m^3 oil/day. The pipeline is to be 32km long and the delivery end is to be 30m higher than the intake. If the frictional pressure drop in the pipeline is estimated to be 5·3MPa and the overall efficiency of the pump-motor set is 60%, calculate the power requirement of the pump-motor set. Given that the density (ρ) and the viscosity (μ) of the oil are 897kg/m^3 and 50m Pas respectively.

5

4. (a) Pineapple juice is passing through an SS pipe of 1·049 inch in diameter. The specific gravity of pineapple juice is 1·05 and viscosity is 2·5C.P. The volumetric flow rate of fruit juice is 50rpm. Calculate :

(i) Reynold's No.

(ii) Determine the fluid flow characteristics

(iii) Mass flow rate of pineapple juice.

6

(b) Prove that the friction head loss in laminar flow is directly proportional to the mean/average velocity.

3

(c) Differentiate between compressible and incompressible fluid.

1

(d) Crude oil of viscosity (μ) $4 \cdot 8 \times 10^{-2} kg/ms$, and density ($\rho$) $800 kg/m^3$ is flowing through $25mm$ diameter pipe of length $45m$ with mean velocity of $0 \cdot 3m/s$.

Determine —

(i) Reynold's Number and type of flow

(ii) Friction head loss

(iii) Resultant pressure drop

(iv) Centre-line velocity

(v) Velocity $5mm$ from the pipe wall.

10

5. (a) A fruit juice with specific gravity $2 \cdot 4$ and a viscosity of $1 \cdot 2\,poise$ flows through a smooth pipe. The phenomenon results the pressure drop of $800N/m^2$ in $2km$ length of the pipe. What is the pipe diameter if the mass flow rate is $2000kg/hour$?

6

(b) Water flows through a pipeline 20 *mm* in diameter and 400 *m* long, the mean velocity of flow is 3 *m/s*. Given that $f = 0142$. Determine the head loss in friction

    (i) using Darcy-Weisbach equation

    (ii) using Chezy's equation.

                      8

(c) In a circular pipe of diameter 100 *mm* of a fluid of viscosity 10 poise and specific gravity 1·2 is flowing. The volumetric flow rate of the flowing fluid is 70 *rpm*. Calculate

    (i) Reynold's Number

    (ii) Fanning's friction factor.

                      6

6. *(a)* A horizontal pipe of 100 *mm* diameter is joined by sudden enlargement to a 150 *mm* diameter pipe. Water is flowing through it at the rate of 2 m^3/*min*. Find

    (i) Loss of head due to sudden expansion

    (ii) Pressure difference in two pipes.

                      8

(b) What is Drag? Give the mathematical expression of drag co-efficient. 4

(c) Calculate the drag force on each side of a thin smooth plate $2m$ long and $1m$ wide with the length parallel to a flow of fluid moving at $30m/s$. The density of the flowing fluid is $800kg/m^3$ and the dynamic viscosity is $8CP$.

4

(d) A cylinder $80mm$ diameter and $200mm$ long is placed in a stream of fluid flowing at $0.5m/s$. The axis of the cylinder is normal to the direction of flow. The density of the fluid is $800kg/m^3$. The drag force is measured and found to be $30N$. 4

7. Write short notes on : *(any five)*

$4 \times 5 = 20$

(a) Venturimeter

(b) Rotameter

(c) Vena contracta

(d) Prandte boundary layer

(e) Orificemeter

(g) Centrifugal pump

(h) Different type of valves and their applications in process industry.