53 (FPT 303) FLMC

2018

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 is the dimensional expression of pressure ? 2

(b) What is the unit of viscosity in S.I. system ? 2

(c) Define absolute, gauge and vacuum pressure. 6

(d) Convert 1 *bar* pressure in *pascal.* 2

(e) Differentiate between specific gravity and density of a substance. 3

(f) Describe the fundamental principles and method of pressure measurement by using v-tube manometer. 5

2. (a) The gauge pressure in water is $50 kN/m^2$. What is the pressure head ? 5

(b) What is the maximum gauge pressure of water that can be measured by using a piezometer $2{\cdot}5m$ in high ? 5

(c) A liquid has a specific gravity of 1·75 and kinematic viscosity of 5 *stokes*. What is the dynamic viscosity ? 5

(d) A manometer is used to measure the pressure in a tank. The specific gravity of the fluid is 0·85 and the manometer column height is $55cm$. If the local atmospheric pressure is $96 kPa$, determine the absolute pressure within the tank. 5

3. *(a)* Categorise the fluid according to viscous property. Give *one* example of each. Characterize Newtonian and Non-Newtonian fluid category by Power Law equation. 3+3+2=8

(b) Express buoyancy mathematically. 3

(c) Classify steady and unsteady flow according to their characteristics. 4

(d) Derive the mathematical expression of conservation of momentum. Explain continuity equation. 2+3=5

4. *(a)* Deduce Bernoulli's equation. How correction factor related to velocity head and pipe friction factors are linked with the equation ? What is pump efficiency ? 6+4+2=12

(b) A liquid fruit juice is pumped using a one horse power pump from a storage tank at the ground level to the processing zone at 10*m* high through a 5·08*cm* diameter pipe. The efficiency of the pump is 65%. The discharge velocity of the juice at the outlet is 260 *gallon/mint.* The specific gravity of the juice may be taken as 1·1. Find the friction losses in the pipe. 8

5. *(a)* Define Reynold's Number and prove that it is a dimensionless quantity. 3

(b) Characterize fluid flow by considering Reynold's number. 3

(c) Orange juice is passing through an SS pipe of 2 *inch* in diameter. The specific gravity of orange juice is 1·05 and viscosity is 2·5 C.P. The volumetric flow rate of the juice is 80 *liter* per minute.

Calculate :

(i) Reynold's Number

(ii) Type of fluid flow

(iii) Mass flow rate. 3+2+3=8

(d) In a circular pipe of diameter 100*cm* a fluid of viscosity 7 *poise* and specific gravity 1·3 is flowing. If the maximum shear stress at the wall of the pipe is $196{\cdot}2 N/m^2$, find

(i) the pressure gradient

(ii) the average velocity and

(iii) Reynold's Number. 6

6. *(a)* Derive Hagen-Poiseuille's equation of friction losses in laminar flow through a circular tube. Define Fanning friction factor. 8+2=10

(b) How friction head loss is directly proportional to the mean velocity squared by Darcy and Weisbach formula ? Indicate the nature of flow. 3+1=4

(c) A liquid with a specific gravity 1·8 and viscosity of 1·2 *poise* flows through a smooth pipe of unknown diameter, resulting in a pressure drop of $800 N/m^2$ in $500 m$ length of the pipe. What is the pipe diameter and average velocity if the mass flow rate is $3500 kg/h$? 6

7. Write short notes on : ***(any five)*** 4×5=20

(a) Drag force and drag coefficient in cylindrical body

(b) Sudden enlargement and contraction in pipe

(c) Orificemeter

(d) Variable area meter

(e) Hydraulic pump

(f) Suction lift and cavitation

(g) Prandtl's boundary layer characteristics.