

**B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING SECOND YEAR
FIRST SEMESTER EXAM 2024**

FLUID FLOW

Full Marks: 100

Time: 3 hrs

(50 Marks for each Part)

Use separate answer script for each Part

PART I (50 Marks)

Answer any four questions (12.5 x 4= 50)

1. Prove that Reynolds No. (N_{Re}) is dimensionless no. Give example of each of bingham plastic and pseudo plastic fluid. What do you mean by flow behavior index and what is its value for Newtonian fluids? Prove that the velocity of a flow in a pipe of circular cross section is inversely proportional to the square of the diameter of the pipe. Water is flowing at a rate of $2 \text{ m}^3/\text{s}$ through a horizontal tube with a diameter of 1m . If the pressure at this point is 80kPa , what is the pressure of the water after the tube narrows to a diameter of 0.5m ? 2 + 2 + (1+1) + 3 + 3.5

2. What are positive displacement pumps? With a neat sketch explain the mechanism of action of a reciprocating pump . Mention the pump heads. What do you mean by 'NPSH'? How do we avoid cavitation? 2 + 5 + 2 + 1+2.5

3. For a Laminar flow of a Newtonian fluid through a pipe of circular cross section , prove that the distribution of velocity (u) is parabolic in nature and the average velocity $\bar{u} = \frac{1}{2} u_{\text{max}}$. Show the position inside the tube where the point velocity of the liquid is equal to the average velocity. 6 + 4 + 2.5

4. With neat sketch show the following fittings: Tee and Reducer. What will be the 'equivalent straight pipe length' of a 90° elbow attached to pipe of 2 inch diameter. Write short note on : Moody chart. What is 'roughness factor' ?

An airplane wing is designed so that the speed of the air across the top of the wing is 25m/s when the speed of the air below the wing is 225m/s . The density of air is 1.29kg/m^3 . What is the lifting force on the plane if the cross sectional area of a single wing is 24m^2 ? 3 + 2 + 2 + 2 + 3.5

5. Cite some examples of fluid flow through packed bed. Deduce the relation between the equivalent diameter of a packed bed column and the diameter of the packing material.

Pressure drop of air flowing through a packed bed of 250 cm length. It has a diameter of 125 cm and is packed with silica particles of 1.25 cm diameter. Bed has a porosity of 0.38 . Air has a flow rate of 6 kg/ min . Density and viscosity of air are 10^{-3}gm/cc and 10^{-2} mPa-sec , respectively. 2 + 4 + 6.5

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Part-II (50 Marks)

Group-A

Answer any one question

5×1=5

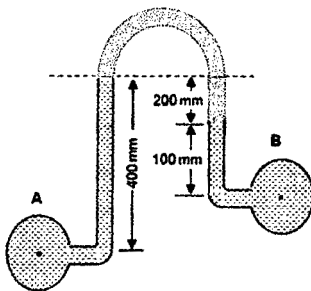
1. What are the different types of manometers? Write the answer with the help of chart.
2. Define absolute pressure and gauge pressure. Express their correlation.

Group-B

Answer any three questions

15×3 =45

3. (a) Derive the expression for pressure change with fluid height (for incompressible fluid).
- (b) An inverted tube differential manometer having an oil of specific gravity 0.9 is connected to two different pipes carrying water under pressure. Determine the pressure in the pipe B. The pressure in pipe A is 2 m of water.



7+ 8 = 15

4. (a) Derive the expression for volumetric flow rate through an orifice meter.
 - (b) A venturi meter of 15 cm inlet diameter and 10 cm throat is laid horizontally in a pipe to measure the flow of oil of 0.9 specific gravity. The reading of a mercury manometer is 20 cm. Calculate the discharge in lit/min?
- 7+8 = 15
5. (a) How do you measure flow rate using a pitot tube? The venture meter coefficient is greater than orifice meter coefficient-why?
 - (b) A rotameter with a stainless steel float has a maximum capacity of 1.2 l/s of water at 28°C. What will be the maximum capacity for kerosene in l/s for the same rotameter and the same float?
The specific gravity of stainless steel = 7.92 and that of kerosene = 0.82.
- 5+2+8 = 15
6. (a) Mention different zones of atmosphere (along height). Write temperature and pressure variation in different zones of the atmosphere.
 - (b) The cruising altitudes of subsonic and supersonic aircraft are 12 km and 20 km respectively. What is the relative difference in air density between these two altitudes?

7+8 = 15