

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

**Fluid Flow**

Time: 3 hrs.

( 50 Marks for each Part)

Full Marks : 100

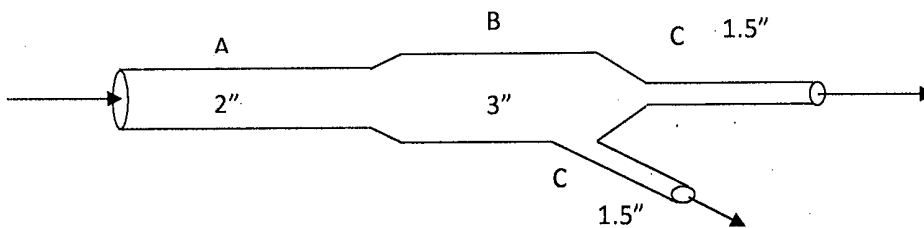
Use separate answer script for each Part

**Part – I**

[Answer any five questions, 10 x 5 = 50 ]]

1. What is Reynolds number and how its related to fluid flow pattern? What do you mean by 'power law' model equation? Show the profile of 'shear stresses against 'shear rate' for different types of fluids citing example for each. What do you mean by 'eddies'? Develop relation between 'Fanning friction factor' and 'Reynolds.No.'  
(2+2+3+1+2)

2.



Crude oil , specific gravity 0.887 at ambient condition, flow through a piping system shown in above fig. Pipe A is 2 inch , B is 3 inch and each of pipes C is 1.5 inch. Equal amount of liquid flows through each of the line C. The flow through the pipe A is 40 gal/min. Calculate (a) mass flow rate in each pipe, in pounds per hr. ( b) the average linear velocity in each pipe, in feet per sec.  
Inner cross-sectional area of 2 in. , 3 in. and 1.5 in. pipe are 0.0233 ft<sup>2</sup> , 0.0513 ft<sup>2</sup> and 0.01414 ft<sup>2</sup>, respectively.  
Assume, 1 ft<sup>3</sup> equals to 7.48 gal. (6 + 4 )

3. Prove that velocity distribution with respect to radius of the flow pipe is a parabola for laminar flow of Newtonian fluid through circular pipe. Show the relation between  $V_{max}$  and  $V_{av}$  in the present case. (7+3)
4. What is the basic objective of using pipe fittings. What is the value of 'equivalent resistance' of 45° elbow ? What is 'Fanning Friction Chart' and what is 'roughness factor' ? (2+1+3)

(b) In an air pipe line , the flow has the following conditions at section 1: temperature 25°C, pressure 1.5 bar, velocity of flow 15 m/s, inside pipe diameter 50mm and at section 2: 25°C, pressure 1.2 bar, inside pipe diameter 75mm. Calculate the mass flow rate of air and the velocity at section 2. At 25°C and 1.5 bar pressure, air has density of 2.1 kg/m<sup>3</sup>. (4)

5. Determine the loss of pressure in overcoming the friction in a coil through which water flows with a velocity of 1.5 m/s. The coil is made of steel pipe with an internal diameter of 30mm. The diameter of a turn of the coil is 1 m. the number of turns is 10. The average temperature of the water in the coil is 30°C. Assume here, density and viscosity of water as 998 kg/m<sup>3</sup> and 0.8 mPa-s. (10)
6. What do you mean by 'void fraction' in a packed bed? What are 'interstitial velocity' and 'superficial velocity' and what is the relation between them ? Develop a relation between pressure drop and length of packing material for flow with very low Reynolds no. ( less than 10 ). (2+3+5)
7. A water softener consists of a vertical tube of 50 mm diameter and packed to a height of 0.5 m with ion-exchange resin particles. May be considered spherical with a diameter of 1.25 mm. water flows over the bed , because of gravity as well as pressure difference , at a rate of 300 ml/s. The bed has a porosity of 0.3. Calculate the frictional pressure drop. (10)

[ Turn over

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**Part-II**

**Use Separate Answer scripts for each Part**

**Group-A**

**Answer any one question**

**1×5 = 5**

1. Classify manometers with the help of a chart.
2. Derive the expression for pressure variation with fluid depth, in incompressible fluid.

**Group-B**

**Answer any three questions**

**3×15 = 45**

3. Write short note on inclined tube manometer. Define absolute pressure and gauge pressure and vacuum. What is the difference between compressible and non-compressible fluid? 7+6+2 = 15
4. (a) How pressure change with height in atmosphere?  
(b) A venture meter having a diameter of 7.5 cm at the throat and 15 cm at the enlarged end, is installed in a horizontal pipe line of 15 cm diameter. The carries an incompressible fluid at a steady rate of 30 liter per second. The difference of pressure head measured in terms of moving fluid in between the enlarged and throat of the venture meter observed to be 2.45m. Taking the acceleration due to gravity as 9.81 m/s<sup>2</sup>. Determine the venture meter coefficient. 5+10 = 15
5. (a) Define venture meter coefficient. Why venture meter coefficient is more than orifice meter coefficient?  
(b) A container of gas is hooked up to an open ended monometer. If the atmospheric pressure is 102 kPa and the mercury is 30 mm higher on the open end. a. Draw a diagram of the manometer. b. Calculate the pressure of the gas. 5+10 = 15
6. (a) Write short note on pitot tube.  
(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? Specific gravity of stainless steel and kerosene are 7.92 and 0.82 respectively. 5+10 = 15