ELEMENTS OF FOOD ENGINEERING–II

Full Marks – 70

Pass Marks – 28

Time – Three hours

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

Answer any *five* questions.

1. (a) What is a fluid ? Mention any four properties
   of fluid.   1+2=3

   (b) A pipe (1–1) 400 mm in diameter, conveying
   water branches into two pipes (2–2 and 3–3)
   of diameters, 300 mm and 200 mm respectively
   as shown in figure-1.

   (i) Find the discharge through the pipe
   (1–1) if the average velocity of water in
   this pipe is 3 m/s.

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(ii) Determine the velocity of water in 200 mm diameter pipe if the average velocity in 300 mm pipe is 2 m/s. 7
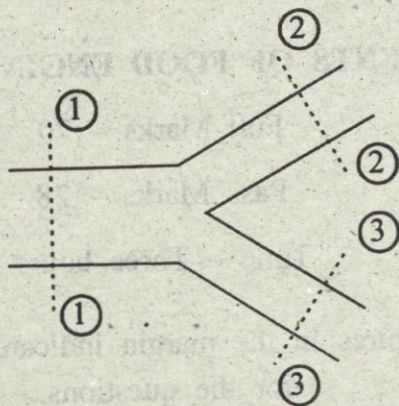

Fig. 1

(c) Distinguish between the steady and unsteady flow. What do you mean by specific gravity ?

2+2=4

2. (a) State Bernoulli's theorem. What are the Newtonian and non-Newtonian fluids ?

2+4=6

(b) Water is flowing through a pipe having diameters 600 mm and 400 mm at the bottom and upper end respectively as shown in figure-2. The intensity of pressure at the bottom end is 350 kN/m² and at the upper

end is 100 kN/m². Determine the difference in the datum head if the rate of flow through the pipe is 60 litres/s.   8
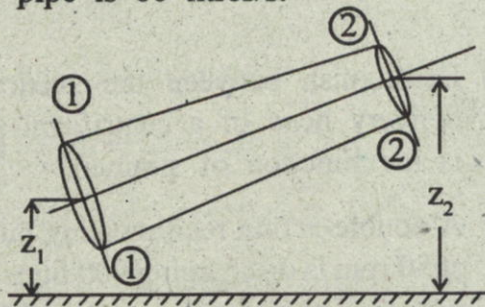

Fig. 2

3. (a) What is the use of a venturimeter ? Mention any three types of venturimeter.   1+3=4

(b) Derive the expression for actual discharge (Q_{act}) of a fluid flowing through a horizontal venturimeter, which is given by

$$Q_{act} = C_d \frac{A_1 A_2}{\sqrt{A_1^2 - A_2^2}} \sqrt{2gh}$$

where, C_d = Coefficient of discharge

   A_1, A_2 = Area at inlet and outlet respectively

   h = Difference of pressure head at inlet and outlet

   g = Acceleration due to gravity.   10

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4. (a) How will you join between two pipes ? If the flow direction of fluid is to be changed in a pipeline, what types of joint will you use ?
2+2=4

(b) Distinguish between the suction head and delivery head of a centrifugal pump. What is the function of strainer ?
2+1=3

(c) A double-acting reciprocating pump, running at 50 rpm is discharging 900 litres of water per minute. The pump has stroke of 400 mm. The diameter of the piston is 250 mm. The delivery and suction heads are 25m and 4m respectively. Find the slip of the pump and power required to drive the pump.
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5. (a) What do you mean by "mass transfer"? 2

(b) Define the term "concentration." Distinguish between the mass fraction and mole fraction.
2+4=6

(c) A mixture of O_2 and N_2 with their partial pressures in the ratio 0.21 to 0.79 is in a container at 25°C. Calculate—
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(i) The molar concentration

(ii) Mass density

(iii) Mass fraction.

6. (a) Define the following terms (any *four*) :

2×4=8

(i) Dry air

(ii) Specific humidity

(iii) Relative humidity

(iv) Dry bulb temperature (DBT)

(v) Drew point temperature (DPT)

(b) Determine the masses of dry air and the water vapour contained in a 240m³ room at 98 KPa, 23°C and 50% relative humidity (RH), if the saturated pressure at 23°C is 2·811 KPa.

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