Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (FT)/SEM-6/FT-604/2010

2010

FOOD PROCESS EQUIPMENT DESIGN

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : $10 \times 1 = 10$

   i) Mango flakes can be prepared using a
      a) spray drier
      b) drum drier
      c) tray drier.

   ii) Liquid nitrogen evaporates at
      a) – 40°C
      b) – 72°C
      c) – 196°C.

   iii) The plate freezer is used for freezing of
      a) prawn
      b) ice cream
      c) fruit juice.

iv) The pressure in a single stage homogenizer is
   a) 200 psig
   b) 500 psig
   c) 2500 psig.

v) Throttling calorimeter is used for the measurement of
   a) heat transfer coefficient
   b) dryness fraction of steam
   c) saturation temperature of steam at a particular pressure
   d) none of these.

vi) The angle of a saddle support
   a) should not normally be greater than 120°
   b) must be equal to 120°
   c) should not normally be less than 120°
   d) none of these.

vii) A vessel of 0·4 m^3 capacity containing 2 kg wet steam has a specific volume (usual unit)
   a) 5 b) 0·2
   c) 0·8 d) none of these.

viii) General equation for flat plate is
   a) $t = C D_e (f/P)^{0.5}$
   b) $t = PD_i /(2f - P)$
   c) $t = C D_e (P/f)^{0.5}$
   d) none of these.

ix) For food products (such as fruit juice) that are very heat sensitive and where low differentials are allowable in the heat exchanger, then they can be concentrated using
   a) long tube evaporator
   b) high pressure evaporator
   c) falling film evaporator
   d) none of these.

x) A food material has a regular cuboid shape whose sides are 1·0, 1·5 & 3·0 units. What is the equivalent spherical diameter ?

a) 2·93 units b) 2·05 units

c) 2·99 units d) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Write a short note on fruit juice extractor.
3. Write the design criteria of cylindrical vessel under internal pressure.
4. Write short notes on freeze drier.
5. Write the operational equation of constant pressure filtration unit.
6. Write a short note on Rotary Drier for drying of paddy.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. It is necessary to design a tray drier for drying of cabbage. What factors should you consider for determination of dimension of drying chamber and trays ? How would you proceed to design the drying unit ? 5 + 10
8. Discuss the design parameters of a drum drier. A drum drier is being designed for drying of mango juice from an initial total solid content of 12% to a moisture content of 4%. An overall heat transfer co-efficient U of 1700 W/m^2 °C is being estimated for the product. An average temperature difference between roller surface and the product of 85°C will be used for design purposes. Determine the surface area of the roller required to provide the production rate of 20 kg product/hr.

5 + 10

9. Discuss the major parameters for the design of a cylindrical shape vessel with welded joint to be subjected to internal pressure. Assume $t/D_i \leq 0{\cdot}25$ where t = wall thickness and D_i = internal diameter of the pressure vessel.

   A process vessel having its nominal diameter of 1·2 m and tangent to tangent length 2·4 m was designed for maximum operating pressure of 500 kN/m^2 and the shell thickness recommended was 6 mm, while the corrosion allowance suggested as 2 mm.

   The material of construction was IS : 2002-1962 Grade 2B quality steel having allowable design stress value of $118MN/m^2$ at working temperature. If the vessel is to be fabricated according to class 2 of IS specification, which stipulates the weld joint efficiency of 0·85. Check the design for the correct thickness. 5 + 10

10. A food powder is to be dried in a 0·5 m diameter fluidized bed drier using air at 50°C. It is found that minimum fluidizing conditions are obtained when the bed pressure drop is 6000 pascal for a bed height of 0·50 m. Using the Kozeny–Carmen equation determine the minimum fluidizing velocity if the surface volume mean particle diameter is
    180 μm and the particle density is 2300 kg/m^3. Given, for air (at 50°C) the density is 1·1 kg/m^3, viscosity is
    $1{\cdot}98 \propto 10^{-5}$ Pa-S.

    Calculate the terminal velocity of falling particles. Given sphericity (ϕ_s) = 0·67, density of particle 2300 kg/m^3.

11. What are the advantages and disadvantages of single and twin screw extruders used in food industry ? Discuss the important design parameters of a twin screw extruder.

    5 + 10