Roll No. **Total No. of Pages : 02**

Total No. of Questions : 08

M.Tech. (Food Technology) (2018 Batch) (Sem.–1)

ADVANCES IN FOOD ENGINEERING

Subject Code : MTFT-511-518

Paper ID : [75598]

Time : 3 Hrs. **Max. Marks : 60**

INSTRUCTIONS TO CANDIDATES :

1.Attempt any FIVE questions out of EIGHT questions.

2.Each question carries TWELVE marks.

Q1. a) Discuss the important mechanical properties of the food materials. How these properties influence the design of handling and storage equipment? (7)

b) What is TDT curve and from this curve derive and define the concept of Z-value. (5)

Q2 a) Explain the graphical method for process time calculations. (7)

b) An ice cream mix having a viscosity of 72 cP and density of 1019 kg/m^3 is being canned aseptically at the rate of 15 litre/min. The mix is heated to 141°C, passed through a pipe of 30 meter length and 22 mm diameter and then cooled. Calculate the Sterilizing value of this process based on D_o =1.82 minute; Z = 14°C. (5)

Q3. Determine the velocity profile for a Non-Newtonian viscous fluid flowing through a circular pipe. Also derive the equation for discharge rates. Considering laminar and one dimensional flow conditions describe the procedure to find out the values of consistency index, flow behavior index and apparent viscosity of the fluid. (12)

Q4. a) Explain the different characteristic curves with neat sketches. (7)

b) A capillary tube viscometer is being used to measure the viscosity of honey at 30 °C. The tube radius is 2.5cm and the length is 25cm. Determine the viscosity of honey at pressure difference (ΔP) of 10 Pa and flow rate (V) of 1.25 cm^3/s. (5)

Q5. a) Derive the expression for effectiveness of heat exchanger by NTU method for the parallel flow heat exchanger. (7)

b) A heat exchanger is used to heat water from 20°C to 50°C when thin walled water tubes (inner diameter 25 mm, length is 15 m) are laid beneath a hot spring water pond, temperature 75°C. Water flows through the tubes with a velocity of 1 m/s. Convective heat transfer coefficient at the inner surface is 3460.8 W/m^{2}K. Estimate the required overall heat transfer coefficient and the convective heat transfer coefficient at the outer surface of the tube. Neglect the resistance offered by wall. (5)

Q6. a) Derive an expression for the rate of heat transfer by conduction & convection through a composite plane wall consisting of three heterogeneous layers having thermal conductivity; K_1, K_2 and K_3 respectively. (6)

b) The walls of a cold storage consists of three layers-an outer layer of ordinary bricks, 25 cm thick, a middle layer of cork, 10 cm thick and an inner layer of cement, 6 cm thick. The thermal conductivities of the materials are 0.7, 0.043 and 0.72 W/m°C, respectively. The temperature of the outer surface of the wall is 30°C and that of the inner is -15°C. Take area perpendicular to heat transfer as 1 m^2. Calculate the driving force for heat transfer, total thermal resistance, thermal conductance, steady state heat transfer rate and temperatures at the interfaces of composite wall. (6)

Q7. Differentiate between ultra-filtration and reverse osmosis. Explain the various types of membrane configurations and modules. Draw a neat diagram of **any one** membrane module. (12)

Q8. a) Derive the Plank's equation for freezing time. Discuss its limitations also. (6)

b) A spherical food product is being frozen in an air-blast freezer. The initial product temperature is 20°C and the cold air - 40°C. The product has a 7 cm diameter with density of 1000 kg/m^3, the initial freezing temperature is -1.25°C, the thermal conductivity of the frozen product is 1.20 W/(m K), the latent heat of fusion is 250 kJ/kg and convective heat transfer coefficient is 50W/m^2K. Using Planks equation calculate the freezing time. (6)