



End Semester Examination – Nov/Dec – 2016

Code : 14FP2021
Sub. Name : Food Process Equipment Design

Semester : 2016-17 ODD
Duration : 3hrs
Max. marks : 100

ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)

Q. No.	Sub Div.	Questions	Course Outcome	Marks
1.	a.	The initial moisture content of a food product is 77% (wet basis), and the critical moisture content is 30% (wet basis). If the constant drying rate is 0.1 kg H ₂ O/(m ² s), compute the time required for the product to begin the falling-rate drying period. The product has a cube shape with 5-cm sides, and the initial product density is 950 kg/m ³ .	CO3	8
	b.	Onions with 75 per cent moisture content on wet basis is dried to a final moisture content of 20 percent. If we dry 1000 kg of onions, what is the final weight of the product, and how much water is removed?	CO3	7
	c.	Write a note on constant drying rate period		5
(OR)				
2.	a.	A food solid was dried from 40 to 10% moisture content in 2 h in a batch drier with constant air conditions. The drying rate remained constant down to a moisture content of 15%. If the equilibrium moisture content is 2%, calculate the total time required to dry from 40 to 4% moisture content. All moisture contents are given on a dry basis.	CO3	8
	b.	Give the classification of dryers	CO1	8
	c.	A 50 kg mass of food has a moisture content of 33.3% (dry basis). How much water is present? What is the moisture content on a wet basis?	CO2	4
3.	a.	1000 kg/h of milk is heated in a heat exchanger from 45°C to 72°C. Water is used as the heating medium. It enters the heat exchanger at 90°C and leaves at 75°C. Calculate the mass flow rate of the heating medium, if the heat losses to the environment are equal to 1 kW. The heat capacity of water is given equal to 4.2 kJ/kg°C and that of milk 3.9 kJ/kg°C	CO3	10
	b.	Calculate a preliminary estimate of the heat exchanger area needed to cool 55,000 lb/hr of a light oil (specific heat = 0.74 Btu/lb.°F) from 190°F to 140°F using cooling water that is available at 50°F. The cooling water can be allowed to heat to 90°F. An initial estimate of the Overall Heat Transfer Coefficient is 120 Btu/hr ft ² °F. Also estimate the required mass flow rate of cooling water	CO3	10
(OR)				
4.	a.	Illustrate with a diagram construction and working of single effect evaporators used in food industries.	CO2	10
	b.	Taking the shell and tube heat exchanger has an area of 178.7 ft ² , how many tubes of 3 inch diameter and 10 ft length should be used?	CO3	5
	c.	A quantity of water is heated with steam of 5 bar from a temperature of 35°C to 100° C over a period of 1200 s. The mass of water is 50 kg and the Specific Heat capacity of water is 4.19 kJ/kg°C. Calculate the heat transfer rate.	CO3	5
5.	a.	A thin cylindrical pressure vessel of 1.2 m diameter generates steam at a pressure of 1.75 N/mm ² . Find the minimum wall thickness, if (a) the longitudinal stress	CO3	8

		does not exceed 28 MPa; and (b) the circumferential stress does not exceed 42 MPa		
	b.	A cast iron cylinder of internal diameter 200 mm and thickness 50 mm is subjected to a pressure of 5 N/mm ² . Calculate the tangential and radial stresses at the inner, middle (radius = 125 mm) and outer surfaces.	CO3	12
(OR)				
6.	a.	The reaction $A \rightarrow B$ is to be carried out isothermally in a continuous-flow reactor. Calculate the CSTR, PFR volume to consume 79% of A, when the entering molar flow rate is 5 mol A/h, the volumetric flow rate is constant at 10 lit/h and the rate is $-r_A = (3 \text{ lit/mol} \cdot \text{h}) C_A^2$	CO3	15
	b.	Give the classification of pressure vessels	CO1	5
7.	a.	Explain about various stresses to be estimated to find strength of an equipment	CO2	8
	b.	Write a note on different types of corrosion	CO1	5
	c.	Give a note on choice of material in equipment design	CO2	5
(OR)				
8.	a.	Enumerate the usage of various ferrous metals in construction of food processing equipments.	CO2	20
<u>Compulsory:</u>				
9.	a.	Explain in brief about the following losses in storage vessels: 1. Breathing losses 2. Filling losses 3. Boiling losses	CO2	10
	b.	Describe in detail about the Hortonspheres	CO2	10

ALL THE BEST