Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY
BE – SEMESTER – VI EXAMINATION – WINTER 2015

Subject Code:161401 **Date:15/12/ 2015**

Subject Name: Food Process Equipment Design
Time: 2:30pm to 5:00pm **Total Marks: 70**
Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use of steam table and psychrometry chart is permitted.**

Q.1		Answer the following in brief:		
		i.	"The best designed food processing equipment may also fail." Justify?	02
		ii.	Discuss role of baffles in the process of agitations?	02
		iii.	Differentiate dryer, oven and evaporator.	03
		iv.	Define HUF, COP and THE in relation to dryer?	03
		v.	List different types of agitators used in the food processing industry.	04
Q.2	(a)	i.	What is significance of power number?	03
		ii.	Derive the equation of the power number?	04
	(b)	i.	What are the advantages of PHE?	02
		ii.	Where it is used in food industry?	02
		iii.	Draw the detailed diagram of Chevron PHE with all its notations.	03
			OR	
	(b)	i.	What are the various types pressure vessel head used in the food industry?	03
		ii.	With diagram explain their applications and limitations.	04
Q.3	(a)		Explain the steam economy with heat and mass balance in single and multiple effect evaporators with diagram?	07
	(b)	i.	Describe possible process hazards in a typical food industry?	04
		ii.	Discuss their preventive measures.	03
			OR	
Q.3	(a)		In a food industry solid-liquid mixing is done and the viscosity of the mix increases. While in operation. Suggest suitable agitator and justify?	07
	(b)		Describe material hazards in a typical food industry?	03
			Discuss their preventive measures and disposal procedures after it occur?	04
Q.4	(a)		Design a pressure vessel head for pressure vessel (Diameter 1800mm and thickness is 8 mm) having operating pressure of 0.42 ± 0.03 N/mm^2 and temperature of 62°C. The permissible stress at 30 and 100°C are 200 and 144N/mm^2 respectively. The joint efficiency and joint checking efficiency are	07

85 and 90 per cent respectively. The desired safety factor is 2.

$t_{head} = C_e D_i \{p/f\}^{0.5}$; $t_{head} = \{p R_i W\} /2f$; $t_{head} = p D V / 2f$;

$t_{head} = p D / 4f$; $V = 0.25 (2 + K^2)$; $W = 0.25 [3+\{R_i / R_c\}^{0.5}]$

Available sheet thickness are: 5.5, 6, 8 and 10 mm

(b) Design the shaft of an agitator, having angular speed of 180 RPM operated by 3HP motor with an impeller of 45 cm. The maximum torque and bending moment on full load are estimated to be 180 and 300 N m. The safe permissible shear and tensile stress are 400 and 600 N/cm^2. 07

OR

Q.4 (a) Design a blower to carry the librated moisture from grain dryer (capacity 2 t) by hot air of 65°C. The dryer is fed with parboiled paddy of 24% moisture content (WB) and dried to 14% moisture content (WB) in 10 hours. The density of the air is 1.1kg/m^3 and absolute humidity of inlet and outlet air is 0.012 and 0.024 kg water vapor per kg dry air. Maximum pressure drop of 5 cm of water column is observed. 07

(b) i. Ambient air (dry bulb 28°C and wet bulb 18 ^{0}C) is heated to 72°C and fed in to the drying chamber of LSU dryer to dry parboiled paddy. If the air coming out of the dryer has temperature of 58°C. With the help of Psychrometry chart find other data of air and evaluate the LSU dryer performance? 04

ii. Suggest the methods to improve the performance of the dryer? 03

Q.5 (a) Design a cylindrical pressure vessel to hold 8 kilo liter juice of specific gravity 1.08 at operating pressure of 0.35 N/mm^2 and temperature of 72°C. The safety factor is 2.2 and all joints are checked thoroughly by radiograph. The joint efficiency is 80%. The permissible stress of the material at 50°C is 160 N/mm^2 and at 100°C is 142 N/mm^2. Available plates in stock: 7

Length : any

Breadth : 710, 1250, 1500 and 2000mm

Thickness : 7, 9, 11, 14, 16, 25, 45, 63, 80 mm

Corners radius is 6 percent of heads radius.

$V = \pi R_i^2 H$; $t = p D_i / \{2f \eta - p\}$;

$t = \{p R_i W\} /2f \eta$; $W = 0.25 [3+\{R_i / R_c\}^{0.5}]$

(b) i. List different types of turbine agitator? 02

ii. Where it can be used in food industry? 02

iii. What are its dimensional limitations? 03

OR

Q.5 (a) i. Explain: Capacity ratio and Fouling factor 02

ii. Explain the various feeding methods in multi effect evaporators with relative advantage of each method? 05

(b) Explain the following passes and flow arrangements in plate heat exchanger with diagram;

i. U- arrangement 02

ii. Z- arrangement 02

iii. 2x4/1x8 arrangement 03

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