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

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI- EXAMINATION – SUMMER 2016

Subject Code:161401 **Date:19/05/2016**

Subject Name:Food Process Equipment Design

Time: 10:30 AM to 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q1 **a** Differentiate between the following **07**

1. Recuperation and Regeneration with reference to heat exchanger
2. Mixed and Unmixed cross flow show with figure
3. Condensation and Evaporation in terms of energy exchange

b Explain the significance of power function number of an agitator? What are the properties of material is considered for designing the agitator shaft? **07**

Q2 **a** What is boiling point elevation? Describe the Duhring lines with help of diagram. Why PHE is more preferable in food industries? Draw the diagram of plate with all notations. **07**

b What are different major and minor loads considered while designing pressure vessels? Calculate the safe permissible stress at 72^0C The safe permissible stress at 30 and 200^0C are 165 and 130 N/mm^2 respectively. The desired safety factor is 2.2. All joints are checked with the radiograph. The joint efficiency is 90%. **07**

OR

b With neat sketch explain the working of LSU dryer. List process and material hazards in tomato ketchup industry. **07**

Q3 **a** Differentiate between AMTD and LMTD. Give the limitations of AMTD. Derive the equation of Number of Transfer Unit for parallel flow: **07**

$$\varepsilon_h \frac{1-\exp[-NTU(1+C)]}{1+C}$$

b Differentiate between single and multiple effect evaporators. Explain steam economy. Give the classification of evaporators with diagram. **07**

OR

a Calculate the capacity of the blower (in cubic meter per minute), to cool the grains (5 t) by 12^oC in 6 hours. The maximum permissible rise in air temperature is 6^oC. The density of the air is 1.1 kg/m^3 and specific heat of grain and air is 2.4 and 1.07kJ/kg^{o}C respectively. Considering there is no loss of moisture and pressure drop of 2.1 cm water column during the process of cooling. Also suggest the power requirement of blower? **07**

b Design a pressure vessel to sterilize the 5 t liquid food of specific gravity 0.92 at 0.25 N/mm^2 and 62^oC. Sheets available in the stock are: Length any size. **07**

Width: 710, 1250, 1500 and 2000 mm and Thickness: 5.5, 6.0, 8.0 and 10 mm

Corners radius is 6 percent of heads radius.

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

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

Q4 **a** Design an agitator shaft to rotate at 90 rpm with 3 hp motor. Impeller diameter of 35 cm. The maximum bending moment and torque are 195 and 350 Nm. Permissible shear and tensile stresses are 400 and 600 N/cm^2 respectively. **07**

b What are the different types of an agitator used in the food industry? **07**

OR

a What are different pressure vessel head? Sketch them and state limitations of each of them? With the Buckingham's Π theorem derive the power function of an agitator. **07**

b Write down the steps of designing pressure vessel and its head. **07**

Q5 **a** Which type of agitator will be used in the ice cream industry and Why? Write a detail note on turbine agitator? **07**

b What do you understand by overall heat transfer coefficient? List the points which are to be kept in mind during the calculation of overall heat transfer coefficient. **07**

OR

a Describe the followings in brief: **07**

1. Heat Capacity ratio
2. Steam economy
3. Fouling factor
4. Chevron angle

b Explain the following passes and flow arrangements in plate heat exchanger with diagram; **07**

1. U- arrangement
2. Z- arrangement
3. 2x4/1x8 arrangement