

Seat No.: \_\_\_\_\_

Enrolment No. \_\_\_\_\_

## **GUJARAT TECHNOLOGICAL UNIVERSITY**

**BE - SEMESTER-VI • EXAMINATION – WINTER • 2014**

**Subject Code: 161401**

**Date: 26-11-2014**

**Subject Name: Food Process Equipment Design**

**Time: 02:30 pm - 05:00 pm**

**Total Marks: 70**

**Instructions:**

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

- Q.1** (a) With the neat sketches describe different types pressure head used for the pressure vessels used in the food processing industry. Discuss which is the strongest, easiest to fabricate and cheapest pressure vessel head. **07**
- (b) What are the various food handling equipments used in the food industry? With neat sketch describe any one. **07**

- Q.2** (a) How the performance of the dryer is evaluated? Suggest suitable measures to improve the performance. **07**
- (b) Develop heat exchanger effectiveness equation for parallel flow and what does it mean? **07**

**OR**

- (b) With the Buckingham's  $\Pi$  theorem derive the power function of an agitator. Discuss its significance. **07**

- Q.3** (a) With the neat sketch explain the working of helical screw agitator. Where it is used in the food processing industry? **07**
- (b) Calculate the safe stress for high alloy stainless steel operated at 122°C with randomly checked lap joint and safety factor of 2.2. The material has allowable stress at 28, 100 and 154°C are 200, 150 and 116 N/mm<sup>2</sup> respectively. The joint efficiency is 83% and joint checking efficiency is 75%. **07**

**OR**

- Q.3** (a) With neat sketch explain the working of rising film evaporator? In which products its use is recommended? **07**
- (b) Stored juices (8°C, specific heat 3.72KJ/kg K is heated to 40°C in a double pipe counter flow heat exchanger. The hot water is used as heating agent enters at 72°C and leaving at 62°C. The flow rate of juice is 1.4 kg/s and area of heat exchanger is 10 m<sup>2</sup>. Calculate the overall heat transfer coefficient. **07**

- Q.4** (a) Discuss possible process and material hazards in tomato processing industry. Suggest precautions should be taken to overcome the same. **07**
- (b) A tray dryer is used to dry onion slices from 270% to 4% moisture content with hot air. Ambient air (22°C) is heated to 65°C by an electric heater and forced in the drying chamber through blower. After the stabilization of drying process the air leaving the drying chamber has temperature of 52°C. The wet bulb temperature of the ambient air, heated air and air coming out of the dryer are 10, 32 and 32°C respectively. What is the performance of the dryer? How it can be improved? **07**

**OR**

- Q.4** (a) Discuss possible process and material hazards in fermentation industry. Suggest precautions should be taken to overcome the same. **07**
- (b) Design a solid agitator shaft for the process of agitation if maximum bending moment and maximum torque developed in the process are 220 and 120 Nm respectively. The material of the shaft have safe permissible tensile stress at the **07**

operating condition is  $450 \text{ N/cm}^2$  and shear stress is 66% of the tensile stress.

- Q.5** (a) Differentiate between Condensation and Evaporation. How the liquid characteristics influence the process of evaporation. Classify the evaporators according to the method of feed. **07**
- (b) Differentiate between: **07**
- I. Recuperation and Regeneration
  - II. Mixed and Unmixed cross flow

**OR**

- Q.5** (a) Differentiate between counter flow and parallel flow with the help of temperature profile diagram. Also prove that **07**

$$Q = \frac{UA[(T_{h1} - T_{c2}) - (T_{h2} - T_{c1})]}{\ln \frac{T_{h2} - T_{c1}}{T_{h1} - T_{c2}}}$$

- (b) What do you understand by NTU? Also discuss Capacity Ratio, Heat Exchanger Effectiveness and develop an equation for effectiveness for parallel flow **07**

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