Enrolment No./Seat No_____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–V (NEW) EXAMINATION – SUMMER 2024**

**Subject Code:3151404 Date:18-05-2024**

**Subject Name:Food Engineering Operation-1**

**Time:02:30 PM TO 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.**
4. **Simple and non-programmable scientific calculators are allowed.**

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| **Q.1** | **(a)** | What are different modes of heat transfer? | **03** |
| | **(b)** | What are the methods of size measurement of agricultural grains? | **04** |
| | **(c)** | It is proposed to build a cold store having an outer wall of concrete (100 mm thick) and an inner wall of wood (10 mm thick), with the space in between (100 mm) filled with polyurethane foam. If the inner wall temperature is 5 $^0$C and the outer wall is maintained at the ambient air temperature of 20 $^0$C, calculate the rate of heat penetration pipe walls per unit area. | **07** |
| **Q.2** | **(a)** | What are traditional methods of food storage? | **03** |
| | **(b)** | Enlist the equipment used for material handling in food industry. Draw a schematic diagram of one of them. | **04** |
| | **(c)** | Water flows through an uninsulated 0.05 m diameter pipe which has a wall thickness of 0.01 m. The thermal conductivity of the pipe wall is 50Wm$^{-1}$ K$^{-1}$ and the inside and outside surface temperatures of the pipe are 70 and 69.5$^0$C, respectively. Calculate the radial heat loss per metre length. | **07** |
| | | **OR** | |
| | **(c)** | Describe (i) Convective heat transfer (ii) Convective mass transfer | **07** |
| **Q.3** | **(a)** | What is molecular diffusion? | **03** |
| | **(b)** | What is sphericity? The average values of three mutually perpendicular intercepts of sapota are 4.0, 7.0, and 3.8 cm. Estimate the sphericity of the fruit. | **04** |
| | **(c)** | A refrigerator door of area 0.6 m$^2$ consists of 25 mm of lagging on top of a thin metal sheet. The film heat transfer coefficients inside and outside the refrigerator are 10.0 and 15.0 W m$^{-2}$ K$^{-1}$, respectively, and the thermal conductivity of the lagging is 0.25 W m$^{-1}$ K$^{-1}$. If the working temperature of the refrigerator is 0◦C and ambient temperature is 20◦C, determine the heat flow through the refrigerator door and the temperature of the inside surface of the door. | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | What are rheological properties of food? | **03** |
| | **(b)** | Define different types of density used in characterization of food. | **04** |
| | **(c)** | Explain different cleaning and separation equipment for the food processing industry. | **07** |
| **Q.4** | **(a)** | Draw a schematic diagram of specific gravity separator | **03** |
| | **(b)** | Differentiate between ideal and actual screen with suitable diagram. | **04** |
| | **(c)** | (i) What is work index and fineness modulus? | **07** |

(ii) Find the fineness modulus of 200 g of the ground material if the masses retained are 20%, 50%, 20%, and 10% of ground material on the three successive sieves and a pan, respectively

**OR**

**Q.4** **(a)** What is screen analysis? **03**

**(b)** Differentiate between direct and indirect damage of grains. **04**

**(c)** Describe the laws for energy calculation during the size reduction of food materials. **07**

**Q.5** **(a)** Write important features of silos. **03**

**(b)** The dimensions of screw are as follows: screw's diameter 31.5 cm, pitch 30 cm and shaft diameter 6 cm. The conveyor is operated at a speed of 60 rpm. Calculate the forward velocity and capacity of the screw conveyor. If the conveyer is reinstalled at an angle of $20^0$ from horizontal, calculate its revised capacity. **04**

**(c)** Explain the phenomena of moisture accumulation of grains during cold environmental condition with suitable sketch **07**

**OR**

**Q.5** **(a)** Draw a diagram of Pusa bin. **03**

**(b)** Describe the working of bucket elevator. **04**

**(c)** Wheat is loaded in a smooth sheet metal silo having 4.5 m internal diameter up to a height of 12 m. The bulk density of wheat, angle of internal friction and angle of external friction are 900 kg/$m^3$, $27^0$ and $12^0$, respectively. Estimate the lateral load at the middle and at the bottom using Janssen's theory if the ratio of horizontal and vertical pressure k is 0.43. **07**

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