

GUJARAT TECHNOLOGICAL UNIVERSITY**BE – SEMESTER- V EXAMINATION-SUMMER 2023****Subject Code: 3151404****Date: 26/06/2023****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.

- Q.1**
- (a) Name different types of screen used for cleaning of grains. **03**
- (b) Define thermal conductivity of food products. Discuss parallel, perpendicular and Krischer model for prediction of thermal conductivity. **04**
- (c) Differentiate between conduction and convection heat transfer. **07**
- A steel pipe with 50 mm outer diameter is covered with a 6.4 mm asbestos insulation ($k = 0.166 \text{ W/m K}$) followed by a 25 mm layer of fiber glass insulation ($k = 0.0485 \text{ W/m K}$). The pipe wall temperature is 393 K and outside insulation temperature is 311 K. Calculate the interface temperature between the asbestos and the fiber glass.
- Q.2**
- (a) Define thermal conductivity, thermal diffusivity and specific heat. **03**
- (b) Derive the equation for heat transfer in rectangular slab. **04**
- (c) In an experiment to measure the thermal conductivity of product, food product was formed into a square section block $5 \text{ cm} \times 5 \text{ cm}$ and 1 cm thick. The edges of the block were insulated and heat was supplied continuously to one face of the block at a rate of 0.80W. The temperatures of each face were measured with thermocouples and found to be 28.5 and 23.3°C, respectively. What is the thermal conductivity of food product? **07**
- OR**
- (c) Explain in detail heat transfer by simultaneous conduction and convection. **07**
- Q.3**
- (a) What is meant by free and forced convection? **03**
- (b) Calculate the rate of heat energy emitted by 100 m^2 of a polished iron surface (emissivity = 0.06). The temperature of the surface is 37°C. Stefan–Boltzmann constant, equal to $5.669 \times 10^{-8} \text{ W/(m}^2 \text{ K}^4)$ **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 $15.0 \text{ W m}^{-2} \text{ K}^{-1}$, respectively, and the thermal conductivity of the lagging is $0.25 \text{ W m}^{-1} \text{ K}^{-1}$. 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) Enlist all the engineering properties of food materials. **03**
- (b) What are rheological properties? Explain the parameters obtained in rheological estimation of solid food material. **04**

- (c) What is air screen cleaners? What are its important design parameters? **07**
- Q.4 (a)** Define the followings **03**
1. Sphericity
 2. Roundness
 3. Bulk porosity
- (b) Explain the concept of convective mass transfer. **04**
- (c) The power requirement for grinding food material having an initial size of 50 mm and final size of 25 mm keeping feed rate of 20 tonnes/h is 400 kW. Out of this, the power required for running the empty mill is 5 kW. Calculate the power required using Rittinger's law if the feed rate is changed to 12 tonnes/h and final size of the product is 10 mm. **07**
- OR**
- Q.4 (a)** What are source of infestation in grains. Briefly explain one of them. **03**
- (b) Discuss static and dynamic angle of repose with diagram. **04**
- (c) Describe the features of Pusa bin. How it is superior to traditional storage structure? **07**
- Q.5 (a)** Draw a diagram of positive displacement hydraulic conveyor. **03**
- (b) Write the construction and working of belt conveyor. **04**
- (c) Discuss the storage of grains in controlled atmosphere storage. **07**
- OR**
- Q.5 (a)** What is function of bucket elevator? **03**
- (b) Write short notes on: **04**
- a. Magnetic separator
 - b. Specific gravity separator
- (c) What are laws of size reduction? Derive their equation. **07**
