

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-V (NEW) EXAMINATION – WINTER 2021

Subject Code:3151404

Date:01/01/2022

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) Discuss the film theory in mass transfer with diagram. **03**
- (b) Discuss the followings; **04**
Aperture, Mesh, grizzly, Thermal diffusivity
- (c) A spherical container of negligible thickness holding a hot fluid at 140°C and having an outer diameter of 0.4 m is insulated with three layers of each 50 mm thick insulation of $k_1 = 0.02$; $k_2 = 0.06$ and $k_3 = 0.16$ W/mK. (Starting from inside). The outside surface temperature is 30°C. Determine (i) the heat loss, and (ii) Interface temperatures of insulating layers. **07**
- Q.2** (a) Discuss different types of pores present in food materials with diagram. **03**
- (b) With the help of diagram explain plane of rupture. Differentiate between shallow bin and deep bin. **04**
- (c) Calculate the rate of heat loss through the vertical walls of a boiler furnace of size 4m by 3m by 3m high. The walls are constructed from an inner fire brick wall 25cm thick of thermal conductivity 0.4 W/mK, a layer of ceramic blanket insulation of thermal conductivity 0.2 W/mK and 8 cm thick, and a steel protective layer of thermal conductivity 55 W/mK and 2 mm thick. The inside temperature of the fire brick layer was measured at 600°C and the temperature of the outside of the insulation 60°C. Also find the interface temperature of layers. **07**

OR

- (c) Dynamic gassing out method is used to measure the k_{LA} in a vessel. The oxygen gas is stripped from the liquid medium, and then readmitted. The concentration of oxygen in the liquid at different time periods in the built-up zone is measured as follows: **07**
The average concentration was noted to be 7ppm. Calculate k_{LA}

Time (S)	0	5	10	15	20	25
O ₂ Con., ppm	0.5	1.7	2.7	3.5	4.2	4.7

- Q.3** (a) Discuss the followings; **03**
Gumminess, Bingham fluid, Dilatant, Boundary volume and Bulk volume
- (b) What do you understand by screen effectiveness? Derive the formula for screen effectiveness. **04**
- (c) Explain convective mass transfer with diagram. On what parameters convective mass transfer depends upon. **07**

OR

- Q.3** (a) Derive the equation for composite wall in series for conduction. **03**
- (b) Describe the working of Specific Gravity Separator with diagram. **04**
- (c) List out the importance of engineering properties of food materials. Give the description of following shapes; **07**
 (a) Round, (b) Oblate, (c) Oblong, (d) Conic, (e) Ovate, (f) Truncate
- Q.4** (a) Determine the screen effectiveness for an IS 50 mesh (opening size 0.5 mm) for which the cumulative mass fractions of feed, overflow and underflow is given as 0.16, 0.615 and 0.03 respectively. **03**
- (b) Explain the difference between ideal screen and actual screen by using graph. **04**
- (c) Define continuous molecular diffusion. Discuss diffusion of oxygen from air in to water through gas-liquid interphase with diagram. **07**
- OR**
- Q.4** (a) Explain the construction and working of an indented cylinder separator. **03**
- (b) What is the expected percent increase in convective heat transfer coefficient if the velocity of the fluid is doubled while all other parameters are kept the same for turbulent flow in pipe? **04**
- (c) List out the application of mass transfer in food processing. **07**
- Q.5** (a) Describe the Rittinger's law, kick's law and Bond's law for size reduction. **03**
- (b) Explain construction and working of bucket elevator with diagram. **04**
- (c) Discuss various modes of heat transfer. Derive the equation for conduction heat flow through pipes in series. **07**
- OR**
- Q.5** (a) Discuss the followings; **03**
 1. Angle of repose
 2. Terminal velocity
 3. Non-Newtonian fluids
- (b) What is work index? Define crushing efficiency and mechanical efficiency in size reduction. **04**
- (c) Define mass transfer. Discuss the principle and theory of diffusion with single phase system. **07**