DHANALAKSHMI SRINIVASAN COLLEGE OF ENGINEERINGAND TECHNOLOGY

DEPARTMENT OF FOOD TECHNOLOGY

QUESTION BANK

V SEMESTER / III YEAR

FD 3304-FOOD PROCESS CALCULATIONS

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QUESTION BANK

Subject Code & Name : FD3304– Food Process Calculations

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UNIT I –INTRODUCTION

Units and Dimensions: Basic and derived units, use of model units in calculations, Methods of expression, compositions of mixture and solutions. Ideal and real gas laws – Gas constant - calculations of pressure, volume and temperature using ideal gas law			
Q.No	**Question**	**BT Level**	**Competence**
PART – A			
1.	State kinetics of molecular theory	BTL1	Remembering
2.	Define ideal gas	BTL1	Remembering
3.	Evaluate the kinetic energy of gas particles	BTL5	Evaluating
4.	Explain the nature of gases	BTL2	Understanding
5.	Define diffusion	BTL1	Remembering
6.	Define Boyle's law	BTL1	Remembering
7.	State Charle's law	BTL1	Remembering
8.	Why we don't get a constant value for pv = k	BTL2	Understanding
9.	Define combined gas law	BTL1	Remembering
10.	State Gay Lussac's law	BTL1	Remembering
11.	State Dalton's law	BTL1	Remembering
12.	Define standard molar volume	BTL2	Understanding
13.	Explain Avagadro's law	BTL2	Understanding
14.	Estimate ideal gas law	BTL5	Evaluating
15.	Define gas density	BTL1	Remembering
16.	Convert 1000 dyne to Newton	BTL5	Evaluating
17.	Convert 88kg of CO_2 in to its amount in molar units	BTL5	Evaluating
18.	Find kilograms of $C_2 H_6$ that contain 4k atom of carbon	BTL5	Evaluating

19.	Define temperature ? Give its most commonly used scales	BTL2	Understanding
20.	Define gas constant	BTL4	Understanding
Part – B			
1.	List out the basic units in SI System? Convert the following : 100Btu|hft^{2o} f to kW|m ^{2o}C; 100 1bmol/ft^2 to kgmol/sm^2	BTL5	Evaluating
2.	A volume of moist air 30 m^3 at a total pressure of 101.325 kPa and a temperature of 303K (30 ^{o}c) contains water vapor in such proportions that its partial pressure is 2.933kPa. Without total pressure being changed, the temperature is reduced to 288 K (15 ^{o}c) and some of water vapor is removed by condensation. After cooling, it is found that the partial pressure of water vapor is 1.693 kPa. Calculate (a) Volume of air at 288 K (15 ^{o}c). (b) Weight of water condensed	BTL5	Evaluating
3.	List out derived units and express its SI system	BTL4	Analyzing
4.	Discuss ideal gas law	BTL2	Understanding
5.	A chemist is interested in preparing 500ml of 1 normal, 1 molar and 1 molal solution of H_2SO_4 . Assuming the density quantities of H_2SO_4 solution to be 1.075 g/cm^3 , Calculate the quantities of H_2SO_4 to be taken to prepare these	BTL5	Evaluating
6.	Derive the method of expressing the composition of mixtures	BTL3	Applying
7.	Calculate the available nitrogen content of solution having 30% urea (NH_2CoNH_2), 20% Ammonium Sulphate and 20% Ammonium nitrate	BTL5	Evaluating
8.	Analysis the relationship between partial pressure, mole fraction of component gas to total pressure	BTL4	Analyzing

9.	A mixture of H_2 and O_2 contains 11.1% H_2 by wt. Calculate (a) Average molecular weight of gas mixture. (b) Partial pressure of O_2 & H_2 at 100 Kpa and 303k(30 ^{o}c)	BTL5	Evaluating
10	A natural gas has the following composition by volume : CH_4 = 82%, $C_2 H_6$ = 12% and N_2 = 6%. Calculate the density of gas at 288k & 101.325Kpa and composition in weight percent	BTL5	Evaluating
Part – C			
1.	Derive ideal gas law. What is effect of conduction , Convection & Radiation in food processing in relationship with solids, liquids and	BTL4	Analyzing
2.	CO_2 is dissolved to the extent of 33 liters per liter of solution containing 27.5 weight% diamino-iso-propanol. The volume of gas is measured at 101.325kPa & 288 k. Calculate wgt% & mole% CO_2 in the solution.	BTL5	Evaluating
3	Analysis the method of expressing the composition of mixture & solution	BTL4	Analyzing
UNIT II			
Fundamental Calculations and Humidity: Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity - Use of humidity in condensation and drying - Humidity chart, dew point.			
Q.No	**Question**	**BT Level**	**Competence**
PART – A			
1.	Write a short note on (a) Relative humidity (b) Absolute humidity	BTL2	Understanding
2.	How does relative humidity related to Dew point	BTL2	Understanding
3.	Define Humidity	BTL1	Remembering
4.	List out the types of humidity	BTL2	Understanding
5.	Explain the factors that affect relative humidity	BTL2	Understanding

6.	Why humidity values are usually given as Relative humidity	BTL1	Remembering
7.	Define Dew point	BTL1	Remembering
8.	What temperature can hold more water vapor	BTL1	Remembering
9.	Define psychrometer	BTL1	Remembering
10.	Analysis the relationship between temperature and relative humidity.	BTL4	Analyzing
11.	The ambient temperature is 40°C and the RH is 50%. Calculate Td?	BTL5	Evaluating
12.	Twet is 38.5°C, Tdry = 40.0°C and the ambient pressure is 1 013 hPa. Calculate RH and Td?	BTL5	Evaluating
13.	The dewpoint Td is 40°C and the total ambient pressure Ptot is 998 hPa. Calculate mixing ratio?	BTL5	Evaluating
14.	The dewpoint Td is 40°C and the total ambient pressure Ptot is 998 hPa. Calculate mixing ratio?	BTL5	Evaluating
15.	How to convert relative humidity to absolute humidit	BTL2	Understanding
16.	How do you calculate molal humidity	BTL2	Understanding
17.	what is absolute humidity in psychrometric chart	BTL2	Understanding
18.	How do you calculate humidity from wet and dry temperature?	BTL1	Remembering
19.	what is molal absolute humidity?	BTL1	Remembering
20.	What is the formula for absolute humidity?	BTL1	Remembering
Part – B			
1.	Write a brief note on theory and application of psychometric chart?	BTL2	Understanding
2.	Elaborate on how to determine moisture and total solids in food materials?	BTL2	Understanding

3.	What are the factors to be considered in measuring the humidity to increase shelf- life of food materials?	BTL2	Understanding
4.	Discuus about humidity effects in solids drying process ?	BTL2	Understanding
5.	Cabbage containing 89% of moisture is to be dried in air at 65°C down to a moisture content on a dry basis of 5%. Calculate the heat energy required per tonne of raw cabbage and per tonne of dried cabbage, for the drying. Ignore the sensible heat. [$2x10^6$ kJ ; $1.73x10^7$ kJ]	BTL5	Evaluating
6.	The efficiency of a spray dryer is given by the ratio of the heat energy in the hot air supplied to the dryer and actually used for drying, divided by the heat energy supplied to heat the air from its original ambient temperature. Calculate the efficiency of a spray dryer with an inlet air temperature of 150°C, an outlet temperature of 95°C, operating under an ambient air temperature of 15°C. Suggest how the efficiency of this dryer might be raised. [41%]	BTL5	Evaluating
7.	Discuss about the strategies to reduce moistur condensation in food facilities ?	BTL2	Understanding
8.	Write about the relationship between relative humidity and dew point? How to calculate pressure dew point and relative humidity for compressed air Systems ?	BTL1	Remembering
9.	Why humidity control is important ? Give some examples of food and drink processes that benefit from humidity control?	BTL2	Understanding

10	In a chiller store for fruit, which is to be maintained at 5°C, it is important to maintain a daily record of the relative humidity. A wet- and dry-bulb thermometer is available so prepare a chart giving the relative humidity for the store in terms of the wet-bulb depression.	BTL4	Analyzing
Part – C			
1.	Food on exposure to unsaturated air at a higher temperature will dry if the air is unsaturated. Steak slices are stored in a chiller at 10 °C. (a) Estimate the maximum weight loss of steak pieces, 15 cm x 5 cm x 2 cm in air at 10°C and 50% RH moving at 0.5 m s-1. The pieces are laid flat on shelves to age. Assuming that the meat behaves as a free water surface, estimate the percentage loss of weight in 1 day of exposure. Specific weight of meat is 1050 kgm-3. (b) if the H of the air were invcreased to 80% what would be the percentage loss? (c) it the meat pieces were also exposed to nearby surfaces at the temperature of the air (dry bulb), what would then be the percentage loss? Assume net emissivity is 0.8. [(a) 12% ; (b) 4.5% ; 18.4%]	BTL5	Evaluating

2	Determine the amount of water and solids present in the carrots wherever possible in the drying operation. You can then do a "mass balance" to follow where the water and solids go in the process. Initial Feed: 175 kg / hour of material at 86% moisture (wet basis) Water in carrots = 175 kg / hour x 0.86 = 150.5 kg / hour Solids in carrots = 175 kg / hour x (1.0 - 0.86) = 24.5 kg / hour Or: Solids= 175kg/hour-150.5kg/hour =24.5kg/ hour Initial Product: The dried product moisture is 11% (wet basis), which means that the dried product will have a solids content of 89% by weight Solids leaving dryer = 24.5 kg / hour (assuming no	BTL5	Evaluating
3.	Convert the following dry basis moistures to wet basis moistures: (1) 3.6 kg water / kg dry solids (2) 4.7 grams of water per gram of dry solids (3) 0.075 grams of water per gram of dry solids	BTL5	Evaluating
UNIT III			
UNIT III Basic Principles of Stoichiometry - Importance of material balance and energy balance in a process Industry-Dimensions, Units, conversion factors and their use – Data sources, Humidity and applications. Material Balance: Stoichiometric principles, Application of material balance to unit operations like distillation, evaporation, crystallization, drying, extraction, Leaching.			
Q.No	**Question**	**BT Level**	**Competence**
PART – A			
1.	What are the factors effecting the rate of heat transfer during the process of a product	BTL1	Remembering

2.	Define (a) Evaporation (b) Drying	BTL1	Remembering
3.	What is the process of leaching and write three basi steps involved in leaching process	BTL1	Remembering
4.	Define conversion factor	BTL1	Remembering
5.	List out the application of extraction	BTL1	Remembering
6.	Explain the principle of stoichiometry	BTL2	Understanding
7.	Define distillation	BTL1	Remembering
8.	Define Extraction	BTL1	Remembering
9.	Define stoichiometric co-efficient	BTL1	Remembering
10.	What is Limiting reactant	BTL1	Remembering
11.	Discuss yield and selectivity	BTL2	Understanding
12.	In the production of SO_3 , 100 K mol of SO_2 and 200 K mol of O_2 are fed to the reactor. The product stream is found to contain 80 Kmol SO_3 production Calculate the percent conversion?	BTL5	Evaluating
13.	Materials balance in continuous centrifuging of milk.If 35,000kg of whole milk containing 4% fat is to be separated in a 6 hour period into skim milk with 0.45% fat and cream with 45% fat, what are th flow rates of the two output streams from a continuous centrifuge which accomplishes this separation?	BTL5	Evaluating
14.	Carbonation of a soft drink In the carbonation of a soft drink, the total quantity of carbon dioxide required is the equivalent of 3 volumes of gas to one volume of water at $0^{o}C$ and atmospheric pressure. Calculate (a) the mass fraction and (b) the mole fraction of the CO_2 in the drink, ignoring all components other than CO_2 and water.	BTL5	Evaluating

15.	Drying yield of potatoes Potatoes are dried from 14% total solids to 93% total solids. What is the product yield from each 1000 kg of raw potatoes assuming that 8% by weight of the original potatoes is lost in peeling.	BTL5	Evaluating
16.	Extraction 1000 kg of soya beans, of composition 18% oil, 35% protein, 27.1% carbohydrate, 9.4% fibre and ash, 10.5% moisture, are: • (a) crushed and pressed, which reduces oil content in beans to 6%; • (b) then extracted with hexane to produce a meal containing 0.5% oil; • (c) finally dried to 8% moisture. Assuming that there is no loss of protein and water with the oil, set out a materials balance for the soya bean constituents.	BTL5	Evaluating
17.	Refrigeration load in bread freezing The bread-freezing operation of Example 2.10 is to be carried out in an air-blast freezing tunnel. It is found that the fan motors are rated at a total of 80 horsepower and measurements suggest that they are operating at around 90% of their rating, under whicl conditions their manufacturer's data claims a motor efficiency of 86%. If 1 ton of refrigeration is 3.52 kW, estimate the maximum refrigeration load imposed by this freezing installation assuming (a) that fans and motors are all within the freezing tunnel insulation and (b) the fans but not their motors are in the tunnel. The heat-loss rate from the tunnel to the ambient air has been found to be 6.3 kW. Extraction rate from freezing bread (maximum) = 104 kW Fan rated horsepower = 80	BTL5	Evaluating

18.	Heat balance for cooling pea soup after canning An autoclave contains 1000 cans of pea soup. It is heated to an overall temperature of 100 ^{o}C. If the cans are to be cooled to 40 ^{o}C before leaving the autoclave, how much cooling water is required if it enters at 15 ^{o}C and leaves at 35 ^{o}C? The specific heats of the pea soup and the can metal are respectively 4.1 $kJ\ kg^{-1}\ {}^{o}C^{-1}$ and 0.50 $kJ\ kg^{-1}\ {}^{o}C^{-1}$. The weight of each can is 60g and it contains 0.45 kg of pea soup. Assume that the heat content of the autoclave walls above 40 ^{o}C is $1.6x10^{4}$ kJ and that there is no heat loss through the walls.	BTL5	Evaluating
19.	In drying casein, the dryer is found to consume 4m^3/h of natural gas with a calorific value of 800kJ/mole. If the throughput of the dryer is 60kg of wet casein per hour, drying it from 55% moisture to 10% moisture, estimate the overall thermal efficiency of the dryer taking into account the latent heat of evaporation only.	BTL5	Evaluating
20.	Explain the application of unit operations	BTL2	Understanding
Part – B			
1.	Write about material balance and its application to unit operations like distillation, evaporation, crystallization, drying and leaching?	BTL1	Remembering
2.	Express stoichiometry principle with an example	BTL2	Understanding
3.	Define extraction? Describe the effects on utilization of solvents in extraction process with an example	BTL2	Understanding
4.	Write the overall energy balance equation for a system at a steady state and express the term mentioned	BTL4	Analyzing

5.	List the important equation carried out in chemical industry	BTL1	Remembering
6.	A single effect evaporator is fed with 10,000 Kg/h o a weak liquor containing 15% caustic by weight anc is concentrated to get thick liquor containing 40% by weight caustic(NaOH). Calculate (a) Kg/h of water evaporated (b) Kg/h of thick liquor obtained	BTL2	Understanding
7.	Explain the importance of material balance and energy balance in process industry	BTL4	Analyzing
8.	Explain the application of material balance of unit operation	BTL3	Applying
9.	A waste acid from a nitrating process contains 23% HNO_3, 57% H_2SO_4 and 20% water by weight. This acid is to be concentrated to contain 27% HNO_3, 60% H_2SO_4 by the addition of concentrated H_2SO_4 containing 93% H_2SO_4 and concentrated nitric acid containing 90% HNO_3. Calculate the amounts in kg of waste and concentrated acids that must be combined to obtain 1000 Kg of desired mixture.	BTL4	Analyzing
10	Explain drying with its application	BTL5	Evaluating
Part – C			

1.	It is desired to freeze 10,000 loaves of bread each weighing 0.75 kg from an initial room tem- perature of 18°C to a final temperature of -18°C. The bread-freezing operation is to be carried out in an air-blast freezing tunnel. It is found that the fan motors are rated at a total of 80 horse- power and measurements suggest that they are operating at around 90% of their rating, under which conditions their manufacturer's data claims a motor efficiency of 86%. If 1 ton of refrigeration is 3.52 kW, estimate the maximum refrigeration load imposed by this freezing installation assuming (a) that fans and motors are all within the freezing tunnel insulation and (b) the fans but not their motors are in the tunnel. The heat-loss rate from the tunnel to the ambient air has been found to be 6.3 kW. Extraction rate from freezing bread (maximum) = 104 kW Fan rated horsepower = 80	BTL3	Applying
2.	Discuss stoichiometric principle with its application to material balance	BTL1	Remembering
3	Heat demand in freezing bread. It is desired to freeze 10,000 loaves of bread, each weighing 0.75 kg, from an initial room temperature of 18 ^{o}C to a final store temperature of –18 ^{o}C. If this is to be carried out in such a way that the maximum heat demand for the freezing is twice the average demand, estimate this maximum demand, if the total freezing time is to be 6 h. If data on the actual bread is unavailable, in the literature are data on bread constituents, calculation methods and enthalpy/temperature tables.	BTL5	Evaluating

UNIT IV

UNIT IV

Energy Balance: Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy.

Q.No	Question	BT Level	Competence
PART – A			
1.	Define Unit Operation	BTL1	Remembering
2.	List out the properties of food materials	BTL2	Understanding
3.	Explain the objective of unit operations in food industry	BTL2	Understanding
4.	Compare the thermal & optical properties of food materials	BTL4	Analyzing
5.	Explain the classification of unit operation	BTL2	Understanding
6.	What is momentum transfer in unit operation	BTL1	Remembering
7.	Define Absorption	BTL1	Remembering
8.	Define mass transfer in unit operation	BTL1	Remembering
9.	Define humidification	BTL1	Remembering
10.	Define dehydration	BTL1	Remembering
11.	Explain complementary unit operation	BTL2	Understanding
12.	List out the application of thermal property	BTL2	Understanding
13.	Define specific heat	BTL2	Understanding
14.	List out the terms used to define thermal property	BTL2	Understanding
15.	Explain thermal conductivity with its units	BTL2	Understanding
16.	Define surface heat transfer co-efficient	BTL1	Remembering
17.	State thermal diffusivity	BTL1	Remembering
18.	Write a note on latent heat & sensible heat	BTL2	Understanding
19.	Write down the application of thermal diffusivity	BTL2	Understanding

20.	List out the application of thermal conductivity	BTL2	Understanding
Part – B			
1.	Explain the effect of temperature and pressure on heat of reaction	BTL2	Understanding
2.	Define energy? Write formula for potential energy & kinetic energy	BTL1	Remembering
3.	Define sensible heat. Explain the effect of sensible heat with appropriate example in the industrial processing	BTL2	Understanding
4.	Define Enthalpy. Explain the application of enthalpy in cryogenic freezing	BTL1	Remembering
5.	List out the fundamental concept of unit operation in food engineering	BTL2	Understanding
6.	Briefly discuss the classification of unit operation	BTL2	Understanding
7.	State thermal properties of food materials	BTL1	Remembering
8.	Explain the main objective of unit operation in food engineering	BTL2	Understanding
9.	Define thermal conductivity with its application	BTL1	Remembering
10	Explain evaluation of Enthalpy	BTL2	Understanding
Part – C			

1.	When 5.03 g of solid potassium hydroxide are dissolved in 100.0 mL of distilled water in a coffee-cup calorimeter, the temperature of the liquid increases from 23.0°C to 34.7°C. The density of water in this temperature range averages 0.9969 g/cm3. What is ΔH soln (in kilojoules per mole)? Assume that the calorimeter absorbs a negligible amount of heat and, because of the large volume of water, the specific heat of the solution is the same as the specific heat of pure water.	BTL5	Evaluating
2.	Chlorine monofluoride can react with fluorine to form chlorine trifluoride: (i) $ClF(g) + F_2(g) \longrightarrow ClF_3(g)$ $\Delta H° = ?$ Use the reactions here to determine the ΔH° for reaction (i): (ii) $2OF_2(g) \longrightarrow O_2(g)+2F_2(g)$ $\Delta H° = -49.4$kJ (iii) $2ClF(g) + O_2(g) \longrightarrow Cl_2O(g) + OF_2(g)$ $\Delta H°_{(iii)} = +205.6$ kJ (iv) $ClF_3(g) + O_2(g) \longrightarrow Cl_2O(g) + 3/2\ OF_2(g)$ $\Delta H°_{(iv)}= +266.7$ kJ	BTL5	Evaluating
3	Calculate the heat required to convert 3kg of ice at -12^{o} C kept in a calorimeter to steam at 100^{o} at atmospheric pressure. (Given: specific heat of ice $=2.100\times10^{5}$ J kg^{-1} K^{-1}, specific heat of water $=4.186\times10^{6}$ J kg^{-1}, latent heat of fusion of ice $=3.35\times10^{5}$ J kg^{-1} and latent heat of steam $=2.256\times106$ J kg^{-1}) .	BTL5	Evaluating
UNIT V			
UNIT V Enthalpy Changes: Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction - Energy balance for systems without chemical			
Q.No	**Question**	**BT Level**	**Competence**
PART – A			

1.	What is the standard heat of formation of reaction?	BTL1	Remembering
2.	What is standard heat of combustion?	BTL1	Remembering
3.	What do you mean by heat of formation and standard heat of formation?	BTL1	Remembering
4.	How do you calculate the standard heat of reaction from heats of combustion?	BTL2	Understanding
5.	What is the specific heat capacity of 60 grams of a substance that heats up from 30 °C to 40 °C when 968 J of energy were added?	BTL5	Evaluating
6.	With 650 KJ of energy, how much carbon can be heated from 20 degrees C to 100 °C? (Given: c = 4.184 J / g °C)	BTL5	Evaluating
7.	When 240 grams of iron cools from 90 °Celsius to 25 °Celsius, how much heat is released? (Given: c = 0.452 J / g °C)	BTL5	Evaluating
8.	When sodium chloride is dissolved in 100 g of wate at 25 °C, the resulting solution has a temperature of 21 °C after proper stirring. If the solution's specific heat capacity is assumed to be 4.18 J / g °C, calculate the heat change during the dissolution process.	BTL5	Evaluating
9.	Calculate the heat change that occurs with ethanol combustion when a specified quantity of the substance is burned in air to increase the temperature from 28 to 42 degrees Celsius of 200 g of water, provided that water has a specific heat capacity of 4.2J/g.K.	BTL5	Evaluating
10.	How does heat of reaction affected by temperature?	BTL2	Understanding
11.	Does heat of reaction depend on pressure?	BTL2	Understanding
12.	Why does enthalpy decrease with pressure?	BTL2	Understanding
13.	Why do we do energy balance?	BTL2	Understanding

14.	Which law is useful to solve the energy balance problem?	BTL2	Understanding
15.	What are the three types of energy balance?	BTL2	Understanding
16.	What is the most basic energy equation?	BTL2	Understanding
17.	What does H value mean ? How is it related to energy balance?	BTL4	Analyzing
18.	What is the importance of energy balance in food industry?	BTL2	Understanding
19.	How do you find the heat of combustion and formation?	BTL2	Understanding
20.	Is heat of formation equal to heat of combustion?	BTL4	Analyzing
Part – B			
1.	**(a)** A 28-g (1-oz) serving of a popular breakfast cereal served with 120 mL of skim milk provides 8 g protein, 26 g carbohydrates, and 2 g fat. Using the average fuel values of these kinds of substances, estimate the energy value (caloric content) of this serving. **(b)** A person of average weight uses about 100 Cal/ mi when running or jogging. How many servings of this cereal provide the energy value requirements fo running 3 min?	BTL5	Evaluating
2.	When a student mixes 50 mL of 1.0 *M* HCl and 50 mL of 1.0 *M* NaOH in a coffee-cup calorimeter, the temperature of the resultant solution increases from 21.0 °C to 27.5 °C. Calculate the enthalpy change for the reaction in kJ/mol HCl, assuming that the calorimeter loses only a negligible quantity of heat, that the total volume of the solution is 100 mL, that its density is 1.0 g/mL, and that its specific heat is 4.18 J/g-K.	BTL5	Evaluating
3.	What is the difference between enthalpy of combustion and enthalpy of formation in detail?	BTL4	Analyzing

4.	Write in detail about thermal properties of food constituents?	BTL2	Understanding
5.	Write in detail about derivation enthalpy in frozen and unfrozen foods?	BTL2	Understanding
6.	A 150 kg beef carcass is to be frozen to a temperature of –20°C. The initial temperature of the beef carcass is 10°C. How much heat must be removed from the beef carcass during this process?	BTL5	Evaluating
7.	Write a brief note on high pressure processing in food industry - Characteristics and applications?	BTL2	Understanding
8.	Fruit juice is fed to a heat exchanges at the rate of 1 kg/h. Saturated steam at 145 kPa pressure is used to heat the juice from 7 ^{0}C to 90 ^{0}C. Assuming the heat capacity of juice 5kJ/kg ^{0}C, find out the quantity of steam required for the operation.	BTL5	Evaluating
9.	Give brief notes on simple mass and energy balances in food drum drying?	BTL2	Understanding
10	A processor is drying parsley flakes for use in the food industry. It is suspected that some pieces of dry parsley are being blown out of the dryer with the exhaust air (i.e., the air leaving the dryer). It is decided to do a mass balance on the process in an attempt to determine the size of these losses. In a test run, 375 kg of fresh parsley (at 85% moisture by weight) enter the dryer and 62.0 kg of dried parsley flakes with a moisture content of 12.0% (by weight) are collected at the other end of the dryer. What is the weight of dry solids (i.e., dried parsley) that has escaped with the exhaust air, if any? How much water is removed in the process? (Express your answer to one decimal place)	BTL5	Evaluating

Part – C			
1.	Write in detail about the derivation of thermal conductivity in foods ?	BTL4	Analyzing
2.	Determine the thermal conductivity and density of lean pork shoulder meat at –40°C. Use both the parallel and perpendicular thermal conductivity models.	BTL5	Evaluating
3	What percent of the heat is actually used in a blanching process where 20 kg of steam at 143.3 kPa is used to heat 300 kg of green beans from 20°C to 98 °C? How much heat is required for the task? How much heat does the steam provide? (Answer: 37,226 kJ of heat are required. 44,604 kJ of heat are supplied by the steam. About 83.5% of the heat is actually used. The remainder is lost to the surroundings.)	BTL5	Evaluating