	Utech
Name:	
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Invigilator's Signature :	

PROCESS CALCULATION, THERMODYNAMICS AND FOOD SCIENCE

Time Allotted: 3 Hours Full Marks: 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A (Multiple Choice Type Questions)

- 1. Choose the correct alternatives of the following: $10 \times 1 = 10$
 - i) A correlation is represented by $X = X_0 2^{t/g}$. The type of graph paper fitted for this equation will be
 - a) log-log
- b) semi-log
- c) rectangular
- d) none of these.
- ii) Specific heat of water is
 - a) same of ice
- b) double of ice
- c) half of ice
- d) none of these.

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iii)

a)

b)

c)

d)

a)

c)

a)

c)

a)

b)

c)

d)

solid & gas

solid, liquid & gas.

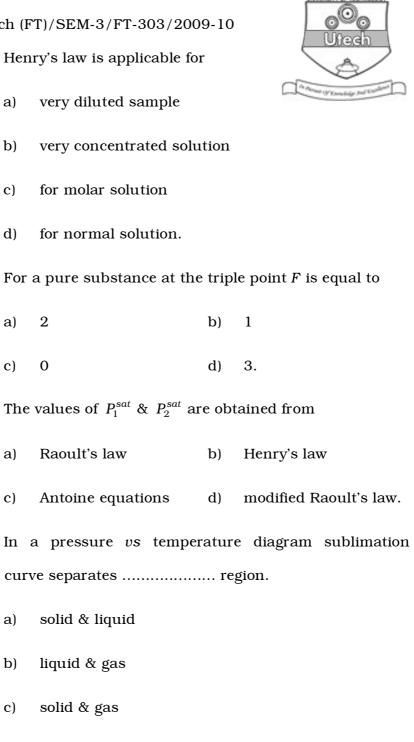
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iv)

v)

vi)



vii) At dew point

- a) vapour phase ceases to exist
- b) liquid phase ceases to exist
- c) both liquid & vapour phases co-exist
- d) none of these.

viii) Unit of enthalpy is

- a) kJ/(kg.K)
- b) kJ/(kgmole.K)

c) kJ/K

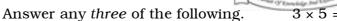
- d) kJ.
- ix) Which one of the following is fermented cereal product?
 - a) Rice

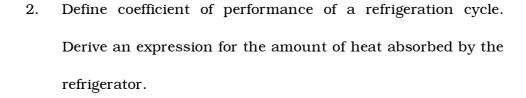
b) Dosa

c) Roti

- d) None of these.
- x) The protein-rich outer layers surrounding the starchy endosperm of a cereal grain is called
 - a) scutellum
 - b) nucellus
 - c) testa
 - d) aleurone.

GROUP - B (Short Answer Type Questions)





- 3. Prove that $dH = C_P dT + [V T(\delta V / \delta T)_P] dP$.
- 4. Derive the mathematical expression of absolute humidity. How is psychometric chart utilized in food engineering problem? 3+2
- 5. What are the characteristic features of a cereal? What is wheat protein and how does it control the wheat flour quality? 2+3
- 6. What is "flour"? Arrange cake flour, bread flour, and all-purpose flour in the order of increasing gluten content in them. Besides human consumption, what is the 2nd most common use of cereal grains? What are the two major nutritional significances of fruits and vegetables?

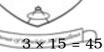
1 + 1 + 1 + 2

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GROUP - C

(Long Answer Type Questions)

Answer any three of the following.



- 7. a) What do you mean by steam quality? Define limiting reactant and excess reactant in a chemical process.
 - b) How many kilogram of guava would be required to produce 100 kg of jam? The standard formula of 45 parts fruit to 55 parts sugar is used. The soluble solid content of the finished product is 65% and the guavas have 12% initial soluble solid content. 5 + 10
- 8. a) Describe the vapour compression cycle with the help of schematic diagram.
 - b) Discuss your opinion about the choice of refrigerant.
- 9. a) How much of water is required to raise the moisture content of a 100 kg of a material from 30% to 75%?
 - b) Determine the amount of apple juice concentrate containing 65% solid and single strength juice containing 15% solid that must be mixed to produce 100 kg of an apple juice concentrate containing 45% solid.

- 10. a) i) Prove that C_p is a function of temperature.
 - ii) Show that $C_P C_V = R$ for an ideal gas.
 - b) Air at 1 bar and 298·15 K is compressed to 5 bar and 298·15 K by two different mechanically reversible processes:
 - i) Cooling at constant pressure followed by heating at constant volume
 - ii) Heating at constant volume followed by cooling at constant pressure

Calculate the heat and work requirements and U and H of the air for each path. The following heat capacities for air may be assumed independent of temperature :

 $C_V = 20.78$ and $C_P = 29.1 \,\mathrm{J}\,\mathrm{mol}^{-1}\,\mathrm{K}^{-1}$; assume also for air that PV/T is a constant, regardless of the changes it undergoes. At 298.15 K and 1 bar the molar volume of air is $0.02479\,\mathrm{m}^3\,\mathrm{mol}^{-1}$.

Whether enthalpy is a path function or not?

$$(2+2)+(10+1)$$

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- 11. a) Write the steps for material balance calculation.
 - b) 1000 kg of $\mathrm{Na_2CO_3}$ solution containing 25% $\mathrm{Na_2CO_3}$ is subjected to evaporative cooling during which process 15% of the water present in the solution is evaporated. From the concentric solution $\mathrm{Na_2CO_3}$, $\mathrm{10H_2O}$ crystallizes out. Calculate how much crystals would be produced if the solubility of $\mathrm{Na_2CO_3}$, $\mathrm{10H_2O}$ is $\mathrm{21.5}$ gm per 100 gm of $\mathrm{H_2O}$.
 - c) What is the significance of K-value in VLE? 5 + 7 + 3

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