	Utech
Name:	
Roll No.:	A special (V Knowledge Stad Challenge)
Invigilator's Signature :	

# BIOPROCESS ENGINEERING & DOWNSTREAM PROCESSING

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.

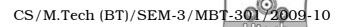
# GROUP - A ( Multiple Choice Type Questions )

- 1. Choose the correct alternatives for any ten of the following:  $10 \times 1 = 10$ 
  - i) Fundamental Dimensions are
    - a) H, T, P
- b) V, T, P

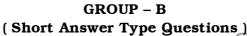
- c) M, L, T
- d) none of these.
- ii) Selectivity is measured as
  - a) the proportion of the total reaction to produce desired product
  - b) the rate of reaction for conversion of product formation
  - c) the choice of reactants for the desired product formation
  - d) none of these.

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- iii) Compressibility factor measures the deviation of a gas from
  - a) ideal behaviour
- b) real behaviour
- c) critical behaviour
- d) none of these.
- iv) In flash vaporization, a liquid mixture is
  - a) partially vapourized
  - b) completely vapourized
  - c) temporarily vapourized
  - d) none of these.
- v) Drying is a
  - a) unit operation
- b) unit process
- c) unit separation
- d) none of these.
- vi) Enthalpy is a
  - a) state function
  - b) path function
  - c) state and path function
  - d) none of these.
- vii) Heat capacity of a substance is generally
  - a) constant but varies with temperature
  - b) not constant but varies with temperature
  - c) not constant but varies with volume
  - d) none of these.
- viii) First law of thermodynamics deals with
  - a) direction of energy transfer
  - b) reversible process only
  - c) irreversible process only
  - d) none of these.



- ix) Heat of reaction is
  - a) dependent on pressure only
  - b) dependent on temperature only
  - c) dependent on pressure and temperature
  - d) none of these.
- x) Heat transfer by conduction is described by
  - a) Fourier's law
  - b) Newton's law
  - c) Stefan Boltzmann's law
  - d) Fick's law.
- xi) Wetted wall tower experiments determine the
  - a) molar diffusivity
  - b) volumetric coefficient
  - c) mass transfer coefficient
  - d) none of these.
- xii) The diffusivity has the same dimension as
  - a) absolute viscosity
  - b) kinetic viscosity
  - c) density
  - d) concentration.





Answer any three of the following.

2. State Raoult's law and Dalton's law.

5

- 3. a) What is mean by conversion of units?
  - b) Stainless steel type 304 having composition of 18% Cr, 8% Ni and 0.08% C maximum, has a thermal conductivity ( K ) of  $16.2 \, \frac{Btu}{(hr) \, (ft) \, (^\circ\!F)}$ . Convert (K) into  $\frac{g \, \text{-cal}}{(\text{sec}) \, (\text{cm}) \, (^\circ\!C)}.$
- 4. Draw a boiling point diagram (T-x-y) for a binary mixture and explain. 5
- 5. What are the considerations to be followed for the particulates to choose proper air pollution control equipments?
- 6. In a factory, a double effect evaporator concentrating a weak liquor containing 4% ( by wt. ) NaOH to produce lye containing 25% ( by wt. ) solid. Calculate the evaporation of water per 100 kg feed in the water.
- 7. Write down the Biochemical effects of Mercury. 5
- 8. a) Derive an expression for the calculation of resistance in case of hollow cylinder.

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b) A flat furnace wall is conducted of a 115 mm layer of sil-o-cel brick with a thermal conductivity of 0.4 kcal/hr.m°C backed by a 230 mm layer of common brick of conductivity 4 kcal/hr.m°C.

The temperature of the inner face of the wall is 760°C and that of the outer face is 77°C.

- i) What is the heat loss through the wall in  $kcal/m^2$  hr.
- ii) What is temperature of the interface between the refractory brick and the common brick?

2

- 9. a) Write down the mechanism of drying.
  - b) Define, critical moisture, equilibrium moisture and free moisture content with diagram.3
- 10. Discuss in brief, the microbial growth kinetics. 5

### GROUP – C ( Long Answer Type Questions )

Answer any *three* of the following.  $3 \times 15 = 45$ 

- 11. A drier is fed with wet solid to reduce the moisture content from 80% to 15%. The product leaving the drier is admitted to an oven which further brings down the moisture to 2%. If the drier can handle 1000 kg of wet solid per day, calculate
  - a) The weight of products leaving the drier and the oven per day.
  - b) The percentage of the original water that is removed in the drier and the oven.

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- 12. Propane is burned with excess air to ensure complete combustion. If  $55~\rm kg$  of  $\rm CO_2$  and  $15~\rm kg$  of  $\rm CO$  are obtained when propane is completely burned with  $500~\rm kg$  air, determine the following :
  - a) The mass of propane burned (in kg)
  - b) The percent excess air.

15

- 13. A crystallizer is charged with 100 kg of a solution containing 25% Ba  $(NO_3)_2$  in water. On cooling 10% of the original water present evaporates. Calculate the yield of crystals when the solution is cooled to 283 K. The solubility at 283 K is 7.0 Ba  $(NO_3)_2/100$  kg total water.
- 14. Describe any two methods developed to recover microbial products.
- 15. a) Define distillation. What are the different types of distillation process?
  - b) A wet solid is dried from 25 to 10 percent moisture under constant drying conditions is  $4\cdot17$  hr. If the critical and equilibrium moisture constants are 15 and 5 percent respectively, how long will it takes to dry the solid from 30 to 8 percent moisture under the same conditions? 5+10

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- 16. a) Write down the different moles of heat transfer with their coefficient units.
  - b) A wet solid is dried from 25 to 10 per cent moisture under constant drying conditions is  $4\cdot17$  hr. if the critical and equilibrium moisture contents are 15 and 5 per cent respectively, how long will it take to dry the solid from 30 to 8 per cent moisture under the same conditions. 5+10
- 17. a) Write down the different modes of heat transfer with all there coefficient's unit.
  - A steel pipe 25 mm ID and 33 mm OD and insulated b) with rock-wool carries stream at 178°C. If the surrounding air temperature is 21°C, calculate the rate of heat loss from one metre length of pipe. The thickness of insulation is 38 mm. Thermal conductivity steel and rock-wool 10.74 are and 0.0418 cal/sec.-m°C respectively. The inside and outside heat transfer coefficients are 1356·17 and 2.7133 cal/sec. m<sup>2</sup>°C respectively. Contact resistance between the pipe and insulation may be neglected.

5 + 10

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