Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech(CT-New)/SEM-4/CHE(CT)-401/2012

2012

UNIT OPERATION-II

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 the following : $10 \times 1 = 10$

   i) What kind of flow strategy is preferred for drying a heat sensitive substance in a continuous dryer ?

      a) Cross current

      b) Counter-current

      c) Co-current.

   ii) Can the moisture content of a solid (dry basis) be above 100% ?

      a) Yes

      b) No

      c) Indeterminate.

iii) What kind of dryer is used for drying of Green Ceramic ware ?

a) Rotary

b) Tunnel

c) Flash.

iv) What is the unit of resistance to solvent flow through a gel layer ?

a) kg/m^2

b) $m^{-1}.s^{-1}$

c) m^{-1}.

v) What type of membrane is used for the desalination of sea water ?

a) UF

b) RO

c) NF.

vi) A UF membrane has a pore size range of

a) 1 – 100Å

b) 1 – 100 μm

c) 1 – 100 nm.

vii) For settling in Newton's law region, the drag coefficient is

a) 0·100

b) 7

c) 0·44.

viii) How does the selectivity of separation change with the increasing membrane thicknesss ?

a) Increases

b) Decreases

c) Remains unchanged.

ix) In which of the following membrane processes, the effect of concentration polarization is least important ?

a) Gas separation

b) Haemodialysis

c) RO.

x) If the 'polarization modulus' in an RO module is unity, the feed side mass transfer coefficient of the solute is

a) very large

b) very small

c) equal to the diffusional resistance of the membrane.

GROUP – B
(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. With a neat sketch, discuss the features of a concurrent spray dryer.

3. With a neat sketch, discuss the working principle of a sedimentation thickener.

4. Explain the principle of 'perpometry' technique for the characterisation of membrane.

5. What is 'Molecular weight cut-off' ? Explain concentration polarization.

GROUP – C
(Long Answer Type Questions)

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

6. A granular wet solid is dried on a tray dryer under cross flow of hot air from 30% initial moisture content to 1% final moisture content. The solid loading is 35 kd dry solid per m^2 tray area. The constant drying rate is 4.5 $kg/m^2.h$. The critical moisture is 10% and the equilibrium moisture is 0.2%.

   I. Calculate the total drying time if the falling rate is linear in moisture content.

   II. What is the drying rate when the moisture content is 5% ? (all moisture concentrations are expressed on dry basis).

   III. Define the following :

      i) Unbound moisture

      ii) Free moisture. $5 + 5 + 2\frac{1}{2} + 2\frac{1}{2}$

7. a) A 0.02 molar feed containing a macromolecular solute is to be concentrated to a 0.1 M concentration by batch ultrafiltration at 25°C. The solute rejection is 95% and the effect of concentration polarization can be ignored for simplicity. If the upstream pressure is 3.5 atm (gauge) and the downstream pressure is essentially atmospheric, calculate the effective pressure driving force at the beginning and at the end of the process. Also estimate the fractional reduction in the solvent flux at the end of the process.

   b) Explian the principle for 'Pervaporation' ? 10 + 5

8. Write short notes on any *three* of the following : 3 × 5

   a) Gravity settling classifier

   b) Cyclone separator

   c) Ball mill

   d) Müller mixer.

9. a) A mixture of silica and galena solid particles having a size range of $5{\cdot}21 \times 10^{-6}$ m to $2{\cdot}50 \times 10^{-5}$ m is to be separated by hydraulic classification using free settling conditions in water at 293·2K. The specific gravity of silica is 2·65 and galena is 7·5. Calculate the size range of the various fractions obtained in the settling. If the settling is in the laminar region, the drag coefficient will be reasonably close to that for spheres.

Density of water = 998 kg/m^3 at 293·2 K.

Viscosity of water = $1{\cdot}005 \times 10^{-3}$ kg/m.s.

b) Discuss the theory of calculating sedimented concentration for slurry. 10 + 5