Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEMESTER B.Tech. END SEMESTER EXAMINATIONS- Dec 2020

SUBJECT: Membrane Science and Technology [CHE 4019]

REVISED CREDIT SYSTEM, (28/12/2020)

Time: 3 Hours **MAX. MARKS: 50**

Instructions to Candidates: Answer ALL the questions. Missing data may be suitable assumed.

1A	Explain the advantages and limitations of membrane separation processes	**3**
1B	Explain the electrically charged membranes and its applications (at least three).	**4**
1C	Explain the three major group of materials i.e rubbery, glassy and inorganic membrane materials	**3**
2A	It is required to design an RO module for production of 2000 m^3/day potable water containing not more than 0.025% salt from sea water containing 3.4% salt content. The water permeation coefficient is 0.043 m^3/m^2 day atm. The recovery of the feed water should be 35% and an operating pressure of 70 atm gauge is suggested. Retentate concentration is 5.186% The permeate side is at essentially atmospheric pressure. The Osmotic pressure for 5% salt solution is 40 atm and osmotic pressure is proportional to salt concentration. One spiral wound module of 4 m^2 effective membrane area each is used, how many modules and power required to produce the above potable water.	**5**
2B	Explain the process limitations of Nano filtration	**3**
2C	Explain the Donnan and Dielectric exclusion in Nanofiltration operation.	**2**
3A	A feed solution containing a whey protein is to be concentrated from 0.001 M to 0.1 M by UF unit at 25 ^{0}C. Retention factor is 97% and maintained same throughout the process. If the up and down stream pressure are 4.5 atm and atmospheric respectively. Find out the effect driving force at the start and end of the module. Also find the reduction of solvent flux at the end. Assume concentration Polarization is zero.	**3**
3B	Explain the external and internal fouling in micro filtration and Factors effecting the membrane fouling.	**4**
3C	Explain the Micellar – Enhanced Ultrafiltration (MEUF) in Wastewater Treatment Process using diagram	**3**
4A	Derive the flux equation $J_i = \frac{P_i^G (p_{i_0} - p_{i_\ell})}{\ell}$ using solution –diffusion model	**5**
4B	Explain the dual sorption model in gas separation	**2.5**
4C	Explain the advantages of pervaporation	**2.5**

5A	Blood from a patients body is pumped through a hemodialyser in a co-current mode at a rate of 250 ml/min to reduce the urea conc. from 100 mg% to 10 mg%. The available membrane area is 1.5 m^2 and the overall mass transfer coefficient is estimated to be $1.2x10^{-6}$ m/s. The volume of blood in a normal human body is 5 lit. If the flow rate of the dialysate fluid is maintained high ($q_d >> q_b$), estimate the time of dialysis. Assume that dialysate fluid is solute free	**5**
5B	Estimate the membrane area and electrical energy requirements for an electrodialysis process to reduce the salt (NaCl) of 24000 m^3/day of brackish water from 1500 mg/L to 300 mg/L with a 50% conversion. Assume each membrane has a surface area of 0.5 m^3 and each stack contains 300 cell pairs. A reasonable current density is 5 mA/cm^3 and the current efficiency is 0.8; Faradays constant is 96520	**5**