Ref. No. : Ex/PG/ChE/T/115B/2018

M.E. CHEMICAL ENGINEERING FIRST YEAR FIRST SEMESTER – 2018

INTERFACIAL SCIENCE AND ENGINEERING

Time: 3 hrs **Full Marks: 100**

Answer any Four questions

1. (a) The critical coagulation concentrations for NaCl, $MgCl_2$ and $AlCl_3$ for negatively charged As_2S_3 colloids are 70 mol/m^3, 0.8 mol/ m^3 and 0.09 mol/ m^3, respectively. Verify whether these values are consistent with the Schulze- Hardy rule or not. (5)

   (b) Derive the expression for terminal velocity based on Stokes' law. (10)

   (c) A spherical particle suspended in water is placed in a centrifugal field. The diameter of the particle is $1*10^{-7}$ m. What should be the rotational speed so that the particle moves from 6.5 cm to 7 cm in 60 s? Density of the particle is 7500 kg/m^3. (10)

2. (a) Define Donnan Equilibrium. State the significance of Deborah number and Peclet Number. (5+5)

   (b) The aggregation number of sodium dodecyl sulfate micelle in water is 100. Calculate the packing parameter, and predict the shape of the SDS micelles. (10)

   (c) Define Kraft point and cloud point. (5)

3. (a) Estimate the surface tension of ethyl acetate at 298 K using the parachor date. Given the density of ethyl acetate is 0.902 g/cc. State the importance of Harkins–Brown factor (6+4).

   (b) The interfacial tension between an oil and water is 50 mN/m. The density of oil is 850 kg/m^3. If the angular velocity is 1050 rad/s, calculate the radius of the cylindrical drop.(7)

   (c) Explain the working principle of tapping mode atomic forced microscopy. (8)

4. Write Short notes on (any five): (i) Scanning Electron Microscopy; (ii) Anionic Surfactants; (iii) Fowkes correlation; (iv) Advancing and Receding Contact Angle; (v) Lennard-Jones potential; (vi) Electrostatic double layer. (5*5)

5. (a) Explain the decaying profile of Potential as a function of distance considering Debye-Huckel Approximation. (10)

   (b) Show that the ratio of force corresponding to VDW interaction energy between a sphere (radius = Rs) and planar half-space (F_{sp}) and Plane parallel halfspaces (F_{pp}) do not depend on Hamaker constant. (10)

   (c) Differentiate hydration force from hydrophobic interaction. (5)