

B. CHEM 4TH YEAR 1ST SEM. EXAM. - 2017

Interfacial Science and Technology

Time: Three Hours

Full marks: 100

*Answer **any four** questions.**Assume any missing data.**Write all assumptions clearly.*

1. (a) The classical use of the term "colloid stability" represents kinetic stability. Explain with necessary schematics and examples.
 (b) Define coalescence and aggregation. Give examples of processes or products in which aggregation (i.e., coagulation) is desirable.
 (c) Using random walk statistics derive an expression for end to end distance of a polymer coil. Also explain the physical significance of each term of the final expression for polymer molecule. Given

$$P(n, x) = (2\pi nl^2)^{-1/2} \exp\left(-\frac{x^2}{2nl^2}\right) \quad [7+6+12]$$
2. (a) Calculate the diameter of a spherical particle ($\rho = 5 \text{ g/cm}^3$) for which the rms displacement due to diffusion at 25°C is 2% the distance of sedimentation in a 24-hr period through a medium for which $\rho = 1 \text{ g cm}^{-3}$ and $\eta = 9 \times 10^{-3} \text{ P}$. For what diameter the diffusion distance will be 20% of the settling distance?
 (b) Derive an expression of surface tension as surface free energy from thermodynamics of surfaces.
 (c) Determine the shape of the soap film stretched between two parallel circular rings having equal diameter and neglecting the effects of gravity. [10+8+7]
3. (a) Define the following terms and their relation to surface energies: (a) work of adhesion, (b) work of cohesion, and (c) spreading coefficient.
 (b) Derive expression for height of a meniscus at a wall. Calculate the height to which an n-octane surface will climb on a teflon wall. Given $\gamma = 30 \text{ mJ/m}^2$, $\theta = 50^\circ$, and $\rho = 0.80 \text{ g/cm}^3$.
 (c) Why does a drop of pentane spread into a thin film when placed on a water surface, whereas a larger hydrocarbon such as dodecane breaks up into smaller droplets? [6+13+6]
4. (a) Explain different steps of sol-gel technique with the help of an example.
 (b) Explain steps of photolithographic technique with appropriate diagrams.
 (c) Explain why effective Hamaker constant A_{212} is always positive, regardless of the relative magnitudes of A_{11} and A_{22} . [10+8+7]

5. (a) What are the common sources of interfacial charges? Explain with pictorial diagram.
- (b) What is the Helmholtz-Smoluchowski equation? How is it different from the Hiickel equation?
- (c) What is zeta potential and how it is related to electrophoretic mobility? What properties of the dispersion influence such a relation?
- (d) What is Debye-length and explain effect of salt concentration on it with help of a diagram. [7+6+6+6]