ST. JOSEPH'S COLLEGE (AUTONOMOUS), BANGALORE-27

M.Sc. Physics – IV SEMESTER

SEMESTER EXAMINATION- MARCH 2014

PH 0310: SOFT CONDENSED MATTER PHYISICS
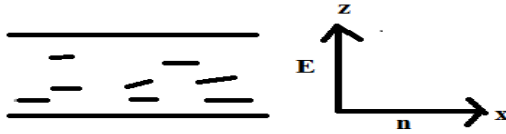
Time: 3hrs. **Maximum Marks: 100**

This question paper has 2 printed pages and 2 parts.

PART A
Answer any **FIVE** of the following [5x15=75]

1. a) For the given configuration if the dielectric anisotropy of the nematic is positive, find the critical value of the field and voltage at which the director field starts to deform.

   Where **E** is the applied electric field and n is the nematic director.

   b) How does a liquid crystal display work? [8+7]

2. a) Derive Poisson-Boltzmann equation.
   b) What is Debye screening length? Derive the expression and explain the effect of adding electrolyte to a colloidal solution. [5+10]

3. Explain Onsanger theory of isotropic to nematic transition. [15]

4. a)What are Hookean solids? Does rubber show Hookean behaviour? Explain.
   b) Explain Kelvin- Voigt model of viscoelasticity. [7+8]

5. Derive an expression for the critical micellar concentration (CMC) of an amphiphilic molecule in terms of the reference chemical potential of a molecule in an aggregate. Also describe any two methods of measuring CMC. [15]

6. a) What are the factors that determine the type of micelles formed? Derive the shape parameter for spherical and cylindrical micelles?
   b) With a neat diagram describe the working of confocal scanning microscope.
   [9+6]

7. What is excluded volume and what is its effects on polymer chains? Derive the theta conditions for a polymer solution by explaining the transition from coil to globule.

[15]

PART B

Answer any **FIVE** of the following   [5x5=25]

8. Explain the effects of depletion interactions in a colloidal system.
9. What is the distribution of possible end to end distance in polymers? A Polymer chain behaves like a spring. Justify
10. How many independent elastic constants does a nematic liquid crystal have? What is their order of magnitude? Sketch the corresponding deformations.

11. Two charged surfaces with surface charge density 0.2 Cm^{-2} are 2nm apart. Calculate the field, potential and counterion density at each surface at 0.2nm from each surface and at the mid plane assuming monovalent counterions, given relative permittivity is 80 and K or M $=1.3361*10^9$ m^{-1}
12. Liquid crystal displays (LCDs) are made from two parallel glass plates, 10 μm apart, with liquid crystal molecules between them. The glass is coated with a conducting material.
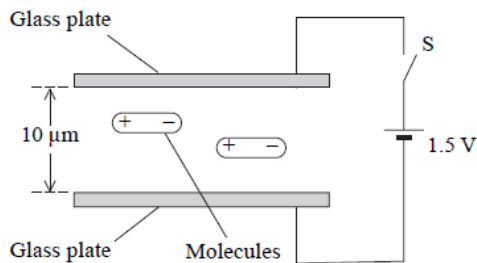
The molecules are positive at one end and negative at the other. They are normally aligned parallel with the glass plates as shown. The switch S is closed and 1.5 V is applied across the glass plates.

a) Calculate the electric field strength between the plates and the critical field required to turn the director where K=5.3 x 10^{-12}N.

b) Explain what happens to the liquid crystal molecules.

13. What are the forces involved in trapping particles in an optical trap? Explain.

14. What are short-range order, long-range order and quasi-long-range order? Give an example each of systems exhibiting these.