ST. JOSEPH'S COLLEGE (AUTONOMOUS), BANGALORE-27
M.Sc. PHYSICS – IV SEMESTER
SEMESTER EXAMINATION: APRIL 2017
PH 0313: Soft Condensed Matter Physics

Time-3 hrs **Max Marks-100**

This paper contains 2 printed pages and 2 parts

PART A

Answer any FIVE of the following **[5 x 15=75]**

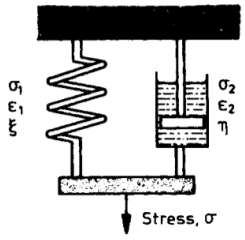
1. Explain Onsager's theory of formation of lyotropic liquid crystals. Which order of phase transition is observed?

2. A solution of cylindrical surfactants can be thought of as a solution of living polymers. Why? Explain the size distribution of aggregate sizes in a system which forms (a) spherical micelles (b) cylindrical micelles.

3. How can optical tweezers be used to measure small forces? Also explain its two calibration techniques.

4. Derive the contact value theorem of colloidal particles and discuss the pressure between the particles at the limit of small separations.

5. a)What are viscoelastic materials? For the given system derive the governing equation and explain creep,recovery and relaxation.



b) Derive an expression for shear modulus of rubber and explain its stress/strain behaviour [8+7]

6. Determine the entropy and free energy of mixing of two species A and B using regular solution model and plot the free energy of mixing against composition change for various interaction parameters

7. a)Why are liquid crystals called so? How do they respond to applied electric field?
b)For a system of nematics aligned parallel to glass plates derive the critical magnetic field above which the director distorts when a field is applied perpendicular to the director and glass plates. Also sketch the system when $H<H_c$ and $H>H_C$ where H_c is the critical field. [5+10]

PART B

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

8. Calculate the diffusion coefficient of a micelle of Span80 of diameter 5 nm in benzene at 300K. What would be its RMS displacement based on Brownian motion after 60 s? Given viscosity of benzene 0.6×10^3 Pa s.

9. Calculate the Debye screening length at 25^0C for (a) 0.01 M NaCl (b) 10^{-4} M NaCl (c) 0.01 M K_2SO_4. How does Debye screening length depend on temperature?

10. The elastic constants for MBBA were measured at 22^0C,with the following results: K_1= 5.3 x10^{-12} N, K_2= 2.2 x 10^{-12} N and K_3= 7.45 x 10^{-12}N. Determine the electric field strength for a Freedericksz for pure splay, twist and bend geometries for this nemato-gen for cells of thickness 1 μm. The relative dielectric permittivities of MBBA are $\varepsilon \parallel = 4.7$, $\varepsilon \perp = 5.4$.

11. What are disclinations in nematic liquid crystals? Sketch the director field around disclinations of strength (a) s=1/2 and (b) -1/2 .

12. Derive the mean square end to end distance of a freely rotating polymer. How does the expression change if the bond is free to rotate but has a definite bond angle?

13. Explain the factors which determine what kind of micelle is formed by a given amphiphile.

14. With a neat diagram explain the working of a phase contrast microscope.