BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI (RAJ)

Midsemester Examination (Closed Book)

SECOND SEMESTER 2022-2023

Soft Condensed Matter Physics (PHY F416)

Date:16th March 2023

Max. Time:60 Mins Max. Marks:60

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1. Answer any 5 questions. Each question carries 6 marks. **[30M]**

i. Write the Young Dupre equation. Explain the parameters of the equation with the help of a schematic diagram.

ii. What is triple point? Draw Pressure vs temperature phase diagram as well as temperature vs density diagram and label all the relevant parameters.

iii. What is disjoining pressure? Write down the expression and explain.

iv. For polymer chains with 10^5 degree of polymerization estimate: (a) the RMS end to end distance in a melt (b) the RMS end-to-end distance in a dilute, good solvent. Given the monomer size or the statistical step length is 0.7 nm.

v. Based on which common characteristics of materials are classified as soft materials?

vi. What is osmotic pressure? Write down the expression for osmotic pressure.

2. Explain with the help of proper schematic diagrams and relevant expressions explain tube model and theory of reptation of polymers. **[15M]**

3. What is (a) Marangoni effect? (b) Gibbs Monolayer (c) Langmuir monolayer? **[15M]**

-----All the best-----

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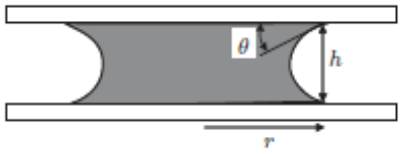
1. A water droplet of volume V is sandwiched between two glass plates separated by a distance *h*. Calculate the capillary force acting on the plates. Assume that the radius of the wet region *r* is much larger than *h* and that the contact angle of the water on the glass is θ. Estimate the value of this capillary force if h=1.2cm, θ = 30 °, and volume is 5cm^3.



[8+7]

2. (a)Estimate the bulk modulus(K) of water at room temperature 27°C assuming that eq. $K = nk_BT$ is valid even in the liquid state of water. Assume that a water molecule is a sphere of diameter 0.4 nm.

(b) Estimate the shear modulus of rubber of density 1 g/cm^3 consisting of subchains of molecular weight 10^5 [g/mol]. **[8+7]**

(k_B= 1.3806452 x 10^{-23} J/K; N_A= 6.02214076×10^{23} mol^{-1}; surface tension of water= 72.5 mN/m)

-----All the best-----