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RAJARATA UNIVERSITY OF SRI LANKA  
FACULTY OF APPLIED SCIENCES

B.Sc. (Special) Degree in Chemistry  
Fourth Year - Semester I Examination – October/November 2017

**CHE 4203 – SURFACE AND COLLOIDAL CHEMISTRY**

Answer **any** four (04) questions

Time: Two (2) hours

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$R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ ,  $c = 3.0 \times 10^8 \text{ m s}^{-1}$ , Boltzmann constant,  $k = 1.381 \times 10^{-23} \text{ J K}^{-1}$

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.Only first four (04) answers will be graded.

1.

- a) Describe the basic requirements, a molecule should possess to be a surfactant and give two examples. (20 Marks)
- b) Design three new surfactant molecules with the use of requirements mentioned above [these should be different molecules from the examples in part (a)] (20 Marks)
- c) Account for the detergency and give a graphical explanation for the process of cleaning action of a surfactant. (30 Marks)
- d) Discuss the nature of micelles and give an application in medicinal chemistry. (30 Marks)

2.

- a) Explain how to use Langmuir trough method to estimate the cross-sectional area of a surfactant molecule. (60 Marks)
- b) It is found that 0.2 mg of palmitic acid covers a  $1000 \text{ cm}^2$  of water surface at the point surface pressure starts rapid increasing. Estimate the cross sectional area (in  $\text{nm}^2$ ) of a molecule. Given that molar mass of palmitic acid is  $256 \text{ g mol}^{-1}$ . (20 Marks)
- c) Relate the contact angle of a liquid to its wetting properties. (20 Marks)



3.

- a) For a surface,

$$dG = -SdT + Vdp + \gamma dA + \sum \mu_i dn_i$$

Derive the Kelvin equation starting from above relationship where  $\gamma$  is the surface tension and  $\mu_i$  is the chemical potential of a liquid. Identify all the terms in the final equation. (50 Marks)

- b) Use Kelvin equation to analyse "super cooling" and "super heating" of a vapour.

(30 Marks)

- c) Illustrate Yung's equation using a labeled diagram.

(20 Marks)

4.

- a) Starting from

$$dU = TdS - pdV + \gamma dA + \sum \mu_i dn_i$$

derive general expression of Gibbs adsorption isotherm

$$d\gamma = -RT \sum \Gamma_i d(\ln a_i) \text{ and identify all the terms.} \quad (50 \text{ Marks})$$

- b) Write down the Gibbs adsorption isotherm for a two component system, where the solute is a nonionic compound.

(15 Marks)

- c) Plot the surface tension vs concentration of a solute in the bulk for capillary active, capillary inactive and surface active substances. Use a diagram to show distribution of surfactant molecules in a nonpolar liquid.

(35 Marks)

5.

- a) Compare and contrast chemisorption and physisorption.

(40 Marks)

- b) Define the terms surface excess.

(10 Marks)

- c) Write a short note on electrical double layer of a colloid particle.

(50 Marks)

- End -