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# B.M.S. College of Engineering, Bengaluru-560019

**Autonomous Institute Affiliated to VTU**

## July 2023 Semester End Main Examinations

**Program: B.E.** **Semester: VI**
**Branch: Chemical Engineering** **Duration: 3 hrs.**
**Course Code: 19CH6DELD2** **Max Marks: 100**
**Course: Interfacial Phenomena** **Date: 12.07.2023**

**Instructions**: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

**Important Note:** Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

| | | UNIT – I | CO | PO | Marks |
|---|---|---|---|---|---|
| 1 | a) | Define surface tension. What are the units of surface tension? | *CO1* | *PO2* | **04** |
| | b) | A thin and light ring of platinum material of radius 3 cm is rested flat on a liquid surface. When slowly raised, it is found that the pull required is 0.03 N force. Find the surface tension of the liquid by du Nuoy ring method. | *CO4* | *PO2* | **08** |
| | c) | Explain with a neat diagram and governing equations, the method of surface tension measurement by drop weight method. | *CO4* | *PO2* | **08** |
| | | **OR** | | | |
| 2 | a) | Describe with a schematic diagram that surface tension is same as the surface free energy. | *CO1* | *PO2* | **04** |
| | b) | Describe the method of measurement of surface tension of a liquid ($\gamma$) by capillary rise method. Note that the capillary is of radius r and density of liquid is $\rho$. | *CO4* | *PO2* | **08** |
| | c) | A drop of water at 25 $^{o}$C and of 0.4 cm radius is split into 125 tiny drops. Find the increase in surface energy. | *CO4* | *PO2* | **08** |
| | | **UNIT – II** | | | |
| 3 | a) | Derive the equation of excess pressure for a spherical bubble of radii of curvature R1 and R2. The ambient pressure is $P_a$ and surface tension of liquid is $\gamma$. | *CO2* | *PO3* | **10** |
| | b) | With the help of the Kelvin's equation, show the relationship between the surface tension and vapour pressure of liquid across a curved surface of radius r. The molecular weight of the liquid is M and, room temperature and pressure are T and P respectively. | *CO2* | *PO3* | **10** |

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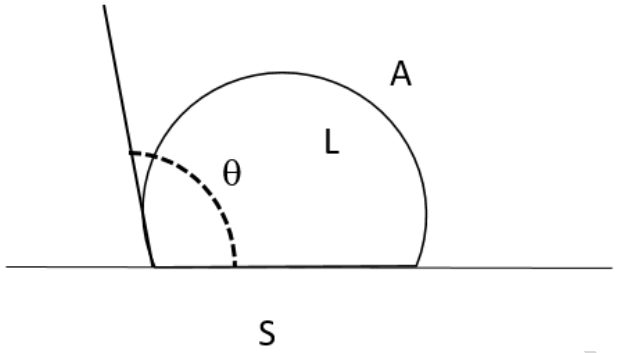
| | | | **UNIT – III** | | | |
| | 4 | a) | What are the different modes of spreading available? Explain the expression of change in free energy of the system due to spreading. | *CO1* | *PO2* | **06** |
| | | b) | A liquid L is dropped on the top of a solid S. The figure below indicates the condition. Show that the spreading coefficient depends on the tensions between solid, liquid and air.   | *CO1* | *PO2* | **07** |
| | | c) | What is Young's equation? With the help of Young's equation show the relationship between work of adhesion and work of cohesion. | *CO1* | *PO2* | **07** |
| | | | **OR** | | | |
| | 5 | a) | Explain the stability of an emulsion from thermodynamics point of view. | *CO3* | *PO6* | **05** |
| | | b) | How does phase inversion take place in emulsion from oil-in - water (O/W) to water-in oil (W/O)? | *CO3* | *PO6* | **07** |
| | | c) | Explain Winsor Type-I and Winsor Type-II system's phase diagrams. | *CO3* | *PO6* | **08** |
| | | | **UNIT – IV** | | | |
| | 6 | a) | Explain Stern and Gouy-Chapman model of electrostatic double layer with a neat diagram**.** | *CO1* | *PO2* | **10** |
| | | b) | Derive the expression for the number of adsorbed ions with the help of Stern theory. | *CO1* | *PO2* | **10** |
| | | | **UNIT – V** | | | |
| | 7 | a) | What is the reason behind the unique characteristics of a surfactant molecule? Explain the various variants of a surfactant with example and the industrial applications. | *CO6* | *PO6* | **08** |
| | | b) | What is HLB value of a surfactant? Calculate the HLB value of Alkyl Benzene Sulphate $C7H7SO4^-Na^+$. HLB group number of $–SO_4^-Na^+$ is 38.7 and $-CH_2-$ is 0.475. | *CO6* | *PO6* | **04** |
| | | c) | Elucidate Foam separation. | *CO5* | *PO12* | **08** |



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