



INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR

Mid-Spring Semester Examination, 2023-2024

Subject: Instability and Patterning of Thin Polymer Films Subject No.: CH 62052

Date: 21.02.2024 (FN)

Time: 2 Hrs

Full Marks: 30

No. of Students: 135

Instructions:

1. All Questions are compulsory.
2. Please answer all parts of the same question together. Else marks will be deducted.
3. Be Precise with your answers. Long, redundant answers can potentially fetch zero!
4. Please use sketches/ figures to explain concepts as much as possible.
5. If you feel any question is wrong, make suitable assumptions. NO DOUBTS will be taken during the examination.

***** Please answer all parts of the same question together *****

1. (a) Two identical colloidal particles are immersed in a liquid. Explore all possible cases and comment on the conditions of colloidal stability. (4)
(b) Based on the above considerations, please mention:
i) The necessary and sufficiency conditions for colloidal stability. (2)
ii) In which of the above cases, the chances of colloidal stability is maximized. (1)

Total Marks for Question 1: (7)

2. (a) "Patterning a flat surface **always** increases the effective contact angle" Is the statement correct? Justify with appropriate scientific logic. (1)
(b) A line grating patterned surface have periodicity of $2.0 \mu\text{m}$. What is the height of the features if line roughness is 1.4? What is the line width? (1+1)
(c) Do you think drop volume has any effect on the value of equilibrium contact angle, or Young's equation? Justify (1)
(d) Discuss the nature of the flow within a liquid/ solution subject to a surface tension gradient with justification (2)

Total Marks for Question 2: (6)

3. (a) Discuss and justify the possible modes of contact line dynamics when a drop of a pure liquid evaporates over a flat, defect free surface. (3)
(b) Now consider a topographically patterned surface having a line grating pattern of the same material, and the same liquid drop is dispensed on this surface. Describe about the initial shape of the drop and the evaporation dynamics of the drop over the patterned surface. (4)
(c) Now discuss the evaporation dynamics of a drop of a dilute solution over a flat, practical surface. Please emphasize all the internal flows sequentially. Use suitable figure. (4)

Total Marks for Question 3: (11)

4. (a) What is spreading coefficient? What is the significance of the sign of spreading coefficient? (1+1)
(b) Why does one get unmanageable fluffy hair after doing shampoo? (2)
(c) Discuss how a soap bubble remains stable. (2)

Total Marks for Question 4: (6)