01.07.2019

Bar-Ilan University

Soft Matter Physics
86-695-01

Lecturer: Prof. Eli Sloutskin
Course type: Lecture
Date: 2018-2019 **semester:** B **weekly hours:** 3

A. Aims

Soft condensed matter physics deals with the behavior of colloidal suspensions, emulsions, foams, polymers, and complex fluids. The typical energy scale associated with the structural changes in soft condensed matter systems is $1k_BT$, where T is the room temperature. Soft condensed matter provides a wide range of simple experimental models, allowing fundamental problems in Physics to be approached by direct experiments. In particular, these systems provide an unprecedentedly detailed insight into collective phenomena, bridging the gap between the behavior of individual particles and the macroscopic thermodynamics and shedding light on long-standing fundamental problems in crystallization and melting, glass formation, and physics of topological charges. This course provides an introduction to soft matter physics and demonstrates its central role in our everyday life, in nanotechnology, and in a wide variety of complex biological systems.

B. Syllabus

1. What is Soft Matter?
2. Surface forces and capillarity.
3. Life at small Reynolds' number.
4. Brownian motion: from spheres to anisotropic objects.
5. Entropic forces and entropy-induced ordering phenomena.
6. Surfactants and micelles.
7. Surface-induced crystallization.
8. Emulsions and foams.
9. Fluid thermodynamics: short-range order in fluids.
10. Random packings and jammed matter.
11. Melting in two dimensions: topological defects and hexatics.
12. Buckling of two-dimensional crystalline membranes
13. Polymers, their melts and solutions.

C. Course mandatories:

Prerequisites: Undergraduate course in Thermodynamics and Statistical Mechanics.
Assignments: As a part of this course, there will be given several homework assignments and a more extended final assignment.

D. Grading:

Homework 15%, Final assignment 85%

E. Bibliography (optional):

1. J. N. Israelachvili, *Intermolecular and surface forces* (Academic Press, 1998)
2. P. M. Chaikin and T. C. Lubensky, *Principles of condensed matter physics* (Cambridge University Press, 1995)
3. J. C. Berg, *An introduction to interfaces and colloids* (World Scientific, 2010)
4. R. J. Hunter, *Foundations of colloid science* (Oxford University Press, 2009).