

PHY205A: Fundamentals of Soft Matter

Instructor: Manas Khan

Course description:

A) Objectives:

We encounter soft matter systems, *i.e.* the systems that are soft and easily deformable in ambient temperature and pressure, everywhere around us. Starting from the building blocks of our body, to the most of the food we eat or drink, and toiletries we use everyday, all fall under the domain of soft matter. They possess many fascinating mechanical properties that are governed by intriguing physical phenomena. In this course you will be introduced to some of those fundamental concepts and their applications in understanding different soft matter systems or to design a soft material with desired properties. These concepts will particularly be useful in various fields of research, including research and development work in soft matter systems.

B) Contents:

S.No.	Broad Title	Topics	No. of Lectures
1	Introduction to soft matter	<ul style="list-style-type: none">• What is soft condensed matter?• Colloids, polymers, amphiphiles, liquid crystals• Forces, energies, timescales	4
2	Brownian motion	<ul style="list-style-type: none">• Equilibrium fluctuation properties• Diffusion in simple fluids and Stokes' drag• Fluctuation dissipation theorem	4
3	Colloids	<ul style="list-style-type: none">• Colloidal dispersions• Excluded volume, depletion interactions• van der Waals, electrostatics, ions, and DLVO• Tunable colloids, active colloids and applications	4
4	Polymers	<ul style="list-style-type: none">• Structure of macromolecules• Random walks and relaxation dynamics• Viscoelasticity	4
5	Surfaces and interfaces	<ul style="list-style-type: none">• Surface tension, interfacial tension• Wetting• Adhesion and friction• Slip behavior	4
6	Soft Matter and food physics	<ul style="list-style-type: none">• Physics of foodstuff and cooking (Additional lectures if time permits or in weekends)	2

C) Pre-requisites, if any: None

D) Short summary:

This course will introduce the fundamental concepts related to soft matter systems and their applications. Starting with basic introduction, *i.e.* what are soft matters, different types of soft materials and their characteristics properties, important phenomena that describe equilibrium and non-equilibrium behavior of soft matter systems will be taught. Two such generic soft matter systems, namely, colloidal dispersions and polymer systems will be discussed in particular. A few lectures on surface and interfacial properties of

liquids will conclude this modular course. If time permits, a couple of lectures will be given on a popular science topic – physics of foodstuff and cooking.

E) Reading materials:

Textbooks:

- “Soft Condensed Matter” by R.A.L. Jones
- “Soft Matter Physics” by M. Doi

Reference:

- “Fundamentals of Soft Matter Science” by Linda S. Hirst

F) Grading policy:

- Attendance and interaction in class: 20%
- Quiz + Assignment: 30%
- Final exam: 50%

G) Timing and Venue: TBA