This is an introductory course on Soft Matter Systems (PHZ 5937). The objective is to give an overview of a selected but very common set of soft matter systems, e.g., liquid crystals, polymers, colloids, surfactants, etc. Certain recent developments in understanding physical properties of biopolymers will be qualitatively discussed. It is expected that students from a heterogeneous background will enroll in this course. Therefore, a substantial portion of the lectures will be descriptive, accordingly, the technical level will be kept at a bare minimum. An approximate course outline for a one semester course is as follows:

- **Introduction to polymers**
  1. Static conformation of polymer: a single chain
  2. Notion of an ideal chain: simple random walk
  3. A real chain in a good solvent: a self-avoiding random walk
  4. Flory exponents
  5. Polymer solution in good solvent: Flory-Huggins theory
  6. Polymer gels: sol-gel transition
  7. Dynamics of a single polymer chain: Rouse and Zimm dynamics
  8. Polymer melt and reptation dynamics.
  9. Properties of biopolymers: DNA, Actin etc.

- **Self-Assembly of Amphiphiles**
  1. Thermodynamics of self-assembly
  2. Exactly solvable simple models
  3. Mean-field approaches
  4. Di- and tri- block copolymers

- **Ordering in Liquid crystals**
  1. An overview of liquid crystals
  2. Statistical mechanical models
  3. Phase transitions: isotropic-nematic-smectic
  4. Liquid crystals under external field

- **van der Walls interaction and forces**
  1. Origin of the van der Walls interaction
  2. General theory of van der Wall forces between molecules
3. Casimir effect

- **Colloidal dispersion**
  1. Examples of colloidal particle in a liquid: Stokes’ Law
  2. Brownian motion, Fluctuation-dissipation theorem & Stokes-Einstein equation
  3. Forces between colloidal particles: Casimir Effect
  4. Electrostatic double-layer forces: Poisson-Boltzmann equation & Debye-Huckel theory

**Prerequisites:** The prerequisite for this course is PHY 3503, or its equivalent, or by the consent of the instructor. Soft Matter Physics is a new emerging area of research. The course inherently has some interdisciplinary character. It is expected that enrollment will cover a wide spectrum of students. Therefore, the technical level will be kept at a minimum level or be taught as necessary. Emphasis will be given to a wide variety of soft matter systems.

**Homework:** Approximately one homework will be assigned every two weeks.

**Group Assignments:** In addition to the individual homework assignments a couple of group projects will be given to facilitate discussions, exchange different ideas, concepts, etc.

**Tests:** There will be one midterm and a comprehensive Final. Each student will be assigned a project, submit a research report, and make a 20-25 minutes presentation.

**Grade:** The final grade will be determined by the overall performance weighted in the following approximate manner:

- Homework and projects - 60%, Midterm I - 20%, Final - 20%

The final evaluation will be done by assigning a grade, e.g., A-, A, B-, B, B+, C-, C, C+ etc.

**Textbooks:**


**Additional References:**