Intended Audience: Seniors/graduate students who are enthusiastic about understanding the physics of polymers. Only a basic working knowledge of calculus, probability, chemistry, and physics is assumed.

<u>Aim:</u> To develop the fundamental concepts required to understand polymers melts, solutions, and gels in terms of both structure and dynamics.

<u>Instructor:</u> Ozge Akbulut – office: FENS 2046; phone: 9968; e-mail: ozge.akbulut@sabanciuniv.edu

<u>Assistant:</u>

Hours: Synchronous lecture, Th 9:40-11:30, Fri 8:40-9:30

Textbook: Rubinstein & Colby, Polymer Physics (2003). ISBN: 0-19-852059-X

Evaluation: Grading is based on weekly, spontaneous quizzes and three assignments.

COURSE OUTLINE:

<u>Week 1:</u> Why are we here? What is a polymer? Soft matter vs hard matter—how polymers differ from other types of materials. Classification of polymers. A statistical view on chain molecules. Molecular weight of polymers

<u>Week 2-3:</u> Ideal chains: Definition of chain conformation; chain dimensions and their distributions. Distribution of end-to-end vectors. Free energy of an ideal chain.

<u>Week 4-5:</u> Real chains: Excluded volume and self-avoiding walks. Deformation of chains. Temperature effects.

<u>Week 6:</u> Introduction to polymer thermodynamics

<u>Week 7:</u> Thermodynamics of mixing: Energy – entropy of mixing. Phase diagrams. Dilute solutions.

<u>Week 8:</u> Polymer solutions: Type of solvents. Osmotic pressure.

<u>Week 9:</u> Definition of polymer networks. Random branching and gelation: Percolation. Branching with and without gelation. Mean-field and scaling models of gelation.

Week 10: Networks and gels: Rubber elasticity. Swelling.

Week 11: Viscoelasticity.

<u>Week 12:</u> Introduction to dynamics. Definition of relaxation phenomena.

<u>Week 13:</u> Dynamics of unentangled polymers: Rouse and Zimm models.

<u>Week 14:</u> Dynamics of entangled polymers. Reptation in melts and semi-dilute solutions.

Course Organization:

- Weekly, time-stamped quizzes through SUCourse+
- Attendance is not counted towards the grade, but the quizzes are tethered to the lecture hours.