

**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.

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

**Instructor:** Ozge Akbulut – office: FENS 2046; phone: 9968; e-mail: ozgeakbulut@sabanciuniv.edu

**Assistant:**

**Hours:** Lecture, Th 2:40–3:30, Fri 2:40–4:30

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

**Evaluation:**

Grading is based two term exams (25 % each), final (35 %), and assignments (15 %).

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## **COURSE OUTLINE:**

**Week 1:** What is a polymer? Soft matter vs hard matter. A statistical view on chain molecules.

**Week 2:** Basic definitions: Structure, phases, and weight of polymers. Molar mass distributions and measurements (viscosity measurements and osmometry)

**Week 3–4:** Ideal chains: Definition of chain conformation; chain dimensions and their distributions. Free energy of an ideal chain.

**Week 5:** Real chains: Excluded volume and self-avoiding walks. Deformation of chains. Temperature effects.

**Week 6:** **Midterm I**, Introduction to polymer thermodynamics

**Week 7:** Thermodynamics of mixing: Energy – entropy of mixing. Phase diagrams. Dilute solutions.

**Week 8:** Polymer solutions: Type of solvents. Osmotic pressure.

**Week 9:** 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.

**Week 12:** **Midterm II**, Introduction to dynamics. Definition of relaxation phenomena.

**Week 13:** Dynamics of unentangled polymers: Rouse and Zimm models.

**Week 14:** Dynamics of entangled polymers. Reptation in melts and semi-dilute solutions.

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## **Course Organization:**

- Problem assignments, partial flip-class
  - Two midterms and a final exam.
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