Polymer Physical Chemistry
(CHM 1302)

Lectures: Tuesday 5-7 pm,
Lecture room GB220

Course coordinator: Professor Eugenia Kumacheva
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Text:
Lecture notes
Dept. of Chemistry website ⇒ Course notes ⇒ CHM 1302
Sperling, L.H. Introduction to Physical Polymer
4-th Edition.
Elias, H.-G. An Introduction to Polymer Science.
Rubinstein M., Colby, R.H., Polymer Physics, 2003
Assignments and tests:

Assignments (2) 15 x 2 = 30 %  
Term paper (presented orally) 20 %  
Final Exam 50 %

Term papers:

Term paper: well-defined length 10 pages (up to 15 with figures), double spacing

Topics and Instructions will be given in February  
Term paper should be given on the topic **NOT RELATED** to the student’s research area or any research project in the group.

Assignment 1 (EK part) will be handed out on Feb 20 and will be due on March 4. Assignment 2 (MAW part) will be handed out on in two parts in March. Each part will be due one week later.
Lecture 1-2
- Basic concepts, Polymer liquids,
molecular weight distributions,
critical concentrations

Lecture 3-4
- Polymer Ideal Chains
  - Molecular Interactions
  - Molecular dimensions
  - Models describing molecular dimensions

Lecture 5-6
- Polymer real chains
  - Excluded volume
  - Flory’s theory
  - Self-similarity and polymer molecules
  - Scaling theory

Lecture 7-8
- Methods of Polymer Characterization
  - Osmometry
  - Light scattering
  - Viscometry
  - Gel Permission Chromatography
Lecture 10-12
Polymer thermodynamics
Flory-Huggins theory
Phase separation
Phase diagrams

Lecture 11-12
Polymer glasses and the crystalline state
Tg and the concept of free volume
Time-temperature superposition
Physical properties of crystalline polymers
How chains pack in crystals
+ Brief introduction to polymer diffusion
Dynamic light scattering and how it works

Lecture 13-14
Mechanical properties of polymers
Tensile strength
E’, E”, G’, G”
Five regions of viscoelastic behavior
Introduction to Polymer viscosity
Shear-rate and concentration dependence

Lecture 15-16
Polymer viscosity continued
Introduction to entanglements
Gels, Gel Formation, Rubber Elasticity
Gelation and the gel point, sol and gel fractions
Lecture 17-18
  Gels and Rubber elasticity continued
  Origin of rubber elasticity
  Swelling of polymer networks

Lecture 19-20
  Polymer dynamics
  Diffusion in dilute solution, Rouse and Zimm models
  Entanglements and diffusion in semi-dilute solution
  Polymer melt viscosity.

Student presentations

Final Exam 3 h
Term paper presentation

• PPT format
• 15 min + 3-5 min for questions
• The topic has to be chosen by a student. **NO PRESENTATION can be given on the topic that is in the scope of research in student’s group.**

• The evaluation will be based on:
  • Novelty and complexity of presented work 20 %
  • Understanding of the material 20 %
  • Oral presentation 20 %
  • Answers to questions 20 %
  • Quality of slides 20 %