Syllabus for EMAC 474

Time: Tuesday, Thursday, 1:15 p.m.-2:30 p.m.

Instructor: Prof. Elena Dormidontova

Jan. 11.	Introduction. Ideal chain. Chain statistics for flexible and rigid chains. Polymer chain with volume interactions. Chain conformation in dilute solutions at different temperatures (solvent quality)
Jan. 13.	Many-chain behavior. Elements of Flory-Huggins theory. Chemical potential. Phase equilibrium.
Jan. 18.	Many-chain behavior. Phase equilibrium. Osmotic pressure. Diagram of state for polymer solutions.
Jan. 20.	Diagram of state for polymer solutions. Blob model. Polymer conformation in semidilute, marginal and concentrated solutions.
Jan. 25.	Polymer viscoelasticity: Elasticity in solids and in polymers (rubber). Single chain stretching. Crosslinked polymers (polymer networks). Thermo-elastic behavior and its thermodynamic origins.
Jan. 27.	Polymer viscoelasticity: Statistical mechanical theory of rubber elasticity.
Feb. 1.	Polymer viscoelasticity: Deviations from classical theory of viscoelasticity. Influence of crosslinks, chain defects, chain swelling, larger deformations. Mooney-Rivlin theory.
Feb. 3.	Test #1.
Feb. 15.	Polymer dynamics: Smoluchowski equation. Brownian motion. Langevin equation. Dynamics of a single chain. Rouse model.
Feb.17.	Dynamics of a single chain. Zimm model. Dynamic light scattering and dynamic viscoelasticity.
Feb. 22.	Dynamic properties of polymer solutions and melts. Cooperative and self-diffusion. Dynamic viscoelasticity for short-chain solutions and melts.
Feb. 24.	Dynamic properties of polymer solutions and melts. Reptation model.
Mar. 1.	Dynamic viscoelasticity for long-chain solutions and melts.
Mar. 3.	Diblock copolymers. Weak segregation theory.
	Spring break.
Mar. 15.	Diblock copolymer melts, polymer micelles. Critical micelle concentration.
Mar. 17.	Diblock copolymer solutions. Critical micelle concentration.
Mar. 22.	Test.2.
Mar. 24.	Polymers at surfaces and interfaces. Theory of polymer adsorption
Mar. 29.	Polymer brushes. Adsorption of diblock copolymers.
Mar. 31.	Glassy amorphous state I
Apr. 5.	Glassy amorphous state II
Apr. 7.	Crystalline state of polymers
Apr. 12.	Computer modeling of polymers

Apr. 14. Crystallization kinetics I
Apr. 19. Crystallization kinetics II
Apr. 21. Test # 3
Each test contribute equally to the final grade.
For handouts see: http://elena.emac.cwru.edu/emac474/

Literature recommended for EMAC 474:

Polymer Physics, U.W. Gedde, Kluwer Academic Publishers, 1995.

Principles of Polymer Chemistry, P. J. Flory, Cornell University Press, Ithaca, N. Y., 1953.

The Physics of Polymers: Concepts for Understanding their Structures and Behavior, G. R. Strobl, Springer-Verlag Berlin Heidelberg, 1997.

Introduction to Polymer Physics, M. Doi, Oxford Science Publications, Clarendon Press, Oxford, 1996 (2001).

Introduction to Polymer Viscoelasticity, John J. Aklonis, William J. MacKnight, Wiley & Sons, 1983.

The Physics of Rubber Elasticity, L.R.G. Treloar, Clarendon Press, Oxford, 1958.

Polymers at Interfaces, G. J. Fleer, M. A. Cohen, Stuart J.M.H.M. Scheutjens, T. Consgrove, B. Vincent, Chapman & Hall, 1993.

Polymers at Surfaces and Interfaces, R.A.L. Jones, R. W. Richards, Cambridge University Press, 1999.

X-ray Structure Determination, George H. Stout and Lyle H. Jensen, John Wiley & Sons, Inc., Second Edition, 1989.