

## Chemistry 424 - Polymer Chemistry Information Sheet

- **Time/Location:** Mondays 8:30, Tuesdays 10:30, Thursdays 9:30/Ontario Hall, Room 207
- **Instructor:** Dr. Guojun Liu, CHE411, [Guojun.Liu@chem.queensu.ca](mailto:Guojun.Liu@chem.queensu.ca); 613-483-6887
- **Topics:** Preparation, characterization (molecular characteristics), and example applications of polymers.
- **Grading Scheme:**

Problem Sets (2):	30%
Mid-term:	30%
Final:	40%
Total:	100%
- **Textbook:** R.J. Young and P.A. Lovell *Introduction to Polymers* 3<sup>rd</sup> ed., CRC Press, Boca Raton, 2011.

## Lecture Outline for Chem 424 in 2014

Lecture #	Content
1	Course Outline, Definition, Importance of Polymer, and Examples of Polymer Application in the Liu Group.
2	History, Nomenclature, Classification, Polymer Characteristic Properties.
3	Molecular Weights, States of Amorphous Polymers.
4	States of Semi-crystalline Polymers, Tensile Modulus, Polymer as a Material.
5	Step Polymerization 1 – General Concept.
6	Step Polymerization 2 – Examples and Mw/Mn.
7	Step Polymerization 3 – Use of More Reactive Monomers, Crosslinkers, and Modern Reactions; Capsule Formation, Summary.
8	Using Chemistry to Solve Practical Problems - Packaging of Wave Worms, Satellite Dish Covering by Snow, and Water-Proof Sun Screen.
9	Free Radical Polymerization 1 – Scope, Practical Example, General Reaction Scheme and Rate Analysis, An Example.
10	Free Radical Polymerization 2 - Determination of $k_d$ , $k_p$ , and $k_t$ and Examples.
11	Free Radical Polymerization 3 – Side Reactions, Effects of Side Reactions, and Mw/Mn.
12	Free Radical Polymerization 4 – Auto-acceleration Effect; Two Examples of Daily Life Problems
13	Emulsion Polymerization
14	Anionic Polymerization 1 – General Scheme, Initiation, Polymerization, and Termination.
15	Anionic Polymerization 2 – Examples and Practical Aspect.
16	Anionic Polymerization 3 – Architectural Polymers and Block Copolymers.
17	<b>Midterm</b>

18	Cationic Polymerization and General Topics of Vinyl Polymerization (Monomer Polymerizability, Head to Tail Addition, and 1,4-Addition)
19	Ring-Opening Polymerization – Cationic ROP, Anionic ROP, and Metathesis Polymerization.
20	Atom Transfer Radical Polymerization – Example System, Overview, and Polymerization Control.
21	Co-polymerization 1 – Introduction, Terminal Model, $f_A$ vs. $F_A$ from the Terminal Model, Example
22	Co-polymerization 2 – Discussion of the $F_A$ Equation; Q-e Scheme.
23	Polymer Characterization Introduction, Lattice Model, Entropy of Mixing
24	Gibbs Free Energy of Mixing; $\Delta H_m$ , Phase Diagrams, $\chi_c$
25	Applications of the $\Delta G_m$ expression (Determination of $\chi$ and Polymer Molecular Weight).
26	Solubility Parameter – Definition, Experimental Determination, and Empirical Estimation
27	Root-Mean-Square End-to-End Distance $R_n$ and $R_G$ .
28	Viscometry 1 – Viscosity and Viscosity Measurements, Intrinsic Viscosity, Mark Houwink-Sakura Equation, Einstein Equation.
29	Viscometry 2 – An Example System
30	Size Exclusion Chromatography 1 – Instrument, Column Packing Material, Operating Principle, Data Gathering and Treatment.
31	Static Light Scattering 1 – Instrument, Raw Data, Factors Affecting $i_\theta$ , Final Expression.
32	Static Light Scattering 2 – Zimm Plot and Example.
33	Dynamic Light Scattering
34	Photolithography
35	Application of Polymers - Electroactive Polymers.
36	Review