

MATERIALS 4P03

Properties of Polymeric Materials

Instructor: Prof. Gu Xu, JHE 357, xugu@mcmaster.ca, x 27341

Course Schedule: Monday, 19:00-22:00, ABB-165

Teaching Assistant: see below

Course Description:

Structure of amorphous and crystalline polymeric materials; mechanical, electrical and optical properties, and their modification through processing.

Course Outcomes:

At the end of the course, students are expected to learn:

- The concept of molar mass and molecular architecture of polymers
- Various synthesis techniques of polymeric materials
- Physical and chemical characterization of polymers
- Structural analysis of polymers
- Mechanical properties of polymeric materials
- Electrical and optical properties of polymeric materials

Textbook and References:

“Polymers: Chemistry and Physics of Modern Materials” by J.M.G. Cowie, and

“Introduction to Polymers” by R.J. Young, both available at the University Bookstore

Evaluation:

- 1) Mid-term (30%): This 1 hr exam will take place in mid-October, covering the first half of the lectures.
- 2) Final Examination (40%): 1hr exam: This exam will focus on contents described and taught during the 2nd half of the lecture part.
- 3) Assignments (30%)

List of topics and timeline of the course:

COURSE OUTLINE

Instructor: G. Xu. Room JHE-357

Text book: "Polymers: Chemistry and Physics of Modern Materials", by J.M.G. Cowie, available at the University Bookstore.

Reference Book: "Introduction to Polymers", by R.J. Young.

The objective of this course is to introduce students to the structure of polymeric materials and their mechanical, electrical and optical properties.

The following lectures will provide the basic knowledge covered by the text book.

Lectures	Topics	Chap. in Text	in R.J. Young
Introduction:	1. Nomenclature and Molecular Architecture	1.1-7	1.1-3
	2. Molar Mass and Degree of Polymerization	1.6	1.4
Synthesis:	3. Step-Growth Polymerization (1)	2.1-3	2.1
	4. Step-Growth Polymerization (2)	2.5-8	2.1
	5. Free Radical Addition Polymerization (1)	3.1-6	2.2
	6. Free Radical Addition Polymerization (2)	3.7-12	2.2
	7. Ionic Polymerization	4.1-2,10	2.3
	8. Copolymerization	5.1-3	2.4
Characterization:	9. Macromolecules in Solution	8.1-3	3.1
	10. Flory-Huggins Theory	8.4-6	3.1
	11. Osmotic Pressure Measurements	8.7,9.7	3.2
	12. Light Scattering Measurements	9.9	3.3
	13. Transport Measurements	9.8, 13	3.4
	14. Gel Permeation Chromatography	8.10, 9.14	3.5
	15. Spectroscopic Analysis of Polymers	10.6-7	3.6
	Mid-Term Test		
Structure:	16. Polymer Crystals	11.1-2	4.1
	17. Semi-crystalline Polymers	11.5-6	4.2
	18. Crystallization and Melting	11.3-4,9	4.3
	19. Amorphous Polymers	11.7-8	4.4
Mechanical:	20. Viscoelasticity (1)	12.1-2	5.1
	21. Viscoelasticity (2)	12.3,13.1-5	5.2
	22. Rubber Elasticity	12.8	5.3
	23. Yield in Polymers	12.13-14	5.4
	24. Deformation Mechanisms	—	5.5
	25. Fracture	—	5.6
Electrical:	26. Conducting Polymers	17.8-11	—
	27. Polymer Electrolytes	—	—
	28. Polymer Liquid Crystals	16.1-2	—
	29. Polymers for Photo-electronic Applications	17.18	—
30.	Course Review		

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. **It is your responsibility to understand what constitutes academic dishonesty.**

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the [Academic Integrity Policy](#), located at <https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/>

The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

AUTHENTICITY/PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor or before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. **All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

COURSES WITH AN ON-LINE ELEMENT

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

ONLINE PROCTORING

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/ software during tests or exams. This software may be required to be installed before the test/exam begins.

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the [Code of Student Rights & Responsibilities](#) (the “Code”). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online**.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students’ access to these platforms.

ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES

Students with disabilities who require academic accommodation must contact [Student Accessibility Services](#) (SAS) at 905-525-9140 ext. 28652 or sas.mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University’s [Academic Accommodation of Students with Disabilities](#) policy.

REQUESTS FOR RELIEF FOR MISSED ACADEMIC TERM WORK

McMaster Student Absence Form (MSAF): In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar “Requests for Relief for Missed Academic Term Work”.

ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the [RISO](#) policy. Students should submit their request to their Faculty Office **normally within 10 working days** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.