MS4621 Selected Topics on Applied Polymer Materials

Academic Year	AY2023-2024	Semester	1
Course Coordinator	Lu Xuehong		
Course Type	MPE/UE/BDE		
Pre-requisites*	MS1014 Materials Chemistry II		
	MS2013 Introduction to Polymer Science		
AU	2		
Grading	Letter Grading		
Contact Hours	26 hrs (lecture 12 h, tutorial 6 h, CA1 2 h, group presentation 4 h, online practice and group project consultation 2 h)		
Proposal Date	1 March 2023		

**Students must pass both MS1014 and MS2013 before registering for MS4621*

Course Aims

This is an advanced-level polymer course. The objectives are to provide Materials Engineering students with specialized knowledge on commonly used engineering polymers and polymerization techniques, and train them how to select suitable polymers for different engineering and functional applications.

Intended Learning Outcomes (ILO)

By the end of this course, students will be able to:

1. differentiate elastomers, thermoplastics & thermosets based on their chemical structures, mechanical properties and processability;
2. identify key structural factors affecting properties of elastomers, thermosets, rigid-chain polymers and rubber-toughened polymer systems, respectively;
3. explain structure-property relationships for the engineering and functional polymers covered in this course;
4. select suitable polymers for common engineering applications based on the structures of the polymers;
5. select polymerisation techniques to obtain polymer products with desired features.

Course Content

No	Topic	Hours
1	Overview of polymer structures and structure-property relationships	**3**
2	Elastomeric network polymers: rubber elasticity theory, structures and properties of typical rubbers and thermoplastic elastomers, application issues including stress relaxation caused by Thirion relaxation & bond exchange, combined effects of temperature and frequency on properties	**3**

3	Rigid thermosetting polymers: structures and properties of epoxy resins including cure reactions, effects of cure and vitrification on properties, concept of vitrimers, structures and properties of unsaturated polyesters and their unique features	**3**
4	Rubber-toughened & ultratough polymers: rubber-toughening mechanisms, rubber-toughened plastics including HIPS, ABS and rubber particle-toughened PMMA, particle-toughend epoxy resins, structures and properties of ultratough UHMWPE and its application issues	**3**
5	Rigid-chain polymers: structures and properties of aromatic polyimides, hyperbranched polyimides, definitions of liquid crystalline phases, classification of liquid crystalline polymers (LCPs), structures and properties of typical thermotropic and lyotropic LCPs	**3**
6	Common polymerization techniques: conventional bulk polymerization, UV-induced stereolithography, suspension polymerization, emulsion polymerization and the mechanism, solution polymerization	**3**
7	CA1 and feedback	**2**
8	Introduction to functional polymers: student group projects & presentations	**6**
	Total	**26**

Assessment (Includes both continuous and summative assessment)

Component	ILO Tested	EAB Graduate Attributes	Weightage	Team / Individual	Rubrics
1. Online practice	1-4	a) Engineering knowledge	5%	Individual	N.A.
2. CA1: Quiz	1-4	a) Engineering knowledge	35%	Individual	N.A.
3. CA2: group project and presentation	3-4	a) Engineering knowledge b) Problem analysis j) Communication l) Life-long learning	Team: 20% Individual: 10%	Team & Individual	Appendix 1
4. Final Examination (1 hr)	1-5	a) Engineering knowledge	30%	Individual	
Total			**100%**		

Readings & References

Joel R. Fried, *Polymer Science and Technology*, 3rd Edition, Prentice Hall, 2014.

Course Policy & Student Responsibility

(1) Online Practice

You are required to complete online practice on due date. You have three attempts. The latest score will be considered in the course assessment.

(2) CA1

All non-attendance must be supported by a medical certificate or other valid official documents. There is a possibility of arrangement of supplementary CA1 (Quiz) in the case of a validated and justified cause. The above doesn't apply to CA2 as it is a group project.

(3) CA2

For the group presentation and subsequent Q&A session, all non-attendance must be supported by a medical certificate or other valid official documents. There is a possibility of arrangement of individual presentation to the examiner and Q&A in the case of a validated and justified cause.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognise your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain about the definitions of any of these terms, you should refer to the Academic Integrity Handbook for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office	Phone	Email
Lu Xuehong	N4.1-01-07	67904585	asxhlu@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course ILO	Readings/Activities
1	Overview of polymer structures and structure-property relationships	1-4	Lectures
2	Elastomeric network polymers	1-4	Lectures & Tutorial 1
3	Rigid thermosetting polymers	1-4	Lectures
4	Rigid-chain polymers	1-4	Lecctures & Tutorial 2
5	Rubber-toughened and ultratough polymers	1-4	Lectures, Online Practice & consultation

6	Common polymerization techniques	5	Lectures & Tutorial 3
7	Topics 1-6	1-4	CA1 & Tutorial 4
8	Topics 1-6	1-4	CA1 feedback
9	Introduction to functional polymers	2-4	Consutation for group project & presentation
10	Introduction to functional polymers	2-4	Student group presentation
11	Introduction to functional polymers	2-4	Student group presentation
12	Topics 1-6	1-5	Summary & consultation