

Annexe A: New/Revised Course Content in OBTL+ Format

Course Overview

The sections shown on this interface are based on the templates [UG OBTL+](#) or [PG OBTL+](#)

If you are revising/duplicating an existing course and do not see the pre-filled contents you expect in the subsequent sections e.g. Course Aims, Intended Learning Outcomes etc. please refer to [Data Transformation Status](#) for more information.

Expected Implementation in Academic Year	AY2025-2026
Semester/Trimester/Others (specify approx. Start/End date)	Semester 1
Course Author * Faculty proposing/revising the course	Dr Zhu Lei
Course Author Email	lxz121@case.edu
Course Title	Polymer Properties & Design
Course Code	MS7480
Academic Units	2
Contact Hours	26
Research Experience Components	

Course Requisites (if applicable)

Pre-requisites	
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	

Course Aims

This course aims to introduce industrially important polymer products (e.g., polyolefins, vinyl polymers, rubbers, polyesters, polyamides, polyurethanes, and epoxy and phenolic thermosets), their properties and design principles, and potential sustainability. The audience should be graduate students in Materials Science, Chemical Engineering, and Chemistry. The knowledge from this course will get them well-prepared for the industrial career and stimulate their creativity in designing better products.

Course's Intended Learning Outcomes (ILOs)

Upon the successful completion of this course, you (student) would be able to:

ILO 1	Understand the industrial synthesis and physical properties of important polymers currently used on the market.
ILO 2	Use the case-study approach to understand the design/working principles of commercial products from these polymers and their potential sustainability (recycling and upcycling).

Course Content

Overview

This course adapts a unique approach to introduce polymer engineering. The emphasis is on correlating polymer structures and architecture with physical properties, which in turn enable the design of various commercial polymer products. Ample examples and case studies will be given from which principles can be drawn concerning molecular design, structure-property relationships and product design rationale of both commodity and engineering polymers. Aspects of polymer circularity and sustainability will also be discussed.

Course Content

1. Introduction

- a. Course instructors
- b. Course structures
- c. Course overview and schedules
- d. Professional ethics practices

2. Polyester products and design

- a. PET families (drink bottles, textiles, multilayer reflection films, film capacitors)
- b. Polycarbonates (shock-proof windows, car parts, medical containers)
- c. Liquid crystalline polymers (5G flexible PCBs, high-performance electronics)
- d. Unsaturated polyesters (the world largest thermoset for all kinds of products)

3. Polyamide products and design

- a. Aliphatic polyamides (daily goods, stocking, brushes, nanocomposites)
- b. Semi-aromatic polyamides (transparent parts, automobile parts)
- c. Aromatic polyamides (firefighter suits and bullet-proof vests)
- d. Polyimides (flexible PCBs)

4. Polyurethane products and design

- a. Polyurethane chemistry
- b. Thermoplastic polyurethane elastomers (Spandex fabrics)
- c. Soft and rigid polyurethane foams (matrices and building insulation)
- d. Polyurethane coatings, adhesives, and sealants

5. Epoxy products and design

- a. Epoxy chemistry
- b. Toughening of epoxy (aerospace adhesives)
- c. Epoxy composites (carbon fiber composites, wind turbine blades, PCBs)
- d. Epoxy coating (floor coating, dry powder coating)

Reading and References (if applicable)

D. Feldman and A. Barbalata, Synthetic Polymers: Technology, Properties, Applications; Chapman & Hall: London, 1996.

Note: The above listing comprises the foundational readings for the course and more up-to-date relevant readings will be provided when they become available.

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Overview and PET-based polyesters	1	N/A	Online	Prerecorded lecture, online consultation
2	PET products, applications, and sustainability	2	N/A	Online	Prerecorded lecture, online consultation
3	Polycarbonates and LCPs	1,2	Lecture notes	Online	Prerecorded lecture, online consultation
4	Unsaturated polyesters	1,2	Lecture notes	Online	Prerecorded lecture, online consultation, Continuous Assessment 1 (CA1): Take-Home Online Quiz 1
5	Aliphatic polyamides	1,2	Lecture notes	Online	Prerecorded lecture, online consultation
6	Semi-aromatic and aromatic polyamides; Polyimides	1,2	Lecture notes	Online	Prerecorded lecture, online consultation

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
7	Epoxy chemistry	1	Lecture notes	Online	Prerecorded lecture, online consultation, Continuous Assessment 2 (CA2): Take-Home Online Quiz 2
8	Curing and toughening of epoxy resins	1	Lecture notes	Online	Prerecorded lecture, online consultation
9	Epoxy-based composite materials	2	Lecture notes	Online	Prerecorded lecture, online consultation
10	Polyurethane chemistry	1	Lecture notes	Online	Prerecorded lecture, online consultation, Continuous Assessment 3 (CA3): Take-Home Online Quiz 3
11	Polyurethane elastomers and processing methods	2	Lecture notes	Online	Prerecorded lecture, online consultation
12	Polyurethane foams: flexible vs. rigid foams	2	Lecture notes	Online	Prerecorded lecture, online consultation
13	Continuous Assessment 4 (CA4): Final Quiz	1,2	N/A	In-person	Continuous Assessment 4 (CA4): Final Quiz

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Blended learning with active use of multi-media resources (TEL)	This will permit flexibility of access to learning materials, activities and assessments and can help you develop independent learning and critical thinking skills. Other TEL components may include online interactions between instructors and students, and among students via NTULearn, etc.
Showing real-world applications	Most of the concepts that are dealt in the course have real-world implications and applications. Therefore, they are used as examples while discussing the related concepts.
Weekly Consultation	Weekly consultation hours will be available to encourage discussions that will reinforce students' understanding on various concepts and applications. Instead of providing answers directly to students' queries, they will be guided to think and make intelligent guesses based on sound principles. This approach will cultivate critical thinking.

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Team/Individual	Rubrics	Level of Understanding
1	Continuous Assessment (CA): Test/Quiz(Continuous Assessment 1 (CA1): Take-Home Online Quiz 1)	1- 2		15	Individual	Holistic	Multistructural
2	Continuous Assessment (CA): Test/Quiz(Continuous Assessment 2 (CA2): Take-Home Online Quiz 2)	1- 2		15	Individual	Holistic	Multistructural
3	Continuous Assessment (CA): Test/Quiz(Continuous Assessment 3 (CA3): Take-Home Online Quiz 3)	1- 2		15	Individual	Holistic	Multistructural
4	Continuous Assessment (CA): Test/Quiz(Continuous Assessment 4 (CA4): Final Quiz)	1- 2		55	Individual	Holistic	Multistructural

Description of Assessment Components (if applicable)

Continuous Assessment 1/2/3 (CA1/2/3): Take-Home Online Quizzes 1/2/3

Students will be assigned a take-home online quiz on teaching weeks 4, 7, and 10 (total 3 sets). Students will be given a 24-hour time frame to complete each quiz. Each take-home online quiz will consist of 15 MCQ questions.

Continuous Assessment 4 (CA4): Final Quiz

A final in-person quiz will be conducted at the end of the semester on teaching week 13. The final quiz will be conducted in open book format and consist of 35 MCQ questions.

Formative Feedback

Feedback is central to this course. Students will receive their grades after each CA. Students are also highly encouraged to attend the course instructor's consultation sessions to clarify any doubts in the lecture and discuss any issues if needed.

NTU Graduate Attributes/Competency Mapping

This course intends to develop the following graduate attributes and competencies (maximum 5 most relevant)

Attributes/Competency	Level
Care for Environment	Intermediate
Creative Thinking	Intermediate
Curiosity	Advanced
Transdisciplinarity	Intermediate
Design Thinking	Intermediate

Course Policy

Policy (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 recognize 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 of the definitions of any of these terms, you should go to the academic integrity website for more information. On the use of technological tools (such as Generative AI tools), different courses / assignments have different intended learning outcomes. Students should refer to the specific assignment instructions on their use and requirements and/or consult your instructors on how you can use these tools to help your learning. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Policy (General)

You are expected to complete all assigned readings, activities, assignments, attend all classes punctually and complete all scheduled assignments by due dates. You are expected to take responsibility to follow up with assignments and course related announcements. You are expected to participate in all project critiques, class discussions and activities.

Policy (Absenteeism)

In-class activities make up a significant portion of your course grade. Absence from class without a valid reason will affect your participation grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies. There will be no make-up opportunities for in-class activities.

Policy (Others, if applicable)

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