

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

Course Overview

Expected Implementation in Academic Year (New format)	AY2026-2027
Semester/Trimester/Others (specify approx. Start/End date)	Semester 1
Course Author * Faculty proposing/revising the course	Assoc Prof Aravind Dasari
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Course Title	Polymer Combustion & Flammability
Course Code	MS6025
Academic Units	3
Contact Hours	39
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 experiential module serves to introduce students to fundamentals of polymer combustion and flammability including thermochemical concepts such as thermal degradation pathways, ignition, flame spread, pyrolysis, heat feedback, and char formation.

The students will be spending time in the laboratory to connect the theoretical knowledge with practical aspects of testing and analyzing the thermal and flammability properties of polymers. They are expected to develop critical thinking by comparing experimental results with literature expectations, industrial standards, and case studies.

Understanding polymer combustion and flammability opens pathways for you to key industry sectors like building and construction, transportation where fire-response and life-safety plays a critical role. If you are interested to work in an relevant industry, this course is for you.

Course's Intended Learning Outcomes (ILOs)

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

ILO 1	Describe the different ways polymers undergo degradation
ILO 2	Explain the fundamental principles of combustion, ignition, and flame propagation in polymeric materials
ILO 3	Evaluate different fire retardant strategies and their effectiveness in reducing flammability
ILO 4	Perform experiments and analyze the length-scale effects observed in polymeric materials when milligram-scale (thermogravimetric), materials-scale, and bench-scale fire tests are used.
ILO 5	Discuss the importance of the tests carried out in the laboratory, and correlate to real-world fire scenarios involving materials through case studies
ILO 6	Understand the laboratory and safe working protocols; improve skills required for scientific problem solving by establishing the problem, formulating the hypothesis, recording the observations, and interpreting/analyzing the experimental data in a comprehensive manner.
ILO 7	Experience team learning and responsibility to complete tasks, along with effectively communicating the data in writing form.

Course Content

- Introduction and applications that demand environmental durability and thermal stability of polymers
- Environmental degradation in polymers and associated mechanisms
- Importance of durability of materials
- Importance of different thermophysical properties
- Polymer combustion and flammability
- Experiential learning (polymer degradation and flammability properties)

Reading and References (if applicable)

There are plenty of textbooks, reference chapters and peer-reviewed articles available on this field. Explore the library and library databases! Some key books are listed below for you to get going.

- Handbook of UV Degradation and Stabilization, George Wypych, ChemTec Publishing, 2010, ISBN-13: 978-1895198461, ISBN-13: 978-1895198461
- Degradable Polymers: Principles and Applications, G. Scott, Kluwer Academic Publishers, ISBN-13: 978-9048160914
- Engineering Heat Transfer, 3rd Edition, William S Janna, CRC press, 2009
- Heat and Mass Transfer: Fundamentals and Applications, YA Cengel and AJ Ghajar, McGraw Hill, 2011 (Chapters 1 and 2).
- Fire Retardancy of Polymeric Materials, Charles A. Wilkie, Alexander B. Morgan (Ed.), CRC Press, 2009, ISBN: 1420084003

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	Delivery Mode	Activities	Readings
1	Introduction and overview of the course	1-5	In-person	Class lecture and interactions, case study discussion	See the listed text books and course slides
2	Environmental durability, degradation and consequences of polymers	1	Online	Online learning	See the listed text books and course slides
3	Flammability and combustion of polymeric materials -1	2-5	In-person	Lecture and discussions (in-person)	See the listed text books and course slides
4	Flammability and combustion of polymeric materials -2	2-5	In-person	Second Case study discussion (in-person)	See the listed text books and course slides
5	Flammability and combustion of polymeric materials -3	2-5	In-person	Class discussions	See the listed text books and course slides
6	Experiential work	6, 7	In-person	Training on equipment and going through the different experiments* *Each group of students will be spending two weeks of lecture hours in the laboratory. There will be another one week for the report submission based on the performed laboratory experiments.	See the listed text books and course slides
7	Experiential work	6, 7	In-person	Training on equipment and going through the different experiments*	See the listed text books and course slides
8	Experiential work	6, 7	In-person	Training on equipment and going through the different experiments*	See the listed text books and course slides
9	Experiential work	6, 7	In-person	Training on equipment and going through the different experiments*	See the listed text books and course slides
10	Experiential work	6, 7	In-person	Training on equipment and going through the different experiments*	See the listed text books and course slides
11	Experiential work	6, 7	In-person	Training on equipment and going through the different experiments*	See the listed text books and course slides

Week or Session	Topics or Themes	ILO	Delivery Mode	Activities	Readings
12	Continuous Assessment (CA)	1-5	In-person	Continuous Assessment (CA)	N/A
13	Discussion of experiments and CA	1-7	In-person	Discussion of experiments and CA	N/A

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Conceptual understanding	This course highlights the fundamental understanding of degradation of polymeric materials with particular emphasis on thermal degradation, combustion and flammability of polymeric materials. This conceptual understanding is expected to help in evaluating the service-life of materials. Students are encouraged to refer different books and literature while exploring case studies.
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.
Face-to-face discussion sessions	To complement some online lecture videos, face-to-face discussion sessions and lectures are also arranged that are designed to check and reinforce the students' understanding of various concepts. The discussion sessions will further clarify important concepts/principles covered in lectures, and cultivate critical thinking.
Case study discussions	Three different case studies will be discussed (physical sessions) to connect the concepts discussed in the course to practicality
Experiential Learning	This part of the course will compliment and reinforce the theoretical knowledge of students.

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Description of Assessment Component	Team/Individual	Rubrics	Level of Understanding
1	Continuous Assessment (CA): Test/Quiz(Conceptual understanding of the topics)	1 to 5		10	This assessment includes online questions after certain lecture topics. The format of the questions varies between MCQs, problems, etc.	Individual	Holistic	Multistructural
2	Continuous Assessment (CA): Test/Quiz(Continuous Assessment (CA))	1 to 5		25	This is an in-person assessment. This will contain short answer questions, problems and critique/analysis based questions.	Individual	Holistic	Multistructural
3	Continuous Assessment (CA): Test/Quiz(Experiential Work: Online assessment (demonstration videos and associated questions))	6, 7		10	These are videos associated with description of the principles behind the different equipment the students will be using. The videos will also briefly highlight the procedures that will be followed. The questions will be based on principles behind equipment to test the students' understanding.	Individual	Holistic	Multistructural

No.	Component	ILO	Related PLO or Accreditation	Weightage	Description of Assessment Component	Team/Individual	Rubrics	Level of Understanding
4	Continuous Assessment (CA): Class Participation(Experiential Work: Technical staff assessment)	6, 7, supplemented by 1-5		10	This is based on laboratory etiquette of the students and determined by TAs and TEs. Individual (5%), Team (5%)	Individual and Team	Holistic	Relational
5	Continuous Assessment (CA): Project(Experiential Work: Peer-review)	7		10	This is an important aspect of collaborative learning and this component assessed through perceptive tool will check on the level of professionalism, preparedness and collaboration among the students.	Individual	Holistic	Relational
6	Continuous Assessment (CA): Report/Case study(Experiential Work: Report)	6, 7 supplemented by 1-5		35	The report expected to contain a detailed analysis of the experiments performed, observations and analysis along with the students' reflection.	Individual	Holistic	Multistructural

Description of Assessment Components (if applicable)

Formative Feedback

- Class room discussions will facilitate formative feedback on any of the concepts or questions that students might have regarding the topics that were discussed.
- CA formative feedback will be provided through verbal sharing on common mistakes.
- After going through the equipment demonstration videos, students are highly encouraged to visit the laboratories to see the equipment and talk to the laboratory technicians.
- General feedback for your performance in final reports will also be provided after the results are released

NTU Graduate Attributes/Competency Mapping

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

Attributes/Competency	Level
Collaboration	Intermediate
Communication	Advanced
Problem Solving	Intermediate
Information Literacy	Intermediate
Critical 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 and experiential activities will support your learning. Absence from classes or activities without a valid reason may affect your 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, but one make-up opportunity will be provided for laboratory-based activities.

Policy (Others, if applicable)

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