

MSE-430

**Life cycle engineering of polymers**

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| Cursus                            | Sem.     | Type |
|-----------------------------------|----------|------|
| Materials Science and Engineering | MA1, MA3 | Opt. |

|                      |                     |
|----------------------|---------------------|
| Language of teaching | English             |
| Credits              | 2                   |
| Session              | Winter              |
| Semester             | Fall                |
| Exam                 | During the semester |
| Workload             | 60h                 |
| Weeks                | 14                  |
| Hours                | <b>2 weekly</b>     |
| Courses              | 2 weekly            |
| Number of positions  |                     |

**Summary**

Students understand what life cycle engineering is and apply this methodology to adapt and improve the durability of polymer-based products. They understand how to recycle these materials and are able to perform an environmental assessment, based on several practical case studies.

**Content****Introduction to life cycle engineering and sustainable development**

- Resources, material intensity and durability

**Durability of polymers**

- Phenomenology of time-dependent polymer properties
- Aging and degradation of polymers
- Stabilization and protection of polymers
- Accelerated aging methods and long term property prediction
- Case study of an automotive component
- Non-destructive testing and health monitoring
- Self-repair polymers

**Recycling of polymers**

- Collection, identification and recycling methods
- Case study: closed-loop recycling of composites
- Group work: recycling of pharmaceutical packaging

**Life cycle assessment and design**

- Methods and examples
- Case study: natural fibers vs glass fibers reinforced composites
- Group work: life cycle engineering of an industrial component

**Learning Prerequisites****Recommended courses**

Polymers, structure and properties  
Polymer processing

**Learning Outcomes**

By the end of the course, the student must be able to:

- Model Define and calculate the material intensity

- Formulate Define and explain the time-temperature equivalences for polymers
- Describe Explain the principles of health monitoring and self-repair materials
- Model Predict the lifetime of a polymer part
- Develop Design a recycling process for polymers and composites
- Design Design a polymer-based part to reduce its environmental impact

### Transversal skills

- Set objectives and design an action plan to reach those objectives.
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.
- Access and evaluate appropriate sources of information.
- Write a scientific or technical report.
- Make an oral presentation.

### Teaching methods

Ex-cathedra with group work

### Expected student activities

- Participate to the course and to the case studies
- Realize a group project on a selected topic (for example, accelerated aging, material intensity of an automotive component, etc.)

### Assessment methods

The examination is in the form of a group project, which is evaluated with a "1 slide" oral presentation in english in the class and a written report in english. The final grade is the average of the following 5 grades :

1. Quality of the report (spelling, quality of the figures)
2. Bibliography (relevance of the information; all sources MUST be cited!)
3. Case study (data quality and novelty)
4. Synthesis and conclusions of the project
5. Quality of the 1-slide presentation (clarity, content and timing)

### Resources

#### Bibliography

Lundquist L., Leterrier Y., Sunderland P.W., Manson J.-A.E., *Life Cycle Engineering of Plastics. Technology, Economy and the Environment*, Elsevier, Oxford (2000).

#### Ressources en bibliothèque

- [Life Cycle Engineering of Plastics / Lundquist](#)

#### Notes/Handbook

A course 'polycopié' is available (latest edition 2013)

#### Moodle Link

- <http://moodle.epfl.ch/course/view.php?id=14546>