GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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|---|---|---|---|
| Subject name and code | Technological and functional properties of plastics, PG_00060799 | | |
| Field of study | Chemical Technology | | |
| Date of commencement of studies | October 2026 | Academic year of realisation of subject | 2028/2029 |
| Education level | first-cycle studies | Subject group | Optional subject group<br>Subject group related to scientific research in the field of study |
| Mode of study | Full-time studies | Mode of delivery | at the university |
| Year of study | 3 | Language of instruction | Polish |
| Semester of study | 6 | ECTS credits | 2.0 |
| Learning profile | general academic profile | Assessment form | exam |
| Conducting unit | Department of Polymer Technology -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr hab. inż. Justyna Kucińska-Lipka | |
| | Teachers | | |

**Lesson types**

| Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|
| Number of study hours | 15.0 | 0.0 | 15.0 | 0.0 | 0.0 | 30 |

E-learning hours included: 0.0

**Learning activity and number of study hours**

| Learning activity | Participation in didactic classes included in study plan | Participation in consultation hours | Self-study | SUM |
|---|---|---|---|---|
| Number of study hours | 30 | 2.0 | 18.0 | 50 |

**Subject objectives**

The aim of the course is to acquaint the student with the basic study of the physical, chemical , technological and functional properties of polymers.

**Learning outcomes**

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| [K6_K02] is aware of the responsibility for his/her work and is ready to work in a team and share responsibility for common tasks. | is prepared to collaborate effectively within a laboratory team and to carry out assigned tasks in a responsible and professional manner. | [SK1] Assessment of group work skills<br>[SK3] Assessment of ability to organize work |
| [K6_W02] Possesses the chemical knowledge necessary to synthesize, analyze and evaluate the properties of compounds and processes used in chemical technology. | lists and describes the technological and functional properties of polymers, as well as the basic methods of polymer processing. The student has the knowledge to describe how laboratory and measuring equipment used to characterize the properties of plastics works. | [SW1] Assessment of factual knowledge |
| [K6_U02] Performs design calculations of technological processes, selects industrial equipment, operates laboratory equipment and conducts material analyses | is able to operate laboratory and measuring equipment for characterizing the properties of plastics. | [SU1] Assessment of task fulfilment<br>[SU4] Assessment of ability to use methods and tools |

**Subject contents**

Course content – lecture

- Introduction (types of properties of polymeric materials, their nature and specificity in relation to low-molecular-weight materials)
- Determination of molecular weights and their distribution (fractionation methods, end-group analysis, vapor and membrane osmometry, light scattering, sedimentation, viscometry, gel permeation chromatography)
- Test methods and apparatus for determining the physicomechanical properties of various polymer varieties (thermoplastics, elastomers, thin films, foams): static and dynamic tensile, compression, and bending tests, hardness, abrasion resistance, impact strength, density
- Characterization of the supramolecular structures of polymers (thermal, X-ray, and microscopic methods)
- Apparatus and methods for testing the thermal properties of polymers (thermophysical and thermomechanical stability of polymers, determination of polymer flammability)
- Polymer test methods for specific non-standard applications (biodegradability, sterility, and other tests).

Course content – laboratory

- Thermal Analysis of Plastics
- Studying the Crystallization Kinetics of Polymers
- Determination of Average Molecular Weights and Dispersion Coefficients: Gel Permeation Chromatography
- Static Tensile Testing Morphology of Polymers and Composites: Scanning Electron Microscopy

**Prerequisites and co-requisites**

**Assessment methods and criteria**

| Subject passing criteria | Passing threshold | Percentage of the final grade |
|---|---|---|
| Laboratory (entry tests, reports activity) | 60.0% | 40.0% |
| Lecture (written exam) | 60.0% | 60.0% |

**Recommended reading**

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|---|---|
| Basic literature | • J.F. Rabek: Współczesna wiedza o polimerach. Tom 1: Budowa strukturalna polimerów i materiały badawcze, PWN, Warszawa 2017<br>• J.F. Rabek: Współczesna wiedza o polimerach. Tom 2: Polimery naturalne i syntetyczne, otrzymywanie i zastosowania, PWN, Warszawa 2017<br>• G.W. Ehrenstein, Ż. Brocka-Krzemińska: Materiały polimerowe: Struktura, właściwości, zastosowanie, PWN, Warszawa 2016 |
| Supplementary literature | Standards for testing of physical, chemical and mechanical properties of plastics (ASTM, DIN, ISO) |
| eResources addresses | |

**Example issues/ example questions/ tasks being completed**

- Show graphically the molecular weight distribution for monodisperse and polydisperse polymers (with a wide and narrow molecular weight distribution). Draw on one of the selected curves the approximate location of the Mn i Mw.
- How can the molecular weight of polymers be determined based on osmometric studies.
- Characterize the method for determining the molecular mass of polymers based on the GPC technique (Gel permeation chromatography).
- Present the characteristics of the curve stress vs. elongation for the tensile test of any chosen material. Present on this curve what parameters can be determined in the subsequent stages of the tensile test.
- Describe any chosen method of testing the susceptibility of polymer materials to the cracks (the so-called brittleness of the material).
- Amorphous and crystalline polymer: how they differ, how to determine the degree of crystallinity of crystalline polymers.
- Characterization of thermal properties of polymers and their connection with plastics processing.
- Present the difference in the operation works of the extruder and injection molding machine. Replace 3 products that can be produced by injection molding and extrusion.
- Based on the selected physical, chemical and functional properties, determine what type of material may have such properties.
- For the indicated type of polymer, list physical, chemical, functional, processing and manufacturing properties as well as the scope of application.

**Practical activites within the subject**

Not applicable