



**University of Miskolc**  
**Faculty of Materials Science and Engineering**  
**Antal Kerpely Doctoral School of Materials Science**  
**and Technology**



# Physics of Polymers

Dr. Marossy Kálmán

**PROGRAM DESCRIPTION**

2016.  
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## Lecturer

Dr. Marossy Kálmán, professor, Institute of Ceramics and Polymer Engineering

room: B1 Bldg. 215. mail: [polkal01@uni-miskolc.hu](mailto:polkal01@uni-miskolc.hu), phone: 1645 (internal), +36 30 289 8107 (cell),

## Recommended for

Course is recommended for all students of the Antal Kerpely Doctoral School, especially for the ones working in the field of polymers.

## Language

Hungarian or English.

## Aim

The Lectures goal is to show the specific physical properties of polymeric materials and to provide an approach based on physical properties towards polymers/plastics.

## Methodology

Consultations carried out in smaller groups of 1-3. The topics will be discussed during the consultations. Discussions of case studies, using different techniques (DSC, DMA, TSD, pendulum impact tester, etc...) practice is also carried out.

## Thematics

Chemical and microscopic structure of polymers. Polymer types. Copolymers. Molecular weight (averages), molecular weight distributions. Spatial structures. Crystallinity of Polymers. Mobility, flexibility of polymer chains. Relaxation time. Elastic states. Polymers in static and oscillating mechanical fields. Behaviour at small and large deformations. Frequency and temperature dependence of the mechanical properties. Testing techniques. Polymers in static and oscillating electric fields. Electric conduction and polarization. Frequency and temperature dependence of the electrical properties., testing techniques. Optical properties. Thermal properties of polymers, measurement techniques. Melt rheology. Plasticizing. Polymer

blends. Thermodynamical basics of miscibility. Application of polymer mixtures, blends, fracture resistant (tough) plastics.

### Recommended literature

- Osswald, T.A.-Menges, G.: Materials Science of Polymers for Engineers. Hanser München-Wien (1992)
- Bodor G.: A polimerek szerkezete. Műszaki Könyvkiadó, Budapest (1982)
- Havriliak, S.- Havriliak, S.J.: Dielectric and Mechanical relaxation in Materials. Hanser München-Wien (1977)
- Hedvig P.: Elektromos vezetés és polarizáció műanyagokban. Akadémiai Kiadó, Budapest (1969), Hedvig, P.: Dielectric Spectroscopy of Polymers. Hilger Bristol (1977)
- Kämpf, G.: Characterization of Plastics by Physical Methods. Hanser München-Wien (1986)
- Rodriguez, F.: Principles of Polymer Systems. McGraw Hill (1982, 1987)
- Halász L.-Zrínyi M.: Bevezetés a polimerfizikába. Műszaki Könyvkiadó, Budapest (1989)
- Recent literature articles

### Completion, Grading

Oral examination.

### Complex Examination Questions

1. Define molecular weight, degree of polymerization! Explain polydispersity and its importance for the applicability of polymers.
2. Explain the crystallinity of polymers, show the requirements of forming crystalline structures! Introduce testing methods to evaluate crystalline contents.
3. What is the relaxation of polymers? Explain how relaxation processes affect the physical properties of polymers! Show the correlation between the mechanical, electrical and thermal behaviors?
4. Define the miscibility of polymers with additives and other polymers, show the thermo dynamical requirements of compatibility! What is the practical importance of polymer mixtures?
5. Co-polymers and macromolecules not classified as polymers. What techniques can be used to examine their structure?