УНИВЕРЗИТЕТ У БАЊОЈ ЛУЦИ
UNIVERSITY OF BANJA LUKA
ПРИРОДНО-МАТЕМАТИЧКИ ФАКУЛТЕТ
FACULTY OF NATURAL SCIENCES AND MATHEMATICS

CHEMISTRY DEPARTMENT | PhD STUDIES

Course name	Selected Polymer Materials for Advanced Application			
Course code	**Course status**	**Semester**	**Hours of instruction**	**ECTS**
DHEM23OPM	**elective**	**II or IV**	**5+0**	**10**
Teacher(s)	**Prof. Milica Balaban, PhD**			

Prerequisite course(s)	**Entry requirements**
none	**/**

Course goals

The aim of learning the subject is to recognize the importance of new and modified polymer materials of interest in the modern technological environment, the use of renewable resources in the synthesis of commercial polymer products, as well as to master advanced synthesis and characterization techniques.

Learning outcomes

The student recognizes and systematizes different types of advanced and modified polymers based on different criteria. The student predicts the mechanical and functional properties of a given polymer based on its structure. The student applies various methods of synthesis and modification to obtain polymers, copolymers, and mixtures and performs basic characterization, independently and in teamwork.

Course content

Depending on the topic of the doctoral dissertation and interest, the student can choose one of the selected topics:

• **Cross-linked polymers**: Polyesters, unsaturated polyesters and alkyds, phenolic polymers: resol phenols, novolac phenols, aminoplastics, epoxy resins, polyurethanes, polysiloxanes, polysulphides. Chemical and physical networks. Intermolecular and intramolecular cross-linking. Monomer functionality (f). Networking density. Gelation and swelling index. The main chemical routes for the synthesis of polymer networks. Gradual polymerization. Vulcanization. Characterization of polymer networks and gels. Theory and mathematical modeling of networking. Properties of cross-linked polymers. Rheology and curing process of cross-linked polymers. Phase separation and two-phase morphology in thermoplastically modified cross-linked polymers.

• **Synthetic biodegradable polymers.** Aliphatic polyesters (PGA, PLA and their copolymers, polybutylene succinate (PBS), polybutylene succinate adipate (PBSA), poly(vinyl alcohol) (PVOH), poly(vinyl acetate) (PVA), poly(ε-caprolactone) (PCL). Polyesters, polyamides, polyurethanes, polyanhydrides.

• **Biodegradable polymers from renewable sources**. Polysaccharides, Polypeptides, Poly(lactic acid and poly(lactides) (PLA), Poly(glycolic acid (PGA). Derivatives and copolymers.

• **Factors affecting biodegradation** - structure, morphology, molecular weight, radiation, and chemical treatments. Mechanism of biodegradation. Techniques for studying biodegradation. Rate of degradation. Mechanical properties of biodegradable polymers. Application of biodegradable polymers in medicine and agriculture, packaging.

Polymers for energy applications in energy storage and conversion.

Teaching methods

Lectures, seminars, consultation, experimental work

Books and other learning materials

Odian, G. (2004). *Principles of polymerization*. John Wiley & Sons.

Hernández-Ortiz, J. C., & Vivaldo-Lima, E. (2013). Crosslinking. Handbook of Polymer Synthesis, Characterization, and Processing, 187–204. doi: 10.1002/9781118480793.ch9.

Biodegradable Polymers: Recent Developments and New Perspectives, Ed. Geraldine Rohman, 05/**2017**: IAPC Publishing ISBN: 978-953-56942-5-0

Ganachari, S.V. **(2019).** Polymers for Energy Applications. In: Martínez, L., Kharissova, O., Kharisov, B. (eds) Handbook of Ecomaterials. Springer, Cham. https://doi.org/10.1007/978-3-319-68255-6_194 . Review and original papers from databases.

Course activities and grading method

Individual project, Final exam

Presentation of project	**40**	**Final exam**	**60**

Additional course notes

Name of the teacher who prepared this form	**Milica Balaban**