

<b>Course: Formulation engineering</b>		
<b>Language: English</b>		
<b>Lecturer:</b> Prof. Mirela Leskovac; Prof. Sanja Lučić Blagojević		
<b>TEACHING</b>	<b>WEEKLY</b>	<b>SEMESTER</b>
<b>Lectures</b>	<b>2</b>	<b>30</b>
<b>Laboratory</b>	<b>-</b>	<b>-</b>
<b>Seminar</b>	<b>1</b>	<b>15</b>
		<b>Overall: 45</b>
		<b>ECTS: 5</b>

**PURPOSE:**

To introduce students with principles and application of product engineering with the aim of formulation and designing of products with desired application properties according market demands. This can be achieved by synthesis of new knowledge about product engineering methods and by application of generic knowledge about materials and processes in design of products with added value through integration of industrial design, engineering, production and marketing.

**THE CONTENTS OF THE COURSE:**

**P (1-3): Product engineering and design.** Paradigms of chemical engineering. The concept and methodology of product design: needs, ideas, selection, production process. Integration design of chemical processes and product homogeneous and structured products. The connection function properties, processes and applications. Pyramid chemical product. Quality factors of product. Systematization of formulation of the product. Multilevel approach in product development. Integration of product and process engineering. Key tasks in chemical product engineering. The path to the prototype product.

**1<sup>st</sup> partial exam**

**Field work (1 day):** Analysis of production in selected industry.

**P (4-6): Surfaces and interfaces phenomena and selected processes in the formulation engineering.** Surface and interface. Compatibility. Effective adhesion at the interface and optimization of properties. Multiphase colloidal systems. Important processes of separation in product engineering: dissolution, extraction, re-crystallization, adsorption. Models and parameter for miscibility estimation of the components in the formulation.

**P (7): The rheology of complex fluids and the product as function of formulation engineering.** Rheological models. Effects of rheological parameters in product engineering. The application of rheometrical techniques in quality control and product formulations. Dependences and application of rheological properties of selected products.

**2<sup>nd</sup> partial exam**

**Field work (1 day):** Analysis of production in selected industry.

**P (8-10): Formulations and properties of liquids as function of product engineering.** Properties and production of dispersions, suspensions, emulsions, microemulsions, pastes, heterogeneous mixture. Stability of emulsions, suspensions and dispersions.

**P (11): The formulations and properties of the solid as function of product engineering.** Properties and stabilization of foams. The solid formulations of powders, agglomerates, granules and microcapsules.

**P (12-13): The functional properties of the product.** Detergents. Pharmaceutical. Pigments and dyes. Cosmetic products. Agro-products. Food. Applying the methodology of product engineering for the product with added value. Multileveled approach. Reaching new functionality in the product. Quality Factors. Physical features. The function of the product application.

### **3<sup>rd</sup> partial exam**

**S (14-15): Seminar / Project assignment for students: a case study.** Analysis of the concept according to the defined objectives. The path to the prototype product.

### **GENERAL AND SPECIFIC COMPETENCE:**

General competencies of students extend by exploration and application of product engineering and design in new product development, as a new paradigm of chemical engineering, as well as by integration of market needs and manufacturing functions in the creation of a new product.

Specific competencies related to the introduction of tools and methods in product engineering and industrial design, in development and in formulation process of a new product by integration and application of already acquired specific generic knowledge that should be applied in the realization of a new product added value.

### **KNOWLEDGE TESTING AND EVALUATION:**

Partial exams; written / oral exam.

### **MONITORING OF THE COURSE QUALITY AND SUCCESSFULNESS:**

Student questionnaire.

### **LITERATURE:**

1. V. Kovačević, M. Leskovac, S. Lučić Blagojević, Produktno inženjerstvo i dizajn proizvoda, interna skripta, 2010.
2. H. Mollet, A. Grubenmann, Formulation Technology: Emulsions, Suspensions, Solid Forms, Wiley-VCH, 2001.
3. K.T. Ulrich, S.D. Eppinger, Product Design and Development, McGraw-Hill International EDITION, 2008.
4. W.D. Seider, J.D. Seader, D.R. Lewin, S. Widagdo, Product and Process Design Principles, John Wiley & Sons, 2009.
5. E.L. Cussler, G.D. Moggridge, Chemical Product Design, Cambridge University Press, 2001.
6. I. Benedek, Pressure-Sensitive Formulation, VSP, 2000.