

## RTU Course "Polymer Composite Materials and Technologies"

32000 Faculty of Natural Sciences and Technology

### General data

Code	KPI761
Course title	Polymer Composite Materials and Technologies
Course status in the programme	Compulsory/Courses of Limited Choice; Courses of Free Choice
Responsible instructor	Remo Merijs-Meri
Academic staff	Jānis Kajaks Agnese Ābele
Volume of the course: parts and credits points	1 part, 4.5 credits
Language of instruction	LV, EN
Annotation	The study course provides the student with opportunities to acquire skills and competencies in the technologies of obtaining and processing polymer composites, as well as the structure and properties of polymer composites. The student is familiar with the classification of polymer blends and composites, will acquire practical skills in obtaining and processing polymer composites and blends, as well as the main methods for determining the structure and properties. The student will gain competence in the production of existing polymer composites and in the development of new polymer composites for a specific application.
Goals and objectives of the course in terms of competences and skills	The aim of the study course is to provide basic theoretical knowledge and practical skills for the development of polymer composites and blends for a specific application, increasing the student's competence for successful work in the field. The tasks of the study course are to provide skills and competencies about the regularities of the structure of polymer composites and blends, to develop skills to apply suitable technologies of polymer composites and blends production and processing, as well as characterization methods.
Structure and tasks of independent studies	Independent studies of scholar, technical and scientific literature, preparation for presentation and discussions. Preparation for laboratory assignments, using lectures, and independently acquired knowledge. Processing, design, and presentation of experimental results of laboratory works. Development of a literature review/course work on the field of production/processing of certain polymer composites.
Recommended literature	Obligatā/Obligatory: 1.W. D. Callister, Jr. Materials Science and Engineering, J. Wiley & Sons, 2015, 905 pp. 2.M. F. Ashby. Engineering materials 2, Elsevier/Butterworth-Heinemann, 2013, 553 pp. 3.T. A. Osswald, Understanding Polymer Processing, Hanser Publications, 2017, 362 pp. 1.Rudin, P. Choi, The elements of polymer science and engineering, Academic Press, an imprint of Elsevier, 2013, 563. Papildu/Additional: 1.Polymer Blends Handbook, Eds. L. A. Utracki, C. Wilkie, Springer, Netherlands, 2014, 2378 pp. 2.D. Hull, T. W. Clyne. An Introduction to Composite Materials, Cambridge University Press, 2012, 360 pp. 3.G. Murray, Ch. V. White, W. Weise. Introduction to Engineering Materials, CRC Press, 2007, 544 pp. 4.J. F. Shackelford. Introduction to Materials Science, Prentice-Hall, 4th Ed., 1996, 670 pp. 5.P. A. Thornton, V. J. Colangelo. Fundamentals of Engineering Materials, Prentice-Hall, 1985, 679 pp. 6.B. D. Agarwal, L. J. Broutman. Analysis and Performance of Fiber Composites, J. Wiley & Sons, 1980, 355 pp. 7.Handbook of Fillers and Reinforcements for Plastics, Ed. H. S. Katz, J. V. Milewski. Van Nostrand Reinhold Company, 1978, 652 pp. 8.P. K. Malick, S. Newman. Composite Materials Technology, Hanser Publishers, 1990, 400 pp. 9.T. Richardson. Composites. A Design Guide, Industrial Press, 1987, 343 pp. 10.L. A. Utracki. Polymer Alloys and Blends, Hanser Publishers, 1990, 356 pp. 115. 11.Композиционные материалы. Справочник. Под ред. Д.М. Карпиноса. Наукова Думка, 1985, 592 стр. 12.Полимерные смеси. В 2-х томах, Ред. Д. Пол, С. Ньюмен. Мир, 1981, 547 стр.+453 стр.
Course prerequisites	Basic knowledge in polymer physics and chemistry.

### Course contents

Content	Full- and part-time intramural studies		Part time extramural studies	
	Contact Hours	Indep. work	Contact Hours	Indep. work
Definition, structure, classification, history of polymer composite materials and mixtures.	2	0	0	0
Basic principles of design of polymer composite materials and mixtures.	2	2	0	0
Types of thermoplastic polymer matrices: synthesis, processing, basic properties.	2	2	0	0
Types of thermosetting polymer matrices: synthesis, processing, basic properties.	2	2	0	0
Regular fillers used in polymer composites: classification, extraction, basic properties.	2	2	0	0
Short fibres used in polymer composites: classification, production, basic properties.	2	2	0	0
Continuous fibres used in polymer composites: classification, extraction, basic properties.	2	2	0	0

Additives in the manufacture of polymer composites.	2	2	0	0
Processing of thermoplastic matrix polymer composites.	2	2	0	0
Processing of thermosetting matrix polymer composites.	2	2	0	0
Structures and properties of polymer composites (density, rheological, mass transfer, mechanical, thermal, electrical, magnetic, etc. properties).	4	4	0	0
Quality aspects and applications of thermoplastic matrix polymer composites.	4	4	0	0
Quality aspects and applications of thermoset composites.	4	4	0	0
Laboratory assignment on practical production of thermoplastic polymer composite / blend.	4	4	0	0
Laboratory assignment on the practical production of thermoset polymer composite.	4	4	0	0
Laboratory assignment on characterization of polymer composite / blend properties.	4	4	0	0
Presentation of a literature review/course work on a specific topic.	4	10	0	0
Tutorials.	8	0	0	0
Exam.	4	8	0	0
<b>Total:</b>	<b>60</b>	<b>60</b>	<b>0</b>	<b>0</b>

### ***Learning outcomes and assessment***

Learning outcomes	Assessment methods
Knows the types of polymer composites and blends, their structural aspects, chemical, and physical properties, as well as their technological solutions for obtaining and processing, application possibilities.	Type of examination: exam. Criteria: the student is able to define the types of polymer composites/blends according to the differences in their structure and properties, knows their basic manufacturing and processing technologies, as well as characterization methods.
Is able to evaluate available information sources, analyse scientific and technical literature.	Type of examination: laboratory assignments, literature review / course work. Criteria: the student is able to summarize the information available in the literature, is able to prepare a presentation of the summary and answer questions and ask questions about the work of classmates.
Knows the technologies of production and processing of composite materials/blends in production, methods of composite materials quality assessment, and is able to apply individual technologies/methods in practice.	Type of examination: exam, laboratory assignments. Criteria: the student knows the theoretical foundations of the basic technologies of production and processing of polymer composites and is able to use certain technologies to obtain certain polymer composites for a specific application.
Knows the types of composite materials/blends in production and their applications.	Type of examination: exam, literature review / course work. Criteria: the student is able to justify the choice for a specific application to use one of the polymer composite materials available in the market.

### ***Evaluation criteria of study results***

Criterion	%
Exam	50
Laboratory assignments	20
Literature review/Course work	30
<b>Total:</b>	<b>100</b>

### ***Study subject structure***

Part	CP	Hours			Tests			Tests (free choice)		
		Lectures	Practical	Lab.	Test	Exam	Work	Test	Exam	Work
1.	4.5	2.0	0.0	1.0		*			*	