3. New Engineering Materials

GENERAL INFORMATION ABOUT THE COURSE		
Course coordinator	Sanja Šolić, PhD, associate professor	
Course name	**NEW ENGINEERING MATERIALS**	
Study program	**Mechanical Engineering**	
Course status	Compulsory	
Year	1	
Semester	1	
Number of credits and teaching methods	ECTS student load coefficient	5
	Number of hours (lectures + seminars + exercises)	30 + 15 + 15

1. DESCRIPTION OF THE COURSE

1.1. Course objectives

Familiarise students with new engineering materials which are used in certain technologies and applications for specific and more demanding working conditions and which have the goal of replacing some materials ordinarily used in certain segments. Students will become familiar with new metal and non-metal materials, their improved properties and conditions based upon which such improvements are achieved. Students will also learn about the possibilities of applying new materials in specific mechanical engineering requirements.

1.2. Course enrolment prerequisites *(if applicable)*

None

1.3. Expected course learning outcomes

After having listened to all the course lectures and passing the exam, the student will be able to:

1. Classify new technical and engineering materials based on properties and areas of application
2. Identify and select new engineering materials as a replacement for existing with respect to improved materials
3. Define equilibrium and disequilibrium transformation in steel
4. Analyse the effect of microstructure on properties of steel, metal materials, polymers and composites
5. Evaluate advanced technical materials based on structure, mechanical, tribological and other importance useful properties

1.4. Course content

1. Overview of metal and non-metal technical and engineering materials current available and widely used
2. Mild steel or low carbon steels and high strength low-alloy steels (HSLA), microstructure, properties, applications
3. Ultra-high strength steels, microstructure, properties, applications
4. Corrosion resistant steels and alloys
5. Low-alloy and high-alloy steels for high work temperature, material creep, demands on materials at high work temperature
6. Superalloys for working at high work temperatures
7. Reversible martensitic transformation, shape memory effect, shape memory alloys (SMA), production and application in engineering and medicine
8. Titanium and titanium alloys, microstructure and properties, application in engineering and medicine
9. Wear-resistant materials
10. Powder metallurgy (PM), production, systematisation and properties of PM, structure and applications
11. Classification of tools, stresses in tools and demands on tool materials
12. Specifics of heat treatment of tool steel, treatment of the entire volume and surfacing finishing procedures
13. Cold work tool steels
14. Hot work tool steels – steels for making moulds, dies and gravures, high-speed steels and hardened steels
15. Special tool steels: Maraging steels, precipitation hardening (PH) steels, sintered tool steels

1.5. Types of teaching	☒ Lectures ☒ Seminars and workshops ☒ Exercises ☒ Distance learning ☒ Field work	☒ Autonomous exercises ☐ Multimedia and network ☒ Laboratory ☒ Mentor assistance ☐ Other types
1.6. Comments		

1.7. Student obligations *(attendance at classes, lectures, tutorials, seminars)*

Attendance at lectures and exercises. Work undertaken in the laboratory as well as autonomously preparing and presenting the seminar paper.

1.8. Tracking student work (proportion of individual activities in terms of ECTS credits based on the total number of ECTS credits)

Class attendance	2	Class participation		Seminar paper	1	Experimental work	
Written exam	1	Oral exam	0.5	Essay		Research	0.5

Project		Continual assessment of knowledge		Written seminar paper		Practical work	
Online activity							

1.9. Grading and assessment of student work during the semester and for the final exam *(interim exam, written exam, oral exam)*

Two interim exams and an autonomously drafted and presenting seminar paper. Oral and written exam.

1.10. **Mandatory literature** (relevant at the time of submitting the proposed study program)

1. Mel Schwartz: NEW MATERIALS, PROCESSES, AND METHODS TECHNOLOGY, Taylor & Francis, 2005.
2. Li Yang, Keng Hsu, Brian Baughman, Donald Godfrey, Francisco Medina, Mamballykalathil Menon, Soeren Wiener: ADDITIVE MANUFACTURING OF METALS: THE TECHNOLOGY, MATERIALS, DESIGN AND PRODUCTION, Springer 2017

1.11. Supplementary literature (relevant at the time of submitting the proposed study program)

- M. Sherif El-Eskandarany: Mechanical Alloying: For Fabrication Of Advanced Engineering Materials, 2001
- Anish Upadhyaya, Gopal Shankar Upadhyaya: Powder Metallurgy: Science, Technology, and Materials, Taylor & Francis, 2011

1.12. Manner of tracking quality to ensure the acquisition of exit knowledge, skills and competences

Compulsory attendance of exercises and lectures. Interim exams, presentation of the seminar paper.

2. COMBINING THE LEARNING OUTCOMES, TEACHING METHODS AND ASSESSMENT OF THE LEARNING OUTCOMES

2.1. Class participation	*2.2. Student participation*	*2.3. Learning outcome*	*2.4. Assessment method*
Lectures	Analysis of professional texts, synthesis of knowledge and presenting them through actively following lectures and presenting what has been learnt	1-5	Filling out the online self-assessment forms and periodical reports (10% of points). Continual assessment of knowledge (60% of points)
Seminar paper	Searching literature, selecting and explaining seminar paper topic, writing the seminar paper,	1-5	Written also on the course website uploading of the registration,

	presenting the seminar paper		elaboration of the topic and actual seminar paper (20% of points)
Online activity	Analysis and review of registration as well as seminar papers, participation in evaluation	1-5	Evaluating all analyses and reviews as well as comparing with those from classes (10% of points)