Faculty of Metalurgy and Technology / METALLURGY AND / TESTING OF MATERIALS

Course:	TESTING OF MATERIALS			
Course ID	**Course status**	**Semester**	**ECTS credits**	**Lessons** (Lessons+Exercises+Laboratory)
3076	Mandatory	4	6	3+0+2
Programs	METALLURGY AND			
Prerequisites	None.			
Aims	Training students to work on testing/characterizing mechanical properties of materials, as well as with NDT (non-destructive) methods for testing/detecting defects in materials.			
Learning outcomes	The student will be able to understand the methods of mechanical testing of materials, the tendency of materials to fracture, methods of non-destructive testing, calculate the indicators of strength and plasticity of testing with the destruction of materials, know the methods and methodology of performing tests and formulate the conditions of performing tests.			
Lecturer / Teaching assistant	prof. dr Kemal Delijić			
Methodology	Lectures, laboratory exercises, independent solving of practical tasks, consultations.			
Plan and program of work				
Preparing week	Preparation and registration of the semester			
I week lectures	Classification of mechanical tests of metal, polymer, ceramic and composite materials; Testing of materials by tension: test tubes, σ-ε diagrams, properties of strength and deformation during tension.			
I week exercises	Introduction to working with a universal device for mechanical testing of materials by uniaxial loading, Tensile testing, part 1: performing tensile tests, determining tensile properties.			
II week lectures	True tension curve, strain hardening, anisotropy factors; Instruments for measuring deformations; machines and devices.			
II week exercises	Tensile testing, part 2: true tensile curves, determination of strain hardening index and anisotropy factor. Comparison of the tensile behavior of different materials, boundary conditions.			
III week lectures	Compressive testing; strength and deformation properties; Shear testing;			
III week exercises	Compression and shear testing and testing of samples of different materials.			
IV week lectures	Hardness testing by static and dynamic force action; dependence of material strength and hardness; hardness testing devices.			
IV week exercises	Working with devices for measuring hardness and testing materials using static and dynamic methods.			
V week lectures	Bending and torsion testing: strength and deformation properties during bending and torsion.			
V week exercises	Work with bending and torsion testing device; examination of different materials, fracture appearance.			
VI week lectures	Fatigue tests: dynamic strength, test method, Veller diagram, dynamic endurance diagrams. Fracture due to fatigue. Factors affecting dynamic strength.			
VI week exercises	Examples from the field of fatigue testing, fracture appearance.			
VII week lectures	Tests with impact loads - testing of toughness by bending and tension, tough and brittle fracture - tendency to brittle fracture; critical ductile-brittle transition temperature.			
VII week exercises	Working with the impact testing device - determining the toughness of the material. I Colloquium/Test			
VIII week lectures	Fracture: critical stress intensity factor, defects in the material that lead to fractures; examination of tendency to brittle fracture in corrosive aggressive environments.			
VIII week exercises	Corrective Colloquium/Test			
IX week lectures	Testing properties at elevated and reduced temperatures. Permanent static tests. Determination of deformations at constant load and temperature. Creep testing; Stress relaxation.			
IX week exercises	Analysis of material properties at elevated and reduced temperatures; Crawling; Stress relaxation.			
X week lectures	Tests of the ability to shape massive pieces and sheets ("bulk workability").; Wear.			
X week exercises	Examples related to testing the ability to shape massive pieces and sheets.			
XI week lectures	Non-destructive material testing (NDT): registration of defects in metals/materials; visual control; penetrant testing, advantages and disadvantages, standards and methods.			

XI week exercises	Laboratory exercises - work with tools for testing porosity with penetrants.
XII week lectures	Magnetic flux tests; testing equipment and fault character. Electromagnetic methods, principles (eddy currents), instruments, measurement of coating and layer thicknesses.
XII week exercises	Colloquium/Test
XIII week lectures	Ultrasonic tests (defectoscopy, thickness). Thermography - determining the size of the defect.
XIII week exercises	Working with equipment for ultrasonic tests, ultrasonic tests (defectoscopy, thickness).
XIV week lectures	Radiographic control; Principles and techniques of testing; Application of NDT in the examination of welded joints.
XIV week exercises	Corrective Colloquium/Test
XV week lectures	Technological tests of finished products, sheets, pipes, wires, ropes.
XV week exercises	Technological tests (Bulge test, Cup test, Eriksen test...); Exam preparation.
Student workload	

Per week	**Per semester**
6 credits x 40/30=8 hours and 0 minuts 3 sat(a) theoretical classes 2 sat(a) practical classes 0 excercises **3 hour(s) i 0 minuts** of independent work, including consultations	Classes and final exam: **8 hour(s) i 0 minuts x 16 =128 hour(s) i 0 minuts** Necessary preparation before the beginning of the semester (administration, registration, certification): **8 hour(s) i 0 minuts x 2 =16 hour(s) i 0 minuts** Total workload for the subject: **6 x 30=180 hour(s)** Additional work for exam preparation in the preparing exam period, including taking the remedial exam from 0 to 30 hours (remaining time from the first two items to the total load for the item) **36 hour(s) i 0 minuts** Workload structure: **128 hour(s) i 0 minuts (cources), 16 hour(s) i 0 minuts (preparation), 36 hour(s) i 0 minuts (additional work)**
Student obligations	Attending classes, working on laboratory exercises and related reports, colloquiums.
Consultations	According to schedule.
Literature	Mechanical Testing and Evaluation, ASM International Vol 08 -(2000), Fractography, ASM International - Vol 12 - (2000) Nondestructive Evaluation; ASM Int nternational - Vol 17; (2000) Fatigue And Fracture, ASM International Vol 19 Materials Science and Engineering. Callister W, Wiley & Sons, Inc.(2010); Ispitivanje metalnih materijala I i II, Oruc M. (2012), Ispitivanje metala, Terzić P. (1985)
Examination methods	Activity during the lecture: 0-5 points Activity during exercises and submitted reports: 0-5 points Two colloquiums of 20 points each: 0-40 points Final exam: up to 50 points A passing grade is obtained if at least 50 points are accumulated cumulatively
Special remarks	None.
Comment	None.

Grade:	F	E	D	C	B	A
Number of points	less than 50 points	greater than or equal to 50 points and less than 60 points	greater than or equal to 60 points and less than 70 points	greater than or equal to 70 points and less than 80 points	greater than or equal to 80 points and less than 90 points	greater than or equal to 90 points