Faculty of Civil Engineering / CIVIL ENGINEERING / THEORY OF PLATES AND SHELLS

Course:	THEORY OF PLATES AND SHELLS			
Course ID	**Course status**	**Semester**	**ECTS credits**	**Lessons** (Lessons+Exercises+Laboratory)
6532	Mandatory	1	5.5	3+1+1
Programs	CIVIL ENGINEERING			
Prerequisites				
Aims	To achieve fundamental understanding of the classical theory of elastic plates and shells, address limitations and differences, introduce nomenclature, and introduce analytical and numerical solution techniques. To enable students to apply theory of plates and shells to problems involving various geometries and boundary conditions to diverse problems in civil engineering.			
Learning outcomes	On successful completion of this course students will be able to: 1. Understand the theory, concepts, principles and governing equations of the theory of shells and plates, 2. Analyze thin plate structural elements and understand behavior of plates under bending and in-plane loads, 3. Understand behavior of basic shell structures in the case of membranes as well as bending theory; 4. Apply the analytical tool for the analysis of plate & shell structures and employ the results for counter-checking with other solutions.			
Lecturer / Teaching assistant	Olga Mijušković - Full Professor			
Methodology	Lectures, calculation exercises. Learning and individual work tasks. Consultations.			
Plan and program of work				
Preparing week	Preparation and registration of the semester			
I week lectures	General behavior of plates. The fundamental assumptions of the linear, elastic, small-deflection theory of bending for thin rectangular plates. Stresses, strains and displacements. Constitutive equations. Governing differential equation for thin plate ben			
I week exercises	Fourier series expansion.			
II week lectures	Navier’s method (double series solution). Morice-Levy’s method (single series solution). Analysis of plate strips.			
II week exercises	Examples: Navier’s method (double series solution).			
III week lectures	The use of influence surfaces in the design of plates. Variational formulation of plate bending problems.			
III week exercises	Examples: Morice-Levy’s method (single series solution) Homework no. 1			
IV week lectures	Circular plates, basic relation and differential equation in polar coordinates. Boundary conditions.			
IV week exercises	Example: Circular plates.			
V week lectures	Annular circular plates. The use of superposition for the axisymmetric analysis. Symmetrical and asymmetrical load.			
V week exercises	Example: Annular circular plates. Symmetrical and asymmetrical load.			
VI week lectures	The finite difference method. Application to rectangular and circular plate bending problems.			
VI week exercises	Example: Modeling using the finite difference method.			
VII week lectures	Plates subjected to in plane loading. Constitutive equations, Airy stress function, differential equation in Cartesian coordinate system. Boundary conditions. The finite element method for the plates under in plane loads.			
VII week exercises	Example: Plates subjected to in plane loading. Homework no. 2			
VIII week lectures	Walls. Differential equation for the plates subjected to in plane loads in polar coordinates. Examples.			
VIII week exercises	Example: Problems of the plates subjected to in plane loads in polar coordinates. FIRST TEST			
IX week lectures	Introduction in to general shell theory. Membrane theory of shells of revolution. Spherical, cylindrical and conical shell.			
IX week exercises	Example: Symmetrically loaded shells of revolution.			
X week lectures	Bending theory of circular cylindrical shells with rotational symmetrical loading. Governing differential equation and solutions for characteristic rotational symmetrical loading.			
X week exercises	Example: Bending theory of cylindrical shells with rotational symmetrical loading.			

XI week lectures	General theory of shells in the form of surface of revolution loaded symmetrically with respect to their axis.
XI week exercises	Example: Solutions for characteristic load types.
XII week lectures	Spherical shell of constant thickness. Spherical shell with a supporting edge ring.
XII week exercises	Example: Spherical shell. Ring beam.
XIII week lectures	Complex plate and shell constructions.
XIII week exercises	Example: Complex plate and shell constructions.
XIV week lectures	Plate and shells structures – basic modeling.
XIV week exercises	Plate and shells structures – basic modeling.
XV week lectures	SECOND TEST
XV week exercises	
Student workload	Weekly 5.5 credits x 40/30 = 7 hours and 20 min. Total course hours : 5.5 x 30 = 165 hours

Per week	**Per semester**
5.5 credits x 40/30=7 hours and 20 minuts 3 sat(a) theoretical classes 1 sat(a) practical classes 1 excercises **2 hour(s) i 20 minuts** of independent work, including consultations	Classes and final exam: **7 hour(s) i 20 minuts x 16 =117 hour(s) i 20 minuts** Necessary preparation before the beginning of the semester (administration, registration, certification): **7 hour(s) i 20 minuts x 2 =14 hour(s) i 40 minuts** Total workload for the subject: **5.5 x 30=165 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) **33 hour(s) i 0 minuts** Workload structure: **117 hour(s) i 20 minuts (cources), 14 hour(s) i 40 minuts (preparation), 33 hour(s) i 0 minuts (additional work)**
Student obligations	Students are required to attend classes (lectures and exercises), calculate and defend homework tasks and pass exams.
Consultations	Monday 12 - 14 Wednesday 12 - 14
Literature	Venstel E., Krauthammer T.: Thin Plates and Shells, Marcel Dekker, New York, 2001
Examination methods	Forms of Assessment: - Regular attendance - max 2 points - Homework – 2 x 9 = 18 points - Tests - 2 x 30 (min 12) = 60 points - Final exam - max 20 points Important notes: -Attendance (lectures and tutorials): min 60 % -Passing grade is ob
Special remarks	
Comment	Additional information can be obtained from the subject teacher, head of the study program and Vice dean for Education.

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