COURSE DESCRIPTION

Name of the Course:	**Advanced Theory of Elasticity, Plates and Shells**							
Specialization Code:	**U02.07.ICV.IZ.M24.**			**Course Code:**	**2.DD.OB06**			
Year of study:	**1**	**Semester:**	**2**	**Examination form:** (**E**-Exam; **Co**- Colloquy; **P**-Project**; P/F**-Passed/Failed)	**E**	**ECTS credits granted (CR):**	**E (Co)**	**5**
							P (P/F)	
Course Category: (**DF**- Fundamental; **DD**- General engineering; **DS**-Specialty engineering; **DC**-Complementary; **PR**-Practical stage)								**DD**
Course Type: (**OB**-Compulsory**; OP**-Elective**; FC**-Facultative)								**OB**
Number of hours per semester: Total of hours per week (TH) x Number of weeks per semester								
TOTAL :	112	**Individual study** (IS)**:**		70	**Contact hours (C + S;L;P):**			42
Academic staff member in charge: (Full name, Academic position and Department)		Assoc.Prof. Ph.D. Ion SIMULESCU						

Faculty	**Engineering in foreign languages Master study programme**		**Number of contact hours per semester**				
			Total	Course	Seminar	Laboratory	Project
Field	**Civil Engineering**						
Specialization	**Structural Engineering**		**42**	28	-	14	

Course objectives - Description of the main competences: Description of the main competences: This course is a graduate level class intended to familiarize the student with the evaluation of the stress, strain and displacement fields induced by the environmental action into a tree-dimensional continua characterized by a linear elastic constitutive low.

Content description:

1. COURSE

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1. Theory of Elasticity in Rectangular Cartesian Coordinates ….**4 hours**
1.1 Deep Beam of Infinite and Finite Height. Stress Field.
1.2 Deep Beam of Finite Height and Width. Stress Field. Strut-and-Tie Analysis.
2. Plane Theory of Elasticity in Polar Coordinates **...2 hours**
2.1 Elastic Half-Space. Concentrated Normal Force (Flamant - Boussinesq Problem). Stress and deformation fields.
2.2 Elastic Half-Space subjected to Normal Uniform Distributed Force.
3. Circular Plates … **2 hours**
3.1 Static Equation in Terms of Displacements.
3.2 Plates with Support and Loading Axial-Symmetry
4. Orthotropic Plates. Physical and Geometrical Orthotropy …… **2 hours**
5. Stability of the Rectangular Plates …… **4 hours**
5.1 Second Order Differential Equation
5.2 Rectangular Plate Simple Supported on the Contour under Mono-Axial Compression. Other Cases of Significance.
5.3 Post-Buckling Behavior
6. Shells in Membrane Theory ……. **4 hours**
6.1 Shells Classification. Shells with Gaussian Positive Curvature (Spherical Dome, Elliptical Paraboloid), with Zero Curvature (Cylindrical and Conical Shells) and Negative Gaussian Curvature (Hyperbolic Paraboloid, Hyperboloid of Revolution).
6.2 Shells of Revolution. Static Equilibrium Equations
6.2.1 Axisymmetric Loads. Circular Cylinder, Conical Shell, Spherical Dome and Hyperboloids of Revolution.
6.2.2 Combined Surfaces Axisymmetric Supported and Loaded. Rings in Curvature Changing Zones.
6.2.3 Symmetric Loading against the Plane of Rotation Axis. Stresses Induced by Wind and Earthquake into Circular Cylinder, Conical Shell, Spherical Dome and Hyperboloid.
6.3 Surfaces of Rotation Axisymmetric Supported and Loaded. Displacement Fields.
6.4 Thin Translation Shells with Double Curvature.

	7. Membrane Theory of Thin Shells. …… **2 hours** 7.1 Equilibrium Differential Equations. General Case. 7.2 Cylindrical Shells Loaded. Edge Beams. 7.3 Analysis of Simple Supported Continuous Multiple Cylindrical Shells. **8. Bending Theory of Thin Shells of Revolution.** …… **6 hours** 8.1 Equilibrium Differential Equations. Displacement Expression for Axisymmetric Supports and Loading. Stresses and Displacement Fields. 8.2 Circular Cylinders with Various Supporting Conditions. 8.3 Circular Cylinders Covered or with Circular, Conical or Spherical End. 8.4 Circular Cylinders under Wind, Earthquake and Temperature Gradient. **9**. **Buckling of Thin Shells. Membrane Theory.** ….. **2 hours** 9.1 Circular Cylinders and Domes under Axisymmetric Loads and Wind. 9.2 Thin Shells wit Double Curvature. Hyperbolic and Elliptic Paraboloid.
2. Seminar / Laboratory / Project / Practical stage	**Laboratory – 14 hours** (2 hours sessions) 1. Deep Beam of Finite Height and Width under a Distributed Load Located at the Upper Face. Numerical Solution: Finite Differences Method, Finite Element Method and Tie-and-Strut Method. 2. Circular Plates Axisymmetric Loaded. **.....** 2 hours 3. Membrane Theory of Thin Shells of Revolution Axisymmetric Supported and Loaded. …… 2 hours 4. Membrane Theory of Cylindrical This Shells. ……. 2 hours 5. Circular Cylindrical Reservoir Analysis Connected to a Foundation under Self-Weight, Internal Pressure and Earthquake. ……. 2 hours 6. Analysis of Hyperbolic Cooling Tower under Self-Weight, Internal Pressure, Earthquake and Temperature. …… 2 hours Analysis of Hyperbolic Paraboloid. Symmetric and Antisymmetric Loading. Membrane and Bending Theories. … 2 hours
3. Bibliography	1. David P. Billington,Thin Shell Concrete Structures, McGraw-Hill,1990 2. Stephen P. Timoshenko, S. Woinowsky-Krieger, Teoria Placilor Plane şi Curbe, Editura Tehnică, 1968 3. Edmund S. Melerski, Design Analysis of Beams, Circular Plates and Cylindrical Tanks on Elastic Foundations, Taylor/Francis, 2000 4. Structural stability - supplementary materials. John Hopkins University http://www.ce.jhu.edu/stability/supplementary/supplementary.htm

Criteria to be considered for the final mark	**Weight of each criterion in the final mark (%)**
1. Exam defence (final examination)	40
2. Appreciation during the entirely semester	
2.1 Seminar activity	
2.1 Laboratory activity	10
2.2 Project activity (the project has not a distinct final mark)	
3. Periodical examinations	
3.1 Written / oral examination	20
3.2 Home works, reports, essays etc.	30
4. Other criteria (to be specified)	
Short description of the final evaluation procedure: The final examination comprises one practical application and one theoretical subject. The final grade is calculated by applying the above weights to the grades obtained during the final examination, laboratory activity, periodical examinations and homework activity.	

Estimation of the total number of hours per semester requested for the individual study (IS)				
Type of individual activity	No. of hours		Type of individual activity	No. of hours
1. Study of the course notes	14		8. Preparation of the final examination	14
2. Study of the compulsory bibliography	4		9. Advisory class participation	6
3. Study of the supplementary bibliography	4		10. Practical documentation on site	
4. Preparation of specific activities	8		11. Additional documentation on library	10
5. Preparation of home works	4		12. Internet network documentation	
6. Preparation of periodical written examinations	6		13. Others (to be specified)	

7. Preparation of periodical oral examinations		**TOTAL number of hours**	70

Signature of the Academic Staff member in charge:

Date: 15.03.2013

Ion SIMULESCU