SYLLABUS

1. Data about the program of study

1.1	Institution	The Technical University of Cluj-Napoca
1.2	Faculty	Faculty of Civil Engineering
1.3	Department	Structural Mechanics
1.4	Field of study	Civil Engineering
1.5	Cycle of study	Bachelor of Science
1.6	Program of study/Qualification	Civil, industrial and agricultural buildings
1.7	Form of education	Full time
1.8	Subject code	37

2. Data about the subject

2.1	Subject name			Theory of Elasticity and Plasticity			
2.2	Course responsible/lecturer			Assoc. prof. Mihai Nedelcu			
2.3	Teachers in charge of seminars			Assoc. prof. Mihai Nedelcu			
2.4 Year of study	3	2.6 Semester	1	2.7 Assessment	E	2.8 Subject category	DD/DI

3. Estimated total time

3.1 Number of hours per week	3	3.2 of which, course:	2	3.3 applications:	1
3.4 Total hours in the curriculum	75	3.5 of which, course:	28	3.6 applications:	14
Individual study					hours
Manual, lecture material and notes, bibliography					13
Supplementary study in the library, online and in the field					3
Preparation for seminars/laboratory works, homework, reports, portfolios, essays					17
Tutoring					
Exams and tests					3
Other activities					

3.7	Total hours of individual study	33
3.8	Total hours per semester	75
3.9	Number of credit points	3

4. Pre-requisites (where appropriate)

4.1	Curriculum	Pass the discipline ”Strength of Materials”
4.2	Competence	Mathematic Analysis and Special Mathematics

5. Requirements (where appropriate)

5.1	For the course	N/A
5.2	For the applications	N/A

6. Specific competences

Professional competences	Define the computational model in the theory of elasticity and plasticity; the difference between the linear and nonlinear analysis from the physical and geometric point of view. Define the stress/strain state, the stress/strain tensors, the displacement state. The general equations of theory of elasticity. Solving the classic problems of plane state using analytical solutions and the stress function F(x,y). Its mechanical interpretation on the contour of a 2D structural element. Analysis of dams, supporting walls, tunnels using the strain plane formulation. The behaviour of plane plates (slabs) under different loading/boundary conditions. The use of numerical methods, in particular the Finite Difference Method to find the solution for deep-beams, walls, slabs etc. C2.3. Using the computational methods specific to each structural type and the design methods of the components of civil, industrial and agricultural buildings in order to develop the required technical documentation.
Cross competences	The correct idealisation of the structural elements based on the admitted fundamental assumptions. Classification of the structural elements based on their dimensions, loading and boundary conditions to find the adequate analysis method. The loading representation in trigonometric series in order to impose the boundary conditions. Verification of the applicability limits of the analytical formulations. Necessary knowledge for the accurate design of the bidimensional elements acted in and out their plane. CT2. Applying the efficient techniques of teamwork, on different levels of hierarchy.

7. Discipline objectives (as results from the *key competences gained*)

7.1	General objective	Adapting the analysis methods used for the civil, industrial and agricultural buildings to their specific behaviour.
7.2	Specific objectives	Understanding the displacement and stress formulations for the problems of the Theory of Elasticity. Elimination of the simplifying assumptions used by the Strength of Materials for the structures made of bars.

8. Contents

8.1. Lecture (syllabus)	Teaching methods	Notes
1. General equations and principles of the theory of elasticity.3-Dimensional elasticity.	Classic presentation, discussions, PowerPoint presentations	video-projector
2. Plane elasticity in Cartesian coordinates, different formulations.		
3. Stress function and its mechanical interpretation on the contour.		
4. Polynomial solutions. Trigonometric series solutions and finite differences.		
5. Deep beams.		
6. Plane problem in polar coordinates.		
7. Different formulations of the plane solution in polar coordinates. Axial symmetric state.		
8. Free torsion of non-circular prismatic bars.		

9. The Prandtl membrane analogy. Plastic torsion.		
10. Flat plates. Assumptions. Displacements, strains, stresses.		
11. Internal forces. Differential equation of the plates. Boundary conditions.		
12. Solutions for the rectangular plate. Polynomial, trigonometric and finite differences solutions.		
13. Circular plates. Differential equation. Axial symmetric state.		
14. Plastic analysis of the plates.		

1. Ioani, AM.., Nedelcu, M., *Theory of Elasticity*, U.T.PRES, Cluj-Napoca, 2014.
2. Precupanu, D., *Theory of Elasticity*, Technical University ”Gh. Asachi”, Civil Engineering and Architecture Faculty, Iasi, 1996.
3. Boresi, A.P., Schmidt, R.J., Sidebottom, O.M., *Advanced Mechanics of Materials*, fifth ed., John Wiley & Sons,Inc., New York,1993.
4. Szilard, R., *Theory and Analysis of Plates*, Prentice Hall, Inc.,Englewood Cliffs, New Jersey,1974.
5. Bia, C., Ille. V., Soare, M.V., *Rezistenţa materialelor şi Teoria elasticităţii,* Edit. Didactica şi Pedagogică, Bucureşti 1983.

8.2. Applications/Seminars	Teaching methods	Notes
1. Beam in pure bending analyzed by the tools of the Theory of Elasticity.	Classic presentation, discussions, PowerPoint presentations, computer programming	Computer, software Matlab, video-projector
2. Stress function. Cantilever beam acted by a force at the free end.		
3. Strains and stresses in beam flange. Calculation of the plate active width.		
4. Use of FDM for the deep beams analysis.		
5. Solution of the plane plate problem using simple and double trigonometric series.		
6. Use of FDM for the rectangular plate analysis.		
7. Plastic analysis of the rectangular plates using the yield lines theory.		

Bibliography

1. Ioani, AM.., Danciu A., Mociran H., Theory of Elasticity – Examples and Problems, U.T.PRES, Cluj-Napoca, 2011.
2. Marţian, I., *Teoria elasticităţii şi plasticităţii pentru constructori,* Universitatea Tehnică din Cluj-Napoca, 1999.

9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

The acquired competences will be necessary to the future employees of the structural design companies.

10. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	Presenting 2 theoretical subjects.	Oral presentation – examination duration 1 hour	60%
10.5 Applications	Solving 1 problem.	Oral presentation - examination duration 1 hour	30%

10.5 Applications	Preparing 7 Homeworks during the semester.	Oral presentation	10%
10.6 Minimum standard of performance			
Correct presentation of at least 50% of each theoretical subject, solving at least 50% of the problem and deliver the 7 Homeworks as scheduled.			

Date of filling in:		**Title Surname Name**	**Signature**
Sept.2019	Lecturer	Assoc. prof. Mihai Nedelcu	
	Teachers in charge of application	Assoc. prof. Mihai Nedelcu	

Date of approval in the department ....

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Head of department
Prof. Cosmin G. Chiorean

Date of approval in the faculty ....

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Dean
Assoc. prof. Nicolae Chira