COURSE DESCRIPTION

Name of the Course:	**Applied Finite Elements Method**							
Specialization Code:	**U02.07.ICV.IZ.M24.**			**Course Code:**	**1.DF.FC03**			
Year of study:	**1**	**Semester:**	**1**	**Examination form:** (**E-**Exam; **Co-** Colloquy; **P-**Project**; P/F-**Passed/Failed)	**C**	**ECTS credits granted (CR):**	**E (Co)**	**4**
							P (P/F)	
Course Category: (**DF**- Fundamental; **DD**- General engineering; **DS**-Specialty engineering; **DC**-Complementary; **PR**-Practical stage)								**DF**
Course Type: F (**OB**-Compulsory**; OP**-Elective**; FC**-Facultative)								**FC**
Number of hours per semester: Total of hours per week (TH) x Number of weeks per semester								
TOTAL :	**98**	**Individual study** (IS)**:**		**42**	**Contact hours (C + S;L;P):**			**56**
Academic staff member in charge: (Full name, Academic position and Department)		*Prof. Tudor BUGNARIU PhD* Department of Hydrotechnical Engineering						

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**		56	28	28		

Course objectives - Description of the main competences:

Main theoretical and practical problems concerning the modeling and computing of structures made of beams, walls, shells or 3D solids, in order to assess the state of stress and deformation. The handed knowledge is required for specialization subjects as geotechnics, foundations as well as concrete, steel, masonry or wood structures. The design procedures for structural elements are based on computer codes dedicated to the Finite Elements Analyses

Content description:

1. COURSE

1. Theoretical fundamentals of the Finite Elements Method (displacement formulation)

1.1 Concepts of physical, mathematical and computing models. Basic equations of deformable media.

1.2 The condition of stable equilibrium. Euler equation.

1.3 General condition equations in the Finite Elements Method (displacement formulation).

2. Structural modeling. Error estimation end convergence criteria for the numerical solution

2.1 Criteria for choosing the shape functions

2.2 Convergence requirements in the FEM

3. Finite Elements for modeling in plain stress and plain strain conditions

3.1 Types of Finite Elements. Triangular and quadrilateral elements. Isoparametric elements.

3.2 Transformation relationships for rotated axes – orthotropic materials.

4. Axy-symmetric bodies with axy-symmetric boundary conditions and loads.

5. Finite Elements for modeling planar and curved shells

5.1 Types of Finite Elements. Isoparametric elements

5.2 Modeling planar and curved plates

5.3 Kirchhoff model. Midlin model.

6. **Finite Elements for modeling 3D solids**

6.1 Types of Finite Elements. Isoparametric elements

6.2 Modeling 3D bodies (foundations, ground, etc.)

7. Computing algorithm in the FEM

7.1 Assembly of the global stiffness matrix and of the load vector

7.2 Storage and solution methods. Reaction forces assessment.

8. Modeling of structures subjected to dynamic loads

8.1 Algorithms for computing the eigenvalues

8.2 Modal analysis

8.3 Direct integration of the equations of motion

8.4 Stationary dynamic response for harmonic excitation

	8.5 Earthquake design based on spectrum analyses **9. The sub-structuring method for modeling large structures. Static and dynamic loads.** 9.1 Sub-structuring procedures 9.2 Static condensation 9.3 Dynamic condensation **10. Geometrical nonlinearities. Buckling.**
2. Seminar / Laboratory / Project / Practical stage	1. Presentation of FEA codes AXIS, SAP2000, ETABS, SAFE, COSMOS, ANSYS, ADINA 2. Modeling, stress and deformation assessment for structures made of planar walls 3. Modeling, stress and deformation assessment for structures in plane stress conditions 4. Modeling, stress and deformation assessment for axy-symmetric structures 5. Modeling, stress and deformation assessment for planar shells 6. Modeling, stress and deformation assessment for curved shells 7. Modeling, stress and deformation assessment for 3D solids 8. Computing of plates on Winkler elastic medium 9. Seismic computation of a planar frame using the spectrum analysis. Assessment of seismic spectra. 10. Seismic computation of a planar frame using the procedure of direct integration 11. Seismic computation of a planar frame using the equivalent static load, associated to the fundamental vibration mode 12. Seismic computation of a 3D frame using the spectrum analysis
3. Bibliography	1. The Finite Element Method – O. C. Zienkiewicz, R. L. Taylor 2. The Finite Element Method – Z. Chen 3. A first course in the FEM – D. L. Logan 4. Basics of the Finite Element Method applied in Civil Engineering – T. Bugnariu 5. Applied Finite Element Analysis http://www.youtube.com/playlist?list=PL3A7B78F0E428DF72

Criteria to be considered for the final mark	**Weight of each criterion in the final mark (%)**
1. Exam defence (final examination)	30%
2. Appreciation during the entirely semester	
2.1 Seminar activity	
2.1 Laboratory activity	30%
2.2 Project activity (the project has not a distinct final mark)	
3. Periodical examinations	
3.1 Written / oral examination	10%
3.2 Home works, reports, essays etc.	30%
4. Other criteria (to be specified)	
Short description of the final evaluation procedure: Final theoretical and practical test, carrying out a FE analysis by means of a dedicated computer code.	

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	10		8. Preparation of the final examination	8
2. Study of the compulsory bibliography	4		9. Advisory class participation	
3. Study of the supplementary bibliography			10. Practical documentation on site	
4. Preparation of specific activities			11. Additional documentation on library	
5. Preparation of home works	10		12. Internet network documentation	5
6. Preparation of periodical written examinations			13. Others (to be specified)	
7. Preparation of periodical oral examinations	5		**TOTAL number of hours**	**42**

Date:
March 2013

Signature of the Academic Staff member in charge:
Tudor BUGNARIU