COURSE DESCRIPTION

Name of the Course:	**Rehabilitation of concrete structures**							
Specialization Code:	**U02.07.ICV.IZ.M26**			**Course Code:**	**3.DS.OP13**			
Year of study:	**2**	**Semester:**	**3**	**Examination form:** (**E-**Exam; **Co-** Colloquy; **P-**Project**; P/F-**Passed/Failed)	**E**	**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)								**DS**
Course Type: (**OB**-Compulsory**; OP**-Elective**; FC**-Facultative)								**OP**
Number of hours per semester: Total of hours per week (TH) x Number of weeks per semester								
TOTAL :	56	**Individual study** (IS)**:**		28	**Contact hours (C + S;L;P):**			28
Academic staff member in charge: (Full name, Academic position and Department)		Viorel POPA, Assoc. Professor., Reinforced concrete structures Stoica Nicolae Daniel – Associate Professor – CCIUT Şerban DIMA, Ph.D., C. Eng., Professor Ruxandra ERBASU – Lecturer - CCIUT						

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**		28	28			

Course objectives - Description of the main competences: Acquire the knowledge necessary for assessment of existing concrete structures safety level. Rehabilitation methods. Types of intervention. Technologies.

Content description:

1. COURSE

Concrete structures

1. Structural survey: definitions, basics of seismic structural response, seismic structural damage of concrete buildings 2h

2. Seismic assessment of concrete buildings: performance objectives, collecting information, qualitative assessment, quantitative assessment, reporting 2h

3. Rehabilitation of concrete members: rehabilitation objectives, retrofitting strategies, jacketing of structural members, experimental tests 2h

4. Rehabilitation of concrete structures: concrete frames, concrete shear walls, dissipation devices, base isolation 2h

Steel structures

1. History of metallic materials in works of art. Faults encountered on old metal materials 2h

2. Methods and techniques for repairing steel structures. Repair by welding 2h

3. Methods and techniques for repairing and reinforcing steel structures. Repair by bolting 2h

4. Methods and techniques for repairing and reinforcing steel structures. Repair by rivetting 2h

Masonry structural …… 8 hours

1. Types of existing masonry structural system buildings designed and erected in the 1890-1963 period, without seismic design codes; Issues about how to structural elements were made, architectural and structural irregularities; Structural behaviour and responses; Issues concerning the infrastructure composition, forms and design;

	2. Behavior and vulnerabilities of masonry structural systems due to seismic actions; 3. Cracks and degradations of components and structural systems made of masonry: • Types of damages; • Degradations through mechanical actions; • Degradation due to physicochemical actions. 4. Technical Survey for the existing buildings: • The need for and scope of technical survey; • Correlation between different types of requirements (stiffness, strength, stability, structural, functional and thermal rehabilitation). 5. General criteria for estimating the safety index for the existing buildings: • Constructive overall concept; • Strength, stiffness and ductility verification. 6. Calculation methods for determining the structural performance to gravitational and seismic actions: automatic calculation methods, seismic risk classes; **Wooden Structural** …….. 4 hours 1. Principles of retrofitting and structural rehabilitation of wood elements; degradations and failures for wooden structures. 2. Joints degradation in wooden construction - retrofitting solutions for joints. 3. Biological degradation of wood building elements, chemical protection measures and constructive compliance to avoid the appearance of biological degradation phenomena. 4. Retrofitting solutions for structural assemblies and wooden construction – case studies

3. Bibliography	1. ATC 40, Seismic Evaluation and Retrofit of Concrete Buildings, Applied Technology Council, 1996. 2. FEMA 356, Prestandard and Commentary for the Seismic Rehabilitation of Buildings, Federal Emergency Management Agency. 3. FEMA 440, Improvement of Nonlinear Static Seismic Analysis Procedures, Federal Emergency Management Agency. 4. EN 1998-3 (2005): Eurocode 8: Design of structures for earthquake resistance – Part 3: Assessment and retrofitting of buildings. The European Union Per Regulation 305/2011, Directive 98/34/EC, Directive 2004/18/EC. 5. P100-3/ Cod de evaluare si proiectare a lucrarilor de consolidare la cladiri existente, vulnerabile seismic, vol. 1 - Evaluare, vol. 2 – Consolidare 6. Aguilar, J.A. (1995). Case studies of rehabilitation of existing reinforced concrete buildings in Mexico-City. Master Degree Dissertation, University of Texas, Austin, SUA. http://fsel.engr.utexas.edu/publications/docs/thesis6.pdf 7. Rizkalla, S., Hassan, T. (2002). Rehabilitation of concrete structures with FRP. Proceedings of the 3rd International Conference on the Behaviour of Damaged Structures, Rio de Janeiro, Brazil. http://www.ce.ncsu.edu/srizkal/linked_files/RehabilitationOfConcreteStructuresWithFRP_Brazil-july02.pdf 8. FEMA 273. (1997). NEHRP guidelines for the seismic rehabilitation of buildings. http://www.wbdg.org/ccb/DHS/ARCHIVES/fema273.pdf 9. EN 1998-1 – Eurocode 8: Design of structures for earthquake resistance – Part 1: General rules, seismic actions and rules for buildings 10. EN 1998-3 – Eurocode 8: Design of structures for earthquake resistance – Part 3: Assessment and retrofitting of buildings 11. Muir, L. Rehabilitation and retrofit of existing steel buildings. http://www.larrymuir.com/Documents/Existing%20Structures.pdf 12. FEMA 273. (1997). NEHRP guidelines for the seismic rehabilitation of buildings. http://www.wbdg.org/ccb/DHS/ARCHIVES/fema273.pdf 13. V.Popescu, N. Patriniche, E Chesaru *Calitatea şi siguranţa construcţiilor metalice*, Ed.Tehnică, 1986. E.Chesaru, D. Preda *Expertizarea şi consolidarea construcţiilor metalice*, Ed. Conspres, UTCB, 1998. CR6 - Masonry Structures Design Code - Daniel Stoica - Structural modeling of masonry wall with ETABS program - Daniel Stoica – Soil-structure interaction modeling with ETABS program - Daniel Stoica – Wooden structure modeling with ETABS or SAP2000 program - Daniel Stoica – Courses notes - Ehsan Minaie – Vulnerability of reinforced masonry structures in seismic regions - Miha Tomazevic – Earthquake resistant design of masonry buildings - Narendra Taly – Design of reinforced masonry structures - Frederick Putnam Spalding – Masonry structures -Thomas Paulay, M.J.Nigel Priestley – Seismic design of reinforced concrete and masonry buildings - A.W. Hendry, B.P. Sinha, S.R. Davies – Design of Masonry Structures - Paulo José Brandão Barbosa Lourenço - Computational strategies for

	masonry structures - Donald E. Breyer, Kenneth J. Fridley, Kelly E. Cobeen, David G. Pollocj Jr. – Design of wood structures - E.C. Ozelton, J.A. Baird – Timber Designers's Manual - J. Porteous, A. Kermani – Structural Timber Design to Eurocode 5 - A. Kemany – Structural Timber Design - F. Naeim, J.M. Kelly – Design of Seismic Isolated Structures – From Theory to Practice - FEMA 273. (1997). NEHRP guidelines for the seismic rehabilitation of buildings. http://www.wbdg.org/ccb/DHS/ARCHIVES/fema273.pdf - Bay Area Regional Earthquake Preparedness Project Strengthening wood frame houses for earthquake safety http://www.johnmartin.com/earthquakes/Eqresid/ - Rashadul I., Inventory of FRP strengthening methods in masonry structures http://upcommons.upc.edu/pfc/bitstream/2099.1/7901/1/01.pdf

Criteria to be considered for the final mark	**Weight of each criterion in the final mark (%)**
1. Exam defence (final examination)	50
2. Appreciation during the entirely semester	
2.1 Seminar activity	
2.1 Laboratory activity	
2.2 Project activity (the project has not a distinct final mark)	
3. Periodical examinations	
3.1 Written / oral examination	
3.2 Home works, reports, essays etc.	50
4. Other criteria (to be specified)	
Short description of the final evaluation procedure: Oral exam, ½ regarding theoretical knowledge obtained during the course with questions from the prepared report and ½ a written report on a topic selected by the professor.	

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	10
2. Study of the compulsory bibliography			9. Advisory class participation	
3. Study of the supplementary bibliography			10. Practical documentation on site	
4. Preparation of specific activities	8		11. Additional documentation on library	
5. Preparation of home works			12. Internet network documentation	
6. Preparation of periodical written examinations			13. Others (to be specified)	
7. Preparation of periodical oral examinations			**TOTAL number of hours**	28

Date:
Septembrie 2017

Signature of the Academic Staff member in charge:
Viorel POPA
Stoica Nicolae Daniel
Şerban DIMA, Ph.D.,
Ruxandra ERBASU