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	Of Structures
1.4	Field of study	Civil Engineering
1.5	Cycle of study	Bachelor of Science
1.6	Program of study/Qualification	Residential, industrial and agricultural buildings English/Engineer
1.7	Form of education	Full time
1.8	Subject code	42.00

2. Data about the subject

2.1	Subject name			Earthquake engineering			
2.2	Subject area			Civil engineering			
2.3	Course responsible/lecturer			Lect. PhD. Eng. Andrei FAUR – andrei.faur@dst.utcluj.ro			
2.4	Teachers in charge of seminars			Lect. PhD. Eng. Andrei FAUR			
2.5 Year of study	III	2.6 Semester	2	2.7 Assessment	E	2.8 Subject category	DID/DOB

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	42	3.5 of which, course:	28	3.6 applications:	14
Individual study					hours
Manual, lecture material and notes, bibliography					21
Supplementary study in the library, online and in the field					3
Preparation for seminars/laboratory works, homework, reports, portfolios, essays					7
Tutoring					2
Exams and tests					3
Other activities					-

3.7	Total hours of individual study	36
3.8	Total hours per semester	78
3.9	Number of credit points	3

4. Pre-requisites (where appropriate)

4.1	Curriculum	Promotion of subjects: Strength of Materials, Statics and dynamics of constructions, Reinforced and prestressed concrete
4.2	Competence	-

5. Requirements (where appropriate)

5.1	For the course	Cluj-Napoca, str. Bariţiu, Nr. 25 – Room with video-projector
5.2	For the applications	Cluj-Napoca, str. Bariţiu, Nr. 25 – Room 157

6. Specific competences

Professional competences	To determine seismic response for different structural systems - methods with minimal character, mandatory standards; To understand the methods of seismic analysis for structures To know the overall seismic principles governing the conceptual design against seismic hazard. To use data from engineering seismology - the seismic response calculations; To determine the relative level displacements and be able to decide if needed second order calculation; To can apply torque effect (simplified method). To choose a system of passive seismic response control
Cross competences	Linking knowledge of design calculation and construction erection with the results of the structural seismic analysis Application of the engineering seismology data Drafting and presentation of a technical report containing the breviary calculation for the seismic response of building

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

7.1	General objective	Skills in the design and seismic protection of construction in the context of sustainable development
7.2	Specific objectives	Specific skills in the analysis and conceptual synthesis: - Seismic response of buildings - Structural and non-structural systems in seismic areas - Constructive composition of seismic protection systems

8. Contents

8.1. Lecture (syllabus)	Teaching methods	Notes
Introduction to seismological and engineering study of earthquakes.	Speech / case studies	Video-projector
The seismic response of a linear single degree of freedom system subjected to dynamic rigid base translation: the equilibrium equation, solution and response spectra.		
The seismic response of nonlinear single degree of freedom system subjected to dynamic translation of rigid base: inelastic response, design spectra, numerical integration.		
The seismic response of linear system with "n" degrees of freedom subjected to dynamic translation of the rigid base.		
Methods of seismic analysis for structures.		
Performance-based design in earthquake engineering.		
Performance requirements and compliance criteria.		
The guiding principles governing the conceptual design against seismic hazard.		
Inelastic dynamic behaviour.		
Design concepts for earthquake resistant reinforced concrete structures.		

Seismic response for non-structural elements.		
The control of structural seismic response.		
Control of seismic response "passive" and "active" structures.		
Seismic protection by special systems.		
Bibliography 1. Amr S. Elnashai, Luigi Di Sarno – Fundamentals of EARTHQUAKE ENGINEERING 2. Yousef Bozorgnia, Vitelmo V. Bertero – EARTHQUAKE ENGINEERING from Engineering Seismology to Performance-Based Engineering, CRC Press LLC, 2004 3. Verdes Doina – Basics of Seismic Engineering, UT-PRESS, 2011.		
8.2. Applications/Seminars	Teaching methods	Notes
The base shear load Fb conforming the P100-2013 Code, the procedure of equivalent static force for a cantilever roof covering a platform in a railway station.	Speech / applications P100-1/2013 EC8	Video-Projector / Shake Table STII
The seismic force on transversal direction for an industrial building. To resolve the seismic response in acceleration, velocity and displacement using the β-Newmark method and a time-history analysis (SAP2000 or ROBOT), using the accelerogram E-V Vrancea 1977. To present the graphs of seismic response for the β-Newmark method and time history analysis results.		
To compute the seismic load conforming the P100 - 2013 Code, the procedure of equivalent lateral force (hand calculation) for a construction that is a residential building, with six levels. The structure has transversal and longitudinal frames on reinforced concrete.		
The modal response spectrum analysis of the structure (SAP2000)		
The lateral displacement check		
Seismic compliance of the structure and structural elements		
The seismic response in acceleration, velocity and displacement for a SDOF system (a one level framework model) subjected to unidirectional translation - experimental analysis on shaking table.		
Bibliography 1. Verdeș Doina, Bompa Dan, Bindea Mihai – Metode de calcul si experimentare in proiectarea seismica, UT-PRESS Cluj-Napoca, 2013. 2. Tudor Postelnicu, Proiectarea structurilor de beton armat în zone seismice, editura MarLink, București, 2012. 3. P100-1/2013. 4. EC8.		

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

Acquired skills will be required for employees who work in structural design companies and in execution field.

10. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	To solve 2 theory questions	Written test – 2 hours	70%
10.5 Applications	Laboratory papers evaluation	Oral test – it is a condition to the exam entrance	30%
10.6 Minimum standard of performance			
Theory: T=(T1+T2)/2 ≥ 5; Applications: L=(L1+L2+L3+L4)/4 ≥ 5; Final: F=0,6xT+0,4xL ≥ 5			

Date of filling in: 18.09.2018		**Title Surname Name**	**Signature**
	Lecturer	Lect. PhD. Eng. Andrei FAUR	
	Teachers in charge of application	Lect. PhD. Eng. Andrei FAUR	
		Lect. PhD. Eng. Paul PERNEȘ	

Date of approval in the department ……..

Head of department
Conf.dr.ing. Attila PUSKAS

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Date of approval in the faculty ……

Dean
Conf.dr.ing. Nicolae CHIRA

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