10.1 CE1011 – Structural Repair and Strengthening

(1) GENERAL

SCHOOL	ENGINEERING SCHOOL		
ACADEMIC UNIT	CIVIL ENGINEERING DEPARTMENT		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**CE1011**	**SEMESTER**	**10**
COURSE TITLE	**Structural Repair and Strengthening**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	4	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialisation Course
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/CIV240/

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Upon completion of the course, students will obtain:

1. In-depth knowledge and critical understanding of the basic principles of design for Rehabilitation of structures using new technologies and information systems.
2. Knowledge and skills on designing and evaluating Bearing capacity of existing structures (Beams, Columns, Frames).
3. Knowledge and synthesis skills, ability for Repair and Retrofit of existing structures made of Reinforced Concrete, Masonry or Steel structures.

Specifically, students will be able to:

1. Describe and identify the constituent phases , from which a Strengthened structure consists.
2. Apply principles of Strength of Materials and appropriate Compatibility and Equilibrium Equations for the evaluation of bending stresses and strains at interfaces between constituent phases of a strengthened structure.
3. Use knowledge from Mechanics of Composite Materials for evaluating bending, shear and torsional stresses due to applied external loadings.
4. Evaluate Stress and Deformation state of Rehabilitated structures using various systems of Repair and Retrofit.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?;.

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*

Specifically, students will be able to perform:

- Study of needs either for repairing or for retrofitting a structure,
- Decision Making for choosing and applying the appropriate and effective materials for strengthening a structure section to bear increased loadings,
- Design and Construction Management on design, choice and application of appropriate Rehabilitation (Repair or Retrofit) technique in strengthening structures,
- Teamwork concerning the ability for dialog, self-esteem and commitment to reach an agreement for the technique and materials used for Rehabilitation of structures.
- Generate new research ideas by Promoting free, creative and inductive thinking to develop new strategic approaches for designing and analyzing repair and retrofit of structures.

(3) SYLLABUS

1. Basic principles for the evaluation of Loading capacity at Existing and Rehabilitated structures..
2. Seismic pathology of Reinforced Concrete and Masonry structures.
3. Strategy and Techniques of Intervention for Structures – Choice of intervention method.
4. Techniques for diagnosis of damages at existing structures.
5. Materials and Intervention techniques –Various repair concretes- Polymeric mortars- Repair Mortars- FRPs- Anchors .
6. Rehabilitation of structures – Safety factors of materials- Metallic joints-Design of Anchors-Design and Evaluation of stresses and strains at Interfaces of cnstituent materials.
7. Repair of Concrete columns .
8. Retrofit of Concrete columns by tightening of column section, FRPS and mantle of RC.
9. Repair of Walls.
10. Retrofit of Concrete walls by tightening of column section and mantle of RC.
11. Repair and Retrofit of slabs and beams.
12. Strengthening in Bending of slabs and beams by mortars, FRPS, steel plates.
13. Strengthening in Shear of beams by mortars, FRPS, steel plates.
14. Repair and Retrofit of RC junction by steel collars and FRPS
15. Retrofit of RC or Masonry structure.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Teaching using ICT, Communication and Electronic Submission.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non- directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open- ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Language of evaluation: Greek Final written examination: 100%

Activity	***Semester workload***
Lectures	75
Laboratory Practice	25
Study	40
Course total	**140**

(5) ATTACHED BIBLIOGRAPHY

Greek Bibliography:

1. Tasios, Th. (1981), Mechanics of Column Repair by Mantle, Proceedings of 5th Greek Concrete Congress, TEE Publ. Nicosia.
2. Chronopoulos, M. (1985), Guidelines for Recheck of Repaired- Retrofitted RC Columns, Proceedings of 7th Greek Concrete Congress, TEE Publ., Vol. 2, Patras.
3. N.T.U.A. (1987), Recommendations for Retrofit of seismic-damaged buildings, Athens.
4. Karadoni - Maragou T. (1997), Design and Rehabilitation of Masonry Structures, Patras: Patras University Publ.
5. Penelis, G.G. and Kappos, A.I.(1999), RC seismic structures, Ziti Publ., Thessaloniki.
6. Fountas G. (2000), Building repair due to seismic damage, FOUNTAS Publ., Athens.
7. Rovilos, A. (2001), Post-seismic control of buildings – Seismic pathology of buildings – Guidelines and repair techniques for seismic damage of buildings, Papasotiriou publ. , Athens.
8. Dritsos, S. (2001), Repair and Retrofit of RC structures, Patras.
9. O.A.S.P. (2002) KANEPE.
10. Spyrakos C. (2004), Retrofit of Structures to Seismic Loadings, Athens: TEE.
11. Triantafyllou Ath. (2006), Strengthening of RC and Masonry structures by FRPS, Patras.
12. C. B. Demakos (2015) Lectures on “Repair and Retrofit of Structures”, Dept of Civil Engineering, University of West Attica.

Foreign Bibliography:

1. Dritsos, S. (1994), Ultimate Strength of Flexural Strengthened R.C. Members, Proc. of 10th European Conference on Earthquake Engineering, Vol. 3, Vienna.