6.4 CE0640 – Reinforced Concrete

(1) GENERAL

SCHOOL	ENGINEERING SCHOOL		
ACADEMIC UNIT	CIVIL ENGINEERING DEPARTMENT		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**CE0640**	**SEMESTER**	**6**
COURSE TITLE	**Reinforced Concrete**		

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	4
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*	Special Background Course
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/CIV221/

(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*

The aim of the course is the comprehension of the behaviour of concrete and its use in structures, the knowledge of its properties and the design of reinforced concrete members.

Upon completion of the course, students will have:

1. Knowledge of the properties of reinforced concrete.
2. In-depth knowledge and critical understanding of theory and principles of structural design and calculation of reinforced concrete structures.
3. Knowledge and skills in modelling, design and calculation of reinforced concrete members.
4. Understanding and ability to identify key parameters such as ductility and strength of reinforced concrete members.
5. Background knowledge to apply what they learn in the courses Repair and Strengthening and Prestressed Concrete.

6. Ability to put what they learn in practical use.
7. Ability to develop personal responsibility and offer scientific opinion.
8. Ability to manage time in an appropriate manner.

Specifically, students will be able to:

10. Understand issues related to the operation of reinforced concrete structures.
11. Design new reinforced concrete members.
12. Evaluate the load-bearing capacity of reinforced concrete members.

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:

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Decision-making.
- Development of critical thinking.
- Production of inductive thinking.
- Autonomous work.

(3) SYLLABUS

1. Introduction. Concrete. Stress-strain diagram of material. Reinforcement steel. Material properties. Design values and safety factors. Reinforced concrete.
2. Composition of concrete, durability, cover to reinforcement.
3. Design limit states. Ultimate and Serviceability limit states. Load combinations and safety factors.
4. Design against axial actions: assumptions, properties of materials. Rectangular sections. Pure axial tension. Flexure with axial loads, diagrams and design tables. Pure axial compression.
5. T-beams. Effective width.
6. Slabs. One-way slabs, Two-way slabs. Cantilever Slabs. Slab thickness estimation, required reinforcement and detailing.
7. Columns. Interaction diagram. Biaxial bending.
8. Shear. Design of shear reinforcement.
9. Bond between concrete and reinforcement bars. Anchorage of steel bars. Lapping of reinforcement.

(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. Communication via email or MS-Teams. Announcements and educational material through the e-learning platform e-Class. Use of Excel software.
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,*	

Activity	***Semester workload***
Lectures	52
Preparation for Project	30

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*		Personal Study	38
		Course total	**120**
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: 80% Preparation for the project: 20%		

(5) ATTACHED BIBLIOGRAPHY

Greek Bibliography:

1. Mosley, B., Bungey, J. & Hulse R. (2016), Reinforced Concrete Design to Eurocode 2. Athens: Klidarithmos (in Greek).
2. Tsonos A.D. (2016), Design of reinforced concrete structures to Eurocodes, Thessaloniki: Sofia Publications (in Greek).
3. Chouliaras I.G. (2003), Reinforced Concrete Structures, Athens: Papasotiriou Publications (in Greek).
4. Gros, G. (2004), Reinforced Concrete according to the Greek Code 2000. Comparison with Eurocode 2 and DIN 1045/2001. Materials - Design – Structures, Athens: Symmetria Publications (in Greek).
5. Georgopoulos, Th. (2015), Reinforced Concrete (vol. A), Pavlos Georgopoulos Publications (in Greek).
6. Georgopoulos, Th. (2015), Athens: Tziola Publications (vol. B), Pavlos Georgopoulos Publications (in Greek).
7. Ekonomou, C.M. (2009), Reinforced Concrete from A to Z, Athens: SELKA-4M Publications (in Greek).
8. Zararis, Pr. (2002), Calculation Methodology of Reinforced Concrete, Thessaloniki: Kyriakidis Bros. Publications (in Greek).
9. Moutsopoulou A., Merkou E., Georgantzia D. (2015), Design of Reinforced Concrete Structures According to Current Earthquake Resistant Design Codes, Athens: Tziola Publications (in Greek).
10. Karayiannis, Ch., (2013), Design of Reinforced Concrete Structures for Seismic Actions, Thessaloniki: Sofia Publications (in Greek).
11. Konstantinidis, Ap. (2008), Earthquake Resistant Buildings Made of Reinforced Concrete, Vol. A – Construction and Detailing, Athens: π-Systems Publications (in Greek).
12. Konstantinidis, Ap. (2013), Earthquake Resistant Buildings Made of Reinforced Concrete, Vol. B – Static and Dynamic Analysis, Athens: π-Systems Publications (in Greek).
13. Karaveziroglou V.M. (2015), Calculation and Design of Structures, Athens: Tziola Publications.
14. Konstantinidis, Ap., (1994), Reinforced Concrete Applications – Vol. A, Athens: π-Systems Publications (in Greek).
15. Konstantinidis, Ap., (1994), Reinforced Concrete Applications – Vol. B, Athens: π-Systems Publications (in Greek).
16. Mehta P.K. and Monteiro P.J.M. (2009), Concrete: Microstructure, Properties, and Materials, 3rd edition, Athens: Klidarithmos (in Greek).

Foreign Bibliography:

1. Bhatt, P., MacGinley, T. J., & Choo, B. S. (2006). "Reinforced Concrete, Design Theory and Examples". 3rd Edition. Taylor & Francis
2. Brooker, O. et. al. (2006). "How to Design Concrete Structures using Eurocode 2". The Concrete Centre.
3. Goodchild, C. H. (2009). "Worked Examples to Eurocode 2". Volume 1. The Concrete Centre.
4. Mosley, B., Bungey, J. & Hulse R. (2007). "Reinforced Concrete Design to Eurocode 2". 6thEdition. Palgrave McMillan
5. Narayanan, R. S., & Goodchild, C. H. (2006). "Concise Eurocode 2". The Concrete Centre.
6. Park and Paulay, (1975),"Reinforced Concrete," John Wiley & Sons.

7. Mehta, P.K. and Monteiro, P.J.M. (2014). Concrete: Microstructure, Properties, and Materials, McGraw-Hill, 4th edition.

Related academic journals:

1. ACI Structural Journal (American Concrete Institute)
2. Structural Concrete Journal of the FIB
3. Engineering structures
4. Journal of Structural Engineering, ASCE
5. International Journal of Concrete Structures and Materials
6. Concrete International
7. Computers and Concrete
8. Advances in Concrete Construction
9. Earthquakes and Structures
10. Structural Engineering International (SEI) Journal
11. Structural Engineering and Mechanics
12. Cement and Concrete Research
13. International Journal of Cement Composites and Lightweight Concrete
14. Cement and Concrete Composites