COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Architecture		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	ARC_240	SEMESTER	2o
COURSE TITLE	Structures II		

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
Lectures and Exercises	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*	Specialised general knowledge
PREREQUISITE COURSES:	During the first lecture, all the basic required knowledge the students should have from the course of the first semester (Structures I) is mentioned. Moreover, some basic principles of Mathematics are also required.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (the course for Erasmus students is taught in English)
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/ARCH102/

(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 course entitled "Structures II" is held during the 2nd semester of the Department of Architecture at the University of Patras and is related to the corresponding course of the winter semester (Structures I).
  The design process for the selection of the most appropriate structures for bridging large openings is described. The structures studied are divided in four categories namely cables, arcs, trusses and beams. The connection between stresses and deformation is presented and the behavior and resistance of the various structural materials in developing deformations is studied.
  Another objective of the course is to provide students with a rational basis of the design of reinforced concrete members and structures through advanced understanding of material and structural behavior. Topics covered include: strength and deformation of concrete under various states of stress; failure criteria; concrete plasticity; fundamental behavior of reinforced concrete structural systems and their members. Moreover, methods for the calculation of the slabs' reinforcement, beams and columns are also presented.

Finally, during the last two lessons the influence of the earthquake in construction is examined and the seismic design process is explained briefly.

- The basic aim of the course "Structures II" is to introduce students to the design of the structural elements used when bridging large openings (beam elements, trusses, cables, arches). The ability to design structures which are statically adequate using a combination of structural members is further developed.

  The second aim of the course is to familiarize students with the technology of concrete, the most widely used civil engineering construction material. It is important that engineers involved in design and construction have a sound appreciation of concrete, its properties and specification.

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…*
	…….

- *Search for, analysis and synthesis of data and information, with the use of the necessary technology*
- *Working independently*
- *Team work*
- Experimental Exercise
- Respect for the natural environment
- Production of free, creative and inductive thinking

(3) SYLLABUS

The course includes several lectures, presentations, representative exercises.

Description of the weekly lectures

1st lecture	Elastic behaviour of materials. Relations between stresses and deformation. Hooke's law. Yield criteria of material. Elastoplastic behaviour of material.
2nd lecture	Design of structures for bridging openings – Part 1: "Beam elements". Stress diagram due to bending and axial force. Influence of intermediate supports. Beams of variable cross section.
3rd lecture	Design of structures for bridging openings – Part 2: "Trusses". The importance of height and reduction of the structure's self-weight is described. Bridges constructed with trusses are presented.
4th lecture	Behaviour of beam elements due to axial loading. Experiments used to determine the stress-deformation curves are shown. Poisson ratio. Behaviour of beams due to bending loading. Differences between Bernoulli and Timoshenko theories are mentioned. Methods for determining the deformation of beams. Exercises for the determination of bending deformation of beams. Brief presentation of Eurocodes. Ultimate limit states – Serviceability limit states. The importance of stiffness in deformation is shown through several examples.
5th lecture	Design of structures for bridging openings – Part 3: "Cables". Geometry of deformed cables due to loading. Comparison with beam elements. Description of cabled bridges. Exercises for the determination of axial stress of cables used in bridges.

6th lecture	Design of structures for bridging openings – Part 4: "Arches". Structures with curved geometry. Comparison between cables and arches. Report on bridges of masonry with arc geometry. Methods for the determination of stress condition of arches. Comparison with beams. Exercises for the determination of stress condition of arches.
7th lecture	Matrix Analysis of statically indeterminate structures. Presentation of pc software for the determination of stress condition of hyperstatic structures
8th lecture	Reinforced Concrete. Introduction to concrete technology. Recognition of structural concrete members. Presentation of sequential construction stages of a reinforced concrete structure.
9th lecture	Strength and serviceability limit states. Strength and deformation properties. Reinforced concrete theory for flexure. Analysis of concrete slabs. Different cases of support for concrete slabs. Solution of the first part of a reinforced concrete project concerning the determination of the required reinforcement for the slab. Design of the calculated reinforcement.
10th lecture	Reinforced concrete theory for shear and bending of beam concrete elements. Load transfer from plates to beams.
11th lecture	Load transfer from beams to columns. Determination of beam and column reinforcement.
12th lecture	Summary of the procedure for analysing buildings constructed from reinforced concrete. Introduction to the formwork designs and the concept of anchoring the reinforcement.
13th lecture	The effect of earthquake in structures and the basic principles of seismic design. Student guidance for the design and implementation of their own structures that will be subjected to a seismic earthquake test in the seismic table of the School of Civil Engineering of the University of Patras.
14th lecture	Revision Exercises. Seismic Excitation Construction Exercise at the seismic table of the School of Civil Engineering of the University of Patras.

(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*	Apart from the theoretical lectures, practical exercises related to engineering constructions are solved. Additionally, photos and videos of existing structures are presented for the recognition of structural members and the developed stresses and deformations. For the Erasmus students, all the additional notes, bibliography and lectures will be given in English. Finally, an experiment is scheduled and implemented to analyze the stress of constructions subjected to seismic stimulation at the seismic table of the School of Civil Engineering of the University of Patras in structures designed by the students themselves. Support Learning through the e-class platform is also implemented.
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-*	

Activity	*Semester workload*
Lectures	52
Simple individual exercises	5
Team work – Experimental Exercise	12
Educational visits	1
Independent Study & Examination of bibliography	30

directed study according to the principles of the ECTS		
	Course total	*100 (25 hours per credit)*
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.*	The evaluation of the students is based on their participation to the exercises and experimental project performed during the semester (30%) and the evaluation of the written examination at the end of the semester (70%).	

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
- Related academic journals:

Greek bibliography

- Π. Βουθούνης, Μηχανική παραμορφώσιμου στερεού – Αντοχή των υλικών, εκδ. Π.Βουθούνης, 2014
- Β. Καραβεζύρογλου, Στοιχεία Υπολογισμού και Διαμόρφωσης Ολόσωμων Κατασκευών, εκδ. Α. Τζιόλα & Υιοι Α.Ε.
- Ελευθέριος Ι. Πανταλέων Αντοχή υλικών, εκδ. Φούντας, 2010.
- Ελευθέριος Ι. Πανταλέων Κτιριοδομικά έργα με φέροντα οργανισμό από Ωπλισμένο Σκυρόδεμα, εκδ. Φούντας, 2010.
- Θ. Κερμανίδης, Αντοχή υλικών 1 και 2, Εταιρεία Αξιοποίησης και Διαχείρισης Περιουσίας Πανεπιστημίου Πατρών, 2009.
- Beer Ferdinand P. και Johnston Russell E., Μηχανική των Υλικών, εκδ. Τζιόλα, 2012.
- Δ. Παναγιωτουνάκος, Μηχανική των Κατασκευών, εκδ. Φούντας, 2007.

English bibliography

- Krenk, Steen, Mechanics and Analysis of Beams, Columns and Cables, Ed. Springer- Verlag Berlin Heidelberg
- David Darwin, Charles Dolan, Arthur Nilson, Design of Concrete Structures
- Prab Bhatt, T.J. MacGinley, Ban Seng Choo, Reinforced Concrete Design to Eurocodes: Design Theory and Examples, CRC Press
- Jack C. McCormac, Russell H. Brown, Design of Reinforced Concrete, John Wiley & Sons