

## COURSE OUTLINE

### (1) GENERAL

|                                                                                                                                                                                                                                                                       |                                                                                                       |                              |                |
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| <b>SCHOOL</b>                                                                                                                                                                                                                                                         | UNIVERSITY OF THESSALY                                                                                |                              |                |
| <b>ACADEMIC UNIT</b>                                                                                                                                                                                                                                                  | DEPARTMENT OF CIVIL ENGINEERING                                                                       |                              |                |
| <b>LEVEL OF STUDIES</b>                                                                                                                                                                                                                                               | UNDERGRADUATE                                                                                         |                              |                |
| <b>COURSE CODE</b>                                                                                                                                                                                                                                                    | TK2901                                                                                                | <b>SEMESTER</b>              | 6th            |
| <b>COURSE TITLE</b>                                                                                                                                                                                                                                                   | Reinforced Concrete Design I                                                                          |                              |                |
| <b>INDEPENDENT TEACHING ACTIVITIES</b><br><i>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</i> |                                                                                                       | <b>WEEKLY TEACHING HOURS</b> | <b>CREDITS</b> |
|                                                                                                                                                                                                                                                                       |                                                                                                       | 4                            | 5              |
|                                                                                                                                                                                                                                                                       |                                                                                                       |                              |                |
|                                                                                                                                                                                                                                                                       |                                                                                                       |                              |                |
| <i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>                                                                                                                                              |                                                                                                       |                              |                |
| <b>COURSE TYPE</b><br><i>general background, special background, specialized general knowledge, skills development</i>                                                                                                                                                | General Background                                                                                    |                              |                |
| <b>PREREQUISITE COURSES:</b>                                                                                                                                                                                                                                          | Solid Mechanics, Statics I, Strength of Materials I, Strength of Materials II, Construction Materials |                              |                |
| <b>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</b>                                                                                                                                                                                                                      | GREEK (or ENGLISH for Erasmus+ students)                                                              |                              |                |
| <b>IS THE COURSE OFFERED TO ERASMUS STUDENTS</b>                                                                                                                                                                                                                      | Yes                                                                                                   |                              |                |
| <b>COURSE WEBSITE (URL)</b>                                                                                                                                                                                                                                           | <a href="https://eclass.uth.gr/courses/CULT_U_193/">https://eclass.uth.gr/courses/CULT_U_193/</a>     |                              |                |

### (2) LEARNING OUTCOMES

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| <p><b>Learning outcomes</b></p> <p><i>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.</i></p> <p><i>Consult Appendix A</i></p> <ul style="list-style-type: none"> <li>• <i>Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area</i></li> <li>• <i>Descriptors for Levels 6, 7 &amp; 8 of the European Qualifications Framework for Lifelong Learning and Appendix B</i></li> <li>• <i>Guidelines for writing Learning Outcomes</i></li> </ul> |
| <p>The course is based on the principles of statics and on the principles of strength of materials, while requiring knowledge of concrete and steel mechanical behavior and properties. One of the main learning outcomes of the course is the essential skills for designing reinforced concrete structures (beams and columns) for bending (with/without axial force) and shear at the ultimate limit state. Knowledge is also gained on the application of provisions of the European structural codes of design (known as Eurocodes) related to reinforced concrete buildings.</p>                                                                                                              |

**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?*

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

Emphasis is placed on independent work as well as teamwork through a semester-long project included in the course framework. During the lectures, critical questions are posed to encourage free, creative, and critical thinking among students.

**(3) SYLLABUS**

|    |                                                                                                              |
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| 1  | General behavior of reinforced concrete (R/C) structures – Constitutive laws (concrete, steel)               |
| 2  | Basic design principles – Actions and combinations of actions                                                |
| 3  | Ultimate limit state (ULS) checks: uniaxial bending (M) with axial force (N) – General equilibrium equations |
| 4  | Design of R/C beams in flexure (rectangular section with single reinforcement)                               |
| 5  | Design of R/C beams in flexure (rectangular cross-section with double reinforcement)                         |
| 6  | Design of T-beams (effective slab width in compression)                                                      |
| 7  | Code provisions and detailing of reinforcement. Ductility classes according to EC8                           |
| 8  | Design of rectangular section columns at ULS (uniaxial bending with axial force – M-N interaction curves)    |
| 9  | ULS checks for columns under biaxial bending (M <sub>x</sub> -M <sub>y</sub> -N interaction curves)          |
| 10 | Design of R/C beams in shear at ULS (failure modes, role of transverse reinforcement)                        |
| 11 | Design of R/C beams in shear at ULS (design against shear force without seismic loading)                     |
| 12 | Design of R/C beams in shear at ULS (critical sections, design against shear force under seismic loading)    |
| 13 | Confinement requirements of R/C columns for increased local ductility demands                                |

**(4) TEACHING and LEARNING METHODS - EVALUATION**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                         |                          |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|--------------------------|--|
| <b>DELIVERY</b><br><i>Face-to-face, Distance learning, etc.</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Face-to-face lectures                                                                   |                          |  |
| <b>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</b><br><i>Use of ICT in teaching, laboratory education, communication with students</i>                                                                                                                                                                                                                                                                                                                                                                         | PowerPoint slides, communication via email, use of an online classroom system (eclass). |                          |  |
| <b>TEACHING METHODS</b><br><i>The manner and methods of teaching are described in detail.</i><br><i>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.</i><br><br><i>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</i> | <i>Activity</i>                                                                         | <i>Semester workload</i> |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Lectures                                                                                | 52 hours                 |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Study of course material                                                                | 30 hours                 |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Extra examples for practice at home                                                     | 10 hours                 |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Term project                                                                            | 30 hours                 |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Exam preparation                                                                        | 20 hours                 |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Final exam                                                                              | 3 hours                  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                         |                          |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Course total                                                                            | 145 hours                |  |

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| <p><b>STUDENT PERFORMANCE EVALUATION</b></p> <p><b>Description of the evaluation procedure</b></p> <p><i>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</i></p> <p><i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i></p> | <p><b>Language of Evaluation:</b><br/>Greek (or English for Erasmus+ students)</p> <p>The performance evaluation is conducted through:<br/>(a) Semester term project<br/>(b) Final written examination at the end of the semester (theory and exercises, simple and complex problem-solving)</p> <p><b>Evaluation Breakdown:</b></p> <ul style="list-style-type: none"> <li>• Semester term project (30% of the final grade)</li> <li>• Written exams (70% of the final grade)</li> </ul> <p><b>Evaluation Criteria</b> (applicable to both the semester project and written exams):<br/>The evaluator assesses the candidate's ability to:</p> <ul style="list-style-type: none"> <li>• Analyze and design R/C beams against bending and shear.</li> <li>• Analyze and design R/C columns against bending and shear (including confinement requirements).</li> <li>• Design R/C T-beam cross-sections.</li> <li>• Think critically and respond to problems related to R/C structures and their mechanical behaviour.</li> </ul> <p>The evaluation criteria are explained in class at the beginning of the semester.</p> |
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## (5) ATTACHED BIBLIOGRAPHY

### **-Suggested bibliography:**

1. Eurocode 2: Part 1-1 (EN1992-1-1)
2. Eurocode 8: Part 1 (EN 1998-1)
3. Koutas L. (2023) – “Reinforced Concrete I: Lecture Notes
4. Koutas L. (2023). “Design of Reinforced Concrete Linear Members”, Kallipos, Open Academic e-books. <http://dx.doi.org/10.57713/kallipos-307>
5. Tsonos A. – Design of Reinforced Concrete Structures to Eurocodes
6. Nilson, A., “Design of Reinforced Concrete Structures”
7. Fardis M., «Reinforced Concrete Notes»
8. Penelis, Stylianidis, Kappos, Ignatakis, «Reinforced Concrete Structures»