CES515 - Advanced Topics in Concrete Structures

Course Title	Advanced Topics in Concrete Structures				
Course Code	CES515				
Course Type	Compulsory				
Level	MSc (Level 2)				
Year / Semester	1st Year / 1st Semester				
Teacher's Name	Dr. Demetris Nicolaides				
ECTS	7	Lectures / week	3	Laboratories / week	0
Course Purpose and Objectives	The aim of the course is to discuss in class advanced topics related to the analysis and design of reinforced concrete structures.				
Learning Outcomes	By the end of the course, the students should be able to: 1. Apply the moment redistribution method for the analysis and design of indeterminate concrete structures. 2. Identify the possible failure patterns and successfully design reinforced concrete slabs by applying the yield line method. 3. Employ strip methods for the customized design of various types and configurations of concrete slabs. 4. Develop a thorough understanding of the concepts of structural robustness and the codes approaches regarding fire engineering. 5. Employ FRP and UHPFRCC composites for repairing and strengthening of reinforced concrete structures. 6. Apply Finite Element techniques for the analysis of the behaviour of reinforced concrete structures.				
Prerequisites	None	Corequisites	None		
Course Content	**Introduction:** Revision of design for bending and combined bending and axial force, Eurocode 2. **Moment Redistribution**: The topic describes the fundamentals of inelastic moment redistribution in indeterminate concrete structures. The fundamentals and statics of redistributed moments in indeterminate structures is discussed and explained in detail. Examples are presented for the analysis and the design of single-span and multi-span concrete beams in accordance to codes. **Yield Line Theory**: The basic principles of the Yield Line Theory are explained and its application as a versatile method for the design and assessment of reinforced concrete slabs is demonstrated. The intention is to give an overall appreciation of the method and comprehensive design guidance on its application to the design of some common structural elements. Emphasis is also given in the recognition of the possible failure patterns and situations where further investigation is required. **Strip Method for Slabs**: Introduction to the lower bound (static) approaches for the design of slabs, based on the satisfaction of equilibrium requirements everywhere in the slab. Description of the fundamental principles of				

	Hillerborg's Strip Method and the modified method proposed by Wood and Armer. Application of the methods in rectangular slabs, slabs that are fixed or continuous over their supported edges, slabs with an unsupported edge, slabs with holes. **Robustness and Stability**: Explain the concept of structural robustness and describe the methods for achieving robustness of structures. Analyse the design approaches, based on the required level of protection (low, medium, high) and introduce the concepts of Alternate Paths. Introduction to fire design of concrete members based on Eurocode and discuss methods for the improvement of performance of concrete members against fire. **Repairing and Strengthening**: Use of Fiber-Reinforced Polymers (FRP) and Ultra High Performance Fibre Reinforced Composites (UHPFRCCs) in repair and strengthening of structural elements. **FE Analysis**: discretisation, material modelling and finite element analysis of reinforced concrete structures.
Teaching Methodology	The course will be presented through theoretical lectures in class and educational field visits. The lectures will present to the student the course content and allow for questions. Part of the material will be presented using visual aids. The aim is to familiarize the student with the different and faster pace of presentation and also allow the instructor to present related material (photographs etc.) that would otherwise be very difficult to do. The learning process will be enhanced with the requirement from the student to solve relevant examples. These include self-evaluation exercises which will be solved in class. These exercises will not be graded. Exercises will also be given as homework which will be part of their assessment. Besides from the notes taken by students in class, all of the course material will be made available through the class website and also through the e-Learning platform. Finally the instructor will be available to students during office hours or by appointment in order to provide any necessary tutoring.
Bibliography	**Textbooks:** 1. Reinforced Concrete Design to Eurocode 2, 7th Edition, 2012, W.H. Mosley, R. Hulse and J.H. Bungey, Palgrave. 2. Designers' Guide to EN 1992-1-1 and EN 1992-1-2. Eurocode 2: Design of Concrete Structures. General Rules and Rules for Buildings and Structural Fire Design. A. W. Beeby and R. S. Narayanan, 2005. **References:** 1. EN 1992 Eurocode 2: Design of Concrete Structures 2. EN 1990 Eurocode 0: Basis of Structural Design 3. EN 1991: Eurocode 1: Actions on Structures
Assessment	The course is assessed through mid-term examinations, term project and a final examination. The criteria for assessment can be found on the individual assignments and exams. The weights of the course assessment are as follows: Midterm Exams: 20% Term Project: 20% Final Exam: 60%
Language	English