

Course unit title:	Concrete Technology		
Course unit code:	CE450		
Type of course unit:	Technical Elective		
Level of course unit:	Bachelor (1st Cycle)		
Year of study:	4		
Semester when the unit is delivered:	7 (Fall) or 8 (Spring)		
Number of ECTS credits allocated :	6		
Name of lecturer(s):	Dr. Demetris Nicolaidis		
Learning outcomes of the course unit:	<ol style="list-style-type: none"> 1. Analyse chemical composition of Portland cement, describe the hydration process and mechanism, explain the microstructure of hydrates, and specify the appropriate tests on physical properties of cement. 2. Analyse of the types of additions in concrete (e.g. ggbs, pfa), explain the origins and manufacture methods of such materials, analyse their chemical composition, describe the physical characteristics and their effects on the properties of concretes and mortars. 3. Analyse strength in tension and compression, describe the failure modes, explain the factors affecting strength, explain the maturity concept and identify the relation between compression and tensile strength. 4. Describe the microcracking phenomenon of concrete and the mitigation measures, and analyse the phenomena of creep, and shrinkage of concrete and the mitigation measures. 5. Explain the durability concept, highlight the causes of inadequate durability, describe the pore structure and analyse the transport processes of fluids in concrete, define the terms of absorption, water permeability, carbonation, acid, sulphate attack and alkali-silica reaction. 6. Analyse reinforcement corrosion, fire resistance, frost damage and delayed ettringite formation, and provide methods of achieving durable concrete. 7. Describe the main tests of concrete, explain the concept of reference testing, describe the accelerated testing methods, and partially destructive and non-destructive testing. 8. Analyse the problems involved in the quality of mixed concrete, describe control techniques, explain the principles for selection of the appropriate control procedure, and finally describe the methods for check of the quality of finished product. 		
Mode of delivery:	Face-to-face		
Prerequisites:	CE205	Co-requisites:	None
Recommended optional program components:			
Course contents:	<p>Cement: Introduce Portland cement and analyse its chemical composition. Describe the hydration process, introduce calcium silicate hydrates and explain the mechanism of hydration. Analyse the setting process and describe the microstructure of hydrates. Specify the appropriate tests on physical properties of cement. Review of the several types of cements, including blended cements.</p> <p>Additions to Concrete: Review of the types of additions, giving emphasis to silica fume, ground granulated blast-furnace slag (GGBS) and pulverised fuel ash (pfa). Explain the origins and manufacture methods of such materials and analyse their chemical composition. Describe the physical characteristics and their effects on the properties of concretes and mortars. Specify the applications of additions and the production of mixed blends (e.g. ternary blends).</p> <p>Aggregates: Describe the methods of classification of aggregates. Explain the importance of particle shape and texture. Analyse the bond, strength and other mechanical properties of aggregates. Explain the terms of specific gravity, bulk density, porosity, adsorption and moisture content of aggregate and analyse their importance. Analyse the soundness test of aggregate and the importance of the</p>		

	<p>alkali-silica and alkali-carbonate reactions of aggregates. Describe sieve analysis method, the fineness modulus and the grading curves. Explain the importance of the grading curves of fine and coarse aggregates and the effect of the maximum aggregate size. Describe the production methods and uses of artificial aggregates.</p> <p>Admixtures: Review the types of admixtures and highlight their applications and benefits. Identify the major types of admixtures. Explain the effects of admixtures on the properties of concretes. Describe the methods and the limitations of using of aggregates.</p> <p>Properties of Fresh and Hardened Concrete: Define workability and explain the need for sufficient workability. Analyse the factors affecting workability. Explain the methods of measurement of workability by different tests. Describe the effect of time and temperature on workability and explain the phenomena of segregation and bleeding. Explain the importance of proper mixing and vibration of concrete. Highlight the importance of water/cement ratio and also describe the term of porosity. Analyse strength in tension and compression, describe the failure modes and explain the factors affecting strength. Explain the maturity concept and identify the relation between compression and tensile strength. Highlight the importance of curing regimes. Describe the microcracking phenomenon of concrete and the mitigation measures. Analyse the phenomena of creep, and shrinkage of concrete and the mitigation measures.</p> <p>Durability of Concrete: Explain the durability concept and highlight the causes of inadequate durability. Describe the pore structure and analyse the transport processes of fluids in concrete. Define the terms of absorption, water permeability, carbonation, acid and sulphate attack on concrete and alkali-silica reaction. Analyse reinforcement corrosion, fire resistance, frost damage and delayed ettringite formation. Provide methods of achieving durable concrete.</p> <p>Test Methods and Equipment: Describe the main tests of fresh and hardened concrete. Explain the concept of reference testing and describe the accelerated testing methods. Analyse method of core drilling and testing and partially destructive and non-destructive testing.</p> <p>Special Concretes: Introduce special types of concretes, such as lightweight aggregate concrete, cellular concrete, high density concrete, fibre reinforced concrete, polymer concrete, high performance concrete, self-compacting concrete, self-cleaning concrete, self-healing concrete, cementless concrete, high strength concrete, recycled concrete, autoclaved aerated concrete, foamed concrete. Highlight the possible applications of special types of concrete.</p> <p>Quality Control: Examine the problems involved in the quality of mixed concrete. Describe control techniques and explain the principles for selection of the appropriate control procedure. Describe the methods for check of the quality of finished product.</p>
Recommended and/or required reading:	
Textbooks:	"Properties of Concrete", Fifth Edition, Adam Neville, Pearson, 2011.
References:	<p>"Construction Materials: Their Nature and Behaviour", Fifth Edition, edited by Marios Soutsos, Peter Domone, CRC Press; 2017.</p> <p>"Design and Control of Concrete Mixtures", 16th Edition, PCA, 2016.</p>
Planned learning activities and teaching methods:	<p>The course is delivered through theoretical lectures in class and demonstrations in civil engineering laboratory. The lectures present to the student the course content and allow for questions. Part of the material is 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, videos, etc.). The learning process is enhanced with the requirement from the student to solve relevant examples. Besides from the notes taken by students in class, all of the course material is available through the class website and also through e-learning</p>

	platform. Finally the instructor is available to students during office hours or by appointment in order to provide any necessary tutoring.
Assessment methods and criteria:	<ul style="list-style-type: none"> • Coursework 50% • Final Exam 50%
Language of instruction:	English
Work placement(s):	No