Course unit title:	Indeterminate Structures		
Course unit code:	CE240		
Type of course unit:	Compulsory		
Level of course unit:	Bachelor (1st Cycle)		
Year of study:	2		
Semester when the unit is delivered:	4		
Number of ECTS credits allocated :	5		
Name of lecturer(s):	Dr. Antonis Michael		
Learning outcomes of the course unit:	1. Develop shear force and bending moment equations and use geometric and virtual work methods to calculate beam deformations from applied loads. 2. Define and apply the principle of superposition for linearly elastic structures and its importance. 3. Classify determinate, indeterminate stable and unstable structures. 4. Apply the concepts of flexibility and stiffness for the analysis of statically indeterminate linearly elastic structures. 5. Analyse models of beams, frames and trusses using the force method and the moment distribution method 6. Appraise the suitability of various methods of analysis of indeterminate structures and validate the results.		
Mode of delivery:	Face-to-face		
Prerequisites:	CE110	Co-requisites:	None
Recommended optional program components:			
Course contents:	**Introduction to Structural Deformation:** Present the various types of deformations such as axial, shear and flexural deformation. Present the importance of deflection calculation in engineering and explain the necessity for the calculation. **Deflections:** Present different methods for the calculation of deflections in structural systems. Calculate deflections in beams using geometric (integration) methods. Calculate deflections in trusses and beams using energy methods (virtual work). **Introduction to Indeterminate Structures:** Define the term “Indeterminate structures” and differentiate between statically determinate and indeterminate structures. Determine the stability and determinacy of structures. Calculate the degree of indeterminacy and recognize the presence (if any) of geometrical instability. Also present the principle of superposition and its importance in the analysis of the indeterminate structures. **Flexibility Method:** Present the concepts of the flexibility method and show the methodology for its use. Define the base structure as well as the redundant structures and draw their deflected shapes. Write compatibility equations in terms of the redundant forces, based on the support conditions and structural configuration using the principle of superposition. Define the influence of the presence of the elastic supports and how these affect the compatibility equations. Solve the compatibility equations to obtain the redundants and then use for the complete analysis of the structure. Present the Maxwell's reciprocal theorem, the definition of the flexibility coefficient and formulate the flexibility method in matrix form. **Moment Distribution:** Present the historical importance of the moment distribution and the general concept of the load distribution/redistribution in individual members. Calculate the element stiffness factors, the joint stiffness factors, the distribution factors and also the fixed end moments. Setup a table for the implementation of the moment distribution for continuous beams and frames with no sway and use the table to calculate element end moments. Extent the method to include sway and		

	calculate the sway related force. Define the role of the sway force and calculate relevant fixed end forces. Setup a similar table to the one for the continuous frames and use to calculate additional moments related to sway. Finally calculate total element end moments, shears and external support reactions.
Recommended and/or required reading:	
Textbooks:	“Structural Analysis”, Russell C. Hibbeler, Prentice Hall; 2008.
References:	“Fundamentals of Structural Analysis”, Kenneth Leet, Chia-Ming Uang, Anne Gilbert., McGraw Hill Higher Education; 2007. “Structural Analysis and Behavior”, F. Arbabi, McGraw Hill, 1991. “Analysis and Behavior of Structures”, E. Rossow, Prentice Hall Inc., 1996
Planned learning activities and teaching methods:	The course will be presented through theoretical lectures in class. 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 exercises. These include self evaluation exercises which will be solved in class. These exercises will not be graded. Exercises will also be given as homework (final project) 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 eLearning platform. Finally the instructor will be available to students during office hours or by appointment in order to provide any necessary tutoring.
Assessment methods and criteria:	• Coursework 50% • Final Exam 50%
Language of instruction:	English
Work placement(s):	No