CES545 - Geotechnical Analysis

Course Title	GEOTECHNICAL ANALYSIS				
Course Code	CES545				
Course Type	Compulsory				
Level	MSc (Level 2)				
Year / Semester	1st Year / 1st or 2nd Semester				
Teacher's Name	Dr. Panicos Papadopoulos / Dr. Christakis Onisiphorou				
ECTS	7	Lectures / week	3	Laboratories / week	0
Course Purpose and Objectives	Within the Masters in Structural Engineering, an important course is one in the field of Geotechnical Analysis. Though most conventional geotechnical design like foundations is covered at undergraduate level, there is advanced material that suits the aim of the masters and combines well with the other structure related courses. Therefore, the purpose of the Geotechnical Analysis course is to provide students with additional knowledge in various advanced fields in geotechnical engineering, directly or indirectly related to structures. The objectives are as follows: students will develop skills for correctly interpreting geotechnical data, will be able to apply methods for modelling soil-structure interaction, select appropriate constitutive models, plan and perform finite element modelling of soil behaviour.				
Learning Outcomes	1. Develop skills to assess site conditions, interpret correctly geotechnical data and understand the importance of a geotechnical site investigation. 2. Apply complex design methodologies and analyses techniques for modelling typical soil-structure interaction problems. 3. Select appropriate constitutive models for modelling soil behaviour. 4. Plan the execution of a finite element analysis in geotechnical engineering. 5. Select appropriate geometrical conditions, meshing, types of analyses for finite element modelling. 6. Apply risk assessment techniques where appropriate for modelling site variability.				
Prerequisites	None	Corequisites	None		

Course Content	• **Site investigation**: importance and main stages of a site geotechnical investigation. Types of in-situ and laboratory tests. Interpretation of results and site characterization. Assessment of soil parameter values and site variability. Design considerations for problematic soils and expansive soils • **Design methodologies**: Eurocode 7 in geotechnical practice. Overview of conventional design methodologies. Design for uplift and hydraulic heave. Excavations. Examples. Settlement considerations and calculations for various applications. • **Techniques for geotechnical analysis**: methods of analysing geotechnical structures, e.g. raft foundations, piled rafts, pile groups, basement/retaining walls. • **Constitutive modelling**: modelling of soil behaviour using complex constitutive modelling. Yield and failure surfaces. Elastic, Simple Elastoplastic models. Critical state, nonlinear stiffness and double hardening models. Typical applications for geotechnical problems. • **Finite element modelling and analysis**: planning of finite element analysis, geometric considerations (plane strain, axisymmetric, 3d, boundary conditions), finite element meshing, stages of analyses (direct, gravity), construction stages, types of analyses (drained, undrained, consolidation). • **Risk analysis in geotechnical engineering**: probabilistic analysis, risk and reliability analysis. Probability of failure and reliability index. Stochastic modelling.
Teaching Methodology	The course will be presented through formal lectures in class and practical design examples. The lectures will present to the student the course content and allow time for questions and discussion. Part of the material will be presented using visual aids such as PowerPoint slides. Other parts of the course will involve solved examples on the board. Notes shall be taken by the students in class during lectures. In addition, all of the course material will be made available through the course 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	• Frank, R., Bauduin, C., Driscoll, R., Kavvadas, M., Krebs Ovesen, N., Orr, T.L.L. & Schuppener, B. 2004. Designer's Guide to EN 1997-1 Eurocode 7: Geotechnical Design-General Rules. Thomas Telford, 2004. • Bowles, J., Foundation Analysis and Design, McGraw-Hill, 2001. • Lees, A. Geotechnical Finite Element Analysis: A practical guide, ICE, 2016. • Potts, D.M. and Zdravkovic, L., Finite Element Analysis in Geotechnical Engineering", Vol. 1 & 2, Thomas Telford, 2001. • Hicks, M.A. (ed.) 2007. Risk and variability in geotechnical engineering. Thomas Telford, London. • Fenton, G. A. & Griffiths, D.V. 2008. Risk Assessment in Geotechnical Engineering. Wiley, New Jersey.
Assessment	The course is assessed through mid-term examinations, assignments 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 Exam: 20% Assignment: 20% Final Exam 60%
Language	English