**COURSE OUTLINE**

1. **GENERAL**

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| **SCHOOL** | SCHOOL OF ENGINEERING | | | | |
| **ACADEMIC UNIT** | DEPARTMENT OF CIVIL ENGINEERING | | | | |
|  | UNIVERSITY OF PATRAS | | | | |
| **POSTGRADUATE PROGRAM: TITLE** | Master’s Degree "Design of Resilient, Sustainable and Intelligent Infrastructures".  Tracks:  (A) Resilient Materials, Structures and Geotechnical Infrastructures,  (B) Hydraulic and Environmental Engineering for Sustainable Infrastructures, and  (C) Intelligent Systems in Transportation and Construction Project Management | | | | |
| **LEVEL OF STUDIES** | POSTGRADUATE PROGRAM | | | | |
| **COURSE CODE** | \*\*\*\* | **SEMESTER** | | SPRING (B’) | |
| **COURSE TITLE** | Modern Geotechnical Seismic Design | | | | |
| **INDEPENDENT TEACHING ACTIVITIES** *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* | | | **WEEKLY TEACHING HOURS** | | **CREDITS** |
| Lectures and Tutorials | | | 3 | | 7.5 |
|  | | |  | |  |
| *Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).* | | |  | |  |
| **COURSE TYPE**  *general background,  special background, specialised general knowledge, skills development* | Specialised General Knowledge | | | | |
| **PREREQUISITE COURSES:** | There are no prerequisite courses. It is anticipated, however, that students should have background of Soil Mechanics and Soil Dynamics | | | | |
| **LANGUAGE OF INSTRUCTION and EXAMINATIONS:** | Greek. | | | | |
| **IS THE COURSE OFFERED TO ERASMUS STUDENTS** | Yes | | | | |
| **COURSE WEBSITE (URL)** | \*\*\* new web site \*\*\* | | | | |

1. **LEARNING OUTCOMES**

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| **Learning outcomes** | |
| *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.*  *Consult Appendix A*   * *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* * *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* * *Guidelines for writing Learning Outcomes* | |
| At the end of this course the students will be able to:   1. Identify the Seismic Hazard in terms of ground shaking, structural hazards, liquefaction, landslides, retaining structures and lifeline hazards. 2. Understand the sources of seismic activity and ground motions parameters. 3. Use analytical and numerical models to predict the ground motion taking under consideration the effect of local site conditions and topography effects. 4. Estimate the risk against soil liquefaction. 5. Analyse and calculate the dynamic response of ground slopes and retaining structures. 6. Understand the principals and usage of seismic codes and microzonation studies. | |
| **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?* | |
| *Search for, analysis and synthesis of data and information, with the use of the necessary technology*  *Adapting to new situations*  *Decision-making*  *Working independently*  *Team work*  *Working in an international environment*  *Working in an interdisciplinary environment*  *Production of new research ideas* | *Project planning and management*  *Respect for difference and multiculturalism*  *Respect for the natural environment*  *Showing social, professional and ethical responsibility and sensitivity to gender issues*  *Criticism and self-criticism*  *Production of free, creative and inductive thinking*  *……*  *Others…*  *…….* |
| *•* Search for, analysis and synthesis of data and information, with the use of the necessary technology   * Production of new research ideas | |

1. **SYLLABUS**

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| **1. INTRODUCTION**  Background, Seismic Hazards (ground shaking, structural hazards, liquefaction, landslides, retaining structures failures, lifeline hazards), mitigation of seismic hazards, significant historical earthquakes.  **2. ELEMENTS OF ENGINEERING SEISMOLOGY**  Internal structure of the earth, continental drift and plate tectonics, faults, elastic rebound theory, location and magnitude of earthquakes.  **3. GROUND RESPONSE ANALYSIS**  One-Dimensional ground response analysis (linear approach, nonlinear approach). Two-Dimensional ground response analysis (dynamic Finite Element Analysis, equivalent linear approach. Effect of local soil conditions and topography effects.  **4. SOIL LIQUEFACTION**  Liquefaction related phenomena (flow liquefaction, cyclic mobility, lateral spreading). Evaluation of liquefaction hazards. Liquefaction susceptibility (historical criteria, geological criteria, state criteria). Liquefaction triggering (flow liquefaction surface, influence of Excess Pore Pressure, evaluation of initiation of liquefaction). Effects of liquefaction (Alteration of ground motion, Development of sand boils, settlement, instability)  **5. SEISMIC SLOPE STABILITY**  Types of earthquake – induced landslides. Earthquake-induced Landslide activity. Evaluation of slope stability. Static slope stability analysis (limit equilibrium analysis, stress-deformation analyses). Seismic slope stability analysis (analysis of inertial instability, analysis of weakening instability)  **6. SEISMIC DESIGN OF RETAINING STRUCTURES**  Types of retaining walls. Types of retaining wall failures. Static pressures on retaining walls. Dynamic response of retaining walls. Seismic pressures on retaining walls. Seismic displacements of retaining walls. Seismic Design considerations.  **7. SEISMIC CODES & MICROZONATION STUDIES** |

1. **TEACHING and LEARNING METHODS - EVALUATION**

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| **DELIVERY** *Face-to-face, Distance learning, etc.* |  |
| **USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY** *Use of ICT in teaching, laboratory education, communication with students* |  |
| **TEACHING METHODS**  *The manner and methods of teaching are described in detail.*  *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.*  *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* | |  |  | | --- | --- | | ***Activity*** | ***Semester workload*** | | Lectures & Tutorials | 39 | | Project | 100 | | Hours for private study | 48.5 | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | | *Course total* | ***187.5*** | |
| **STUDENT PERFORMANCE EVALUATION**  *Description of the evaluation procedure*  *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*  *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.* | 1. Written exams which include problem solving (20%)  2. Project evaluation (80%) |

1. **ATTACHED BIBLIOGRAPHY**

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| *- Suggested bibliography:*   1. Kramer S., L. (1995) “Geotechnical Earthquake Engineering”, Prentice-Hall, – 28 Dec. 1995 2. Day, R. (2012),” Geotechnical Earthquake Engineering Handbook”, 2nd Edition, Mc Grow Hill, 2012 3. Αθανασόπουλος, Γ. (2012) “Γεωτεχνική Σεισμική Μηχανική», Εκδόσεις Πανεπιστημίου Πατρών |