**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** | 6012 | **SEMESTER** | AUTUMN (A’) |
| **COURSE TITLE** | APPLIED MATHEMATICS |
| **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** |
|  | 3 | 7.5 |
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| *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* | General background |
| **PREREQUISITE COURSES:** | Typically, there are no prerequisite courses. Essentially, the students should possess knowledge of differential and integral calculus, as well as of differential equations (ordinary and partial). |
| **LANGUAGE OF INSTRUCTION and EXAMINATIONS:** | Greek |
| **IS THE COURSE OFFERED TO ERASMUS STUDENTS** | Υes (in English) |
| **COURSE WEBSITE (URL)** | https://eclass.upatras.gr/courses/CIV1555/ |

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*
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| It is the main course through which students come into contact with specific mathematical methodologies, with the help of which they can study various problems related to the science of Civil Engineering, such as problems of oscillations, deformations, hydraulics, wave propagation, traffic, etc. In particular, they are introduced in dimensional analysis, qualitative methods for the study of nonlinear systems of differential equations, approximate methods for solving nonlinear differential equations and advanced analytical methods for solving differential equations. In addition, several methodologies are implemented using packages of symbolic calculations.Upon successful completion of the course, students will be able to* Recognize problems in the science of civil engineering that can be addressed using specific mathematical methodologies.
* Use dimensional analysis to study various problems in the science of civil engineering and to extract useful information.
* Study qualitatively nonlinear systems of differential equations
* Solve differential equations, linear and non-linear, ordinary or partial, using approximate methods or advanced analytical methods
* Use symbolic calculation packages to implement the mathematical methodologies taught during the course.
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| **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…**…….* |
| * Working independently
* Production of free, creative and inductive thinking

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1. **SYLLABUS**

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| * Dimensional analysis.
* Curvilinear coordinate systems.
* Nonlinear systems of ordinary differential equations (equilibrium points, stability theory)
* Perturbation methods. Boundary layer analysis.
* Wave solutions of partial differential equations (travelling waves, standing waves, shock waves, solitons).
* Green functions.
* Implementation of various methods using symbolic packages.
* Applications to civil engineering problems.
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1. **TEACHING and LEARNING METHODS - EVALUATION**

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| **DELIVERY***Face-to-face, Distance learning, etc.* | Face to face lectures in the classroom or distant teaching if necessary |
| **USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY** *Use of ICT in teaching, laboratory education, communication with students* | Use of a scientific package of symbolic computations.Support via the eclass platform |
| **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* |

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| ***Activity*** | ***Semester workload*** |
| Lectures | 39 |
| Practice exercises | 38.5 |
| Essay writing | 50 |
| Hours for private study | 60 |
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| *Course total*  | ***187.5*** |

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| **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.* | The language of evaluation is Greek (or English in the case of Erasmus students).The evaluation procedure is done using one, a combination of all or some of the following ways, depending on the number of students participating in the course:1. two written exams (the first about the middle of the semester and the second after the end of the course) or one final written exam (EXA) where the students are asked to solve specific exercises and problems,
2. solving 6 groups of exercises, given during the lectures which are available at the eclass of the course, which must be delivered on specific dates,
3. preparation of an assignment (A) (individual or in group) related to the subject of the course, delivered typed and presented using slides

If all three of the above methods are used, the final grade (G) of the course is derived from the formulaG = (75% \* EXA) + (10% \* EXE) + (15% \*A),where EXA = the average of the grades of the two written exams or the grade of the final written exam, EXE = the average of the grades for the 6 groups of exercises and A = the grade for the assignment (which is determined both by the content of the work and by its presentation). Obviously, the above formula is modified appropriately if not all of the above methods are used. |

1. **ATTACHED BIBLIOGRAPHY**

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| *- Suggested bibliography:*1. C. M. Bender & S. A. Orszag, Advanced mathematical methods for scientists and engineers, Mc-Graw Hill Book Company, 1978.
2. W. E. Boyce & R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems., 10th edition, John Wiley & Sons, Inc, 2012.
3. J. D. Logan, Applied mathematics, 3rd edition, John Wiley & Sons, Inc,, 2006.
4. A. H. Nayfeh, Introduction to perturbation techniques, John Wiley & Sons, Inc, 1981.
5. N. Ioakimeidis, Notes and exercises in selected chapters of applied mathematics for civil engineers, 2014.
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