**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** | **GPOL\_C\_26304** | **SEMESTER** | SPRING(B’) |
| **COURSE TITLE** | **ENVIRONMENTAL HYDRAULICS** |
| **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 |
|  |  |  |
| *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:** | Open Channel Hydraulics (undergraduate) |
| **LANGUAGE OF INSTRUCTION and EXAMINATIONS:** | Greek |
| **IS THE COURSE OFFERED TO ERASMUS STUDENTS** | No |
| **COURSE WEBSITE (URL)** | https://eclass.upatras.gr/courses/CIV1512/ |

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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| Desired learning outcomes:1. Principles of velocity field hydrodynamic computation and velocity measurement techniques.
2. Methodologies for contaminant transport in inland and coastal waters.
3. Basic design principles for protection of waters from contamination.

Specific knowledge and competences:1. Proper use of equations for determination of the velocity field
2. Use of velocity field for contaminants transport and mixing.
3. Determination of contaminated area and containment plans
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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…**…….* |
| * Search for, analysis and synthesis of data and information, with the use of the necessary technology
* Decision-making
* Working independently
* Project planning and management
* Respect for the natural environment
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1. **SYLLABUS**

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| * Analysis and design for waste and heat disposal in receiving waters (rivers, lakes, reservoirs and coastal waters)
* Computation of velocity field and velocity measurement techniques
* Well – mixed-reactor model
* Mass and heat transport due to advection, diffusion and dispersion
* Modeling of non – conservative contaminants
* Design aspects
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1. **TEACHING and LEARNING METHODS - EVALUATION**

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| **DELIVERY***Face-to-face, Distance learning, etc.* | Face to face  |
| **USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY** *Use of ICT in teaching, laboratory education, communication with students* | Support of the learning process using the e-class 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 (3 hours by 13 weeks) | 39 hours |
| Home study | 39 hours |
| Literature search and review | 50 hours |
| Homework solution and submittal  | 50 hours |
| Preparation for final exam | 9,5 hours |
| *Course total*  | ***187,5 hours*** |

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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.* | Homework (60%)Final Exam (40%) |

1. **ATTACHED BIBLIOGRAPHY**

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| (*Indicative. The study of papers from international journals ia also assigned. In addition, the**students receive class notes prepared by the Instructor*)1. Boiten, W., **Hydrometry**, IHE Delft Lecture Note Series, A.A. Balkema, Rotterdam, 2000.
2. Fischer, H.B; List, E.J., Koh, R.C.Y., Imberger, J. & Brooks N.H., **Mixing in inland and coastal waters**, Academic Press, New York, 1979.
3. Harleman, D.R.F., “The past and future of environmental Hydraulics as applied to waste treatment and disposal in marine waters”, **Environmental hydraulics**, J.H.W. Lee & Y.K. Cheung (eds.), A.A. Balkema, Rotterdam, 1991.
4. Herschy R.W. (ed.), **Hydrometry: Principles and practices**, Second Edition, J. Wiley & Sons, Chichester, 1999.
5. Liggett, J.A., **Fluid mechanics**, McGraw-Hill, Inc., New York, 1994.
6. Müller, A. (ed.), **Discharge and velocity measurements,** IAHR Proc., Short Course, Zurich 26-28 August 1987, A.A. Balkema, Rotterdam, 1988.
7. Patankar, S.V. Spalding, D.B., **Heat and mass transfer in boundary layers**, Second Edition, Intertext, London, 1970.
8. Rastogi, A.K. & Rodi, W., “Predictions of heat and mass transfer in open channels”, **J. Hydr. Div.**, ASCE, Vol. 104, No HY3, 1978.
9. Rich, L.G., **Environmental systems engineering**, McGraw-Hill, New York, 1973.
10. Rodi, W., **Turbulence models and their application to hydralics: A state – of – the – art review**, Third Edition, IAHR Monograph, A.A. Balkema, Rotterdam, 1993.
11. Vreugdenhil, C.B., **Computational hydraulics: An introduction**, Springer – Verlag, Berlin, 1989.
12. Yannopoulos, P.C., Demetracopoulos A.C., “Contributions towards the prediction of velocity distribution in open channel flows”, Proc. Intl. Conf. Comp. Methods in Water Resour. XII, Crete, Greece June 1998, **Computational methods in surface and ground water transport**, V.N. Burganos et al. (eds.), Comp. Mechanics Publ., 1998a.
13. Yannopoulos, P.C., Demetracopoulos, A.C., “Comparison of two turbulence models for flow and mass transport computations in streams”, Proc. Intl. Conf., Halkidiki, Greece, July 1998, **Protection and restoration of the environment IV**, K.L. Katsifarakis et al. (eds.), 1998b.
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