6.3 CE0630 – Engineering Hydrology

(1) GENERAL

SCHOOL	ENGINEERING SCHOOL		
ACADEMIC UNIT	CIVIL ENGINEERING DEPARTMENT		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**CE0630**	**SEMESTER**	**6**
COURSE TITLE	**Engineering Hydrology**		

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**
	4	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*	Specialization Course
PREREQUISITE COURSES:	Fluid Mechanics (CE0430) English level B2 or higher is required for Erasmus incoming students
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek (English/Erasmus)
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/CIV218/

(2) LEARNING OUTCOMES

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*

Upon successful completion of the course students will:

1. Understand the object and methods of Engineering Hydrology, with emphasis on understanding how to construct and solve the water balance equation of a reference volume or a catchment area.
2. Understand the statistical methods in Engineering Hydrology, with emphasis on the calculation of extreme values of hydrological variables, especially the peak outflow rates at the drainage basin's outlet.

3. Understand basic concepts such as: catchment area, equivalent rainfall height, rainfall intensity and duration, hyetograph, spatial integration of rainfall point measurements, intensity-duration-frequency (idf) curves, actual vs potential evapotranspiration, infiltration rate, the Φ index, concentration time, peak runoff - rational method, hydrograph, correlation between active rainfall hyetograph and direct runoff hydrograph, unit hydrograph, hydrologic routing methods.

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	*Search for, analysis and synthesis of data and information, with the use of the necessary technology*
Adapting to new situations	*Adapting to new situations*
Decision-making	*Decision-making*
Working independently	*Working independently*
Team work	*Team work*
Working in an international environment	*Working in an international environment*
Working in an interdisciplinary environment	*Working in an interdisciplinary environment*
Production of new research ideas	*Production of new research ideas*

The course aims that the student acquires - practice the following general skills:

- Search for, analysis of, and synthesis of data and information, implementing appropriate technologies
- Decision-taking
- Independent work - Team work - Working in an international / interdisciplinary environment
- Respect natural environment - Social, professional and ethical responsibility

(3) **SYLLABUS**

INTRODUCTION
- The science of Hydrology
- The hydrological cycle
- Hydrological variables and their measurement units
- The spatial and temporal scale in Hydrology
- The hydrological budget – the water balance equation

INTRODUCTION TO THE STATISTICAL ANALYSIS OF HYDROLOGICAL PHENOMENA
- Basic concepts
- Frequency analysis of hydrologic variables
- Estimation of theoretical probability distributions
- Suitability check of a theoretical probability distribution
- Estimation of extreme values of hydrologic variables – return period and frequency factor
- Confidence intervals

PRECIPITATION
- Formation, precipitation mechanisms and types of precipitation
- Precipitation measurement (Rain gauges, snow measurement, meteorological radar, installation and networks of rain gauges)
- Homogenization and missing rainfall data estimation
- Surface integration of point rainfall measurements (methods of arithmetic average, Thiessen polygons, isohyetal lines) - Elevation correction of surface rainfall
- Rainfall intensity - duration-frequency (IDF) curves

EVAPORATION - EVAPOTRANSPIRATION
- Definitions - Processes
- Evaporation measurements: evaporation pan, atmometers.
- Evaporation estimation: water balance method, energy balance method, mass transfer method, combination method (Penman)
- Transpiration

Evapotranspiration (direct, indirect estimation, water balance methods, methods for determining potential evapotranspiration from climatic data, methods for determining true evapotranspiration)

INFILTRATION

Definition - Process

Infiltration calculation (Horton model)

The Φ index

RUNOFF

The catchment area

Hydrograph (hydrograph characteristics, hydrograph separation, factors influencing hydrograph shape)

Streamflow measurements (measurement techniques, stage-discharge curves)

Rainfall - runoff modelling: Empirical methods (Rational method of estimating peak outflow)

Rainfall - runoff modelling: Unit hydrograph (assumptions, unit hydrograph derivation, flood hydrograph estimation by unit hydrograph techniques, Snyder synthetic unit hydrograph)

FLOOD ROUTING

General concept

Flood routing techniques

Hydrologic flood routing in a river (the Muskingum Method)

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face in-class teaching. When needed, distance teaching (synchronous/asynchronous)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of I.C.T. in Teaching and Student Communication
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***
In Class (/Distance) Teaching	52
Literature Study	46
Exercises / Paradigms	52
Course total	**150**

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.*	Language of evaluation: Greek (English/Erasmus) Written examination, 2,5-hours Problem solving, Multiple choice test, Questions and Answers, Written Essay / Project The evaluation criteria are announced to the students well before the examination; weights per subject /exercise are explicitly indicated. The examination results (including total / partial grading) are announced on the web. Students may require to have access to their tests, they may ask for clarifications on mistakes, grading etc.

(5) ATTACHED BIBLIOGRAPHY

Greek Bibliography:

1. Μπαλτάς Ε. και Μιμίκου Μ., «Τεχνική Υδρολογία», 6η έκδοση, Εκδόσεις ΠΑΠΑΣΩΤΗΡΙΟΥ, 2018.
2. Κουτσογιάννης Δ. και Ξανθόπουλος Θ., «Τεχνική Υδρολογία», 3η έκδοση, Τυπογραφείο ΕΜΠ, 1999.
3. Τσακίρης Γ., «ΥΔΑΤΙΚΟΙ ΠΟΡΟΙ: Ι. Τεχνική Υδρολογία και Εισαγωγή στη Διαχείριση Υδατικών Πόρων»,
4. Εκδόσεις Συμμετρία, Αθήνα, 2013.
5. Τσακίρης Γ. Και Βαγγέλης Χ., «ΥΔΑΤΙΚΟΙ ΠΟΡΟΙ: ΙΙ. Εφαρμογές Τεχνικής Υδρολογίας», Εκδόσεις Συμμετρία,
6. Αθήνα, 2009.
7. Κωτσόπουλος Σ., «Υδρολογία», Εκδόσεις Ίων, 2006.
8. Σακκάς Ι., «Τεχνική Υδρολογία Τόμος Ι Υδρολογία Επιφανειακών Υδάτων», 2η έκδοση αναθεωρημένη, Εκδότης Χ.Ν. Αϊβάζης, Θεσσαλονίκη, 2007.

Foreign Bibliography:

1. Chow Te Ven, Maidment David and Mays Larry,"Applied Hydrology," 2nd edition, McGraw-Hill, 2013.
2. Maidment David, "Handbook of Hydrology," McGraw-Hill, 1993.
3. Hornberger, G. et al., "Elements of Physical Hydrology," Johns Hopkins University Press, 1999.