

COURSE DESCRIPTION

1. GENERAL INFORMATION

SCHOOL	CIVIL ENGINEERING		
DEPARTMENT			
EDUCATION LEVEL	Undergraduate		
COURSE CODE	1002	SEMESTER	8
COURSE TITLE	IRRIGATION ENGINEERING		
COURSE UNITS <i>σε περίπτωση που οι διδακτικές απονέμονται σε διακριτά μέρη του μαθήματος π.χ. Διαλέξεις, Εργαστηριακές Ασκήσεις κ.λπ. Αν οι διδακτικές απονέμονται ενιαία για το σύνολο του μαθήματος αναγράφεται εβδομαδιαίες ώρες διδασκαλίας και το σύνολο των διδακτικών μονάδων / ECTS</i>		HOURS	ECTS CREDITS
Lectures		3	6
<i>Προσθέστε σειρές αν χρειαστεί. Η οργάνωση διδασκαλίας και οι διδακτικές μέθοδοι που χρησιμοποιούνται περιγράφονται αναλυτικά στο 4.</i>			
COURSE TYPE: <i>Γενικού Υποβάθρου, Ειδικού Υποβάθρου, Ειδικότητας</i>	Specialization		
PREREQUISITE KNOWLEDGE:	None		
COURSE AND EXAMS LANGUAGE:	Greek		
COURSE OFFERED TO ERASMUS STUDENTS:	No		
COURSE WEBSITE (URL):	https://helios.ntua.gr/2022-23/user/preferences.php?userid=17569		

2. LEARNING OBJECTIVES

Learning Objectives <i>Περιγράφονται τα μαθησιακά αποτελέσματα του μαθήματος οι συγκεκριμένες γνώσεις, δεξιότητες και ικανότητες καταλλήλου επιπέδου που θα αποκτήσουν οι φοιτητές μετά την επιτυχή ολοκλήρωση του μαθήματος. Συμβουλευτείτε το Παράρτημα Α</i> - Περιγραφή του Επιπέδου των Μαθησιακών Αποτελεσμάτων για κάθε ένα κύκλο σπουδών σύμφωνα με Πλαίσιο Προσόντων του Ευρωπαϊκού Χώρου Ανώτατης Εκπαίδευσης - Περιγραφικοί Δείκτες Επιπέδων 6, 7 & 8 του Ευρωπαϊκού Πλαισίου Προσόντων Διά Βίου Μάθησης και Παράρτημα Β - Περιληπτικός Οδηγός συγγραφής Μαθησιακών Αποτελεσμάτων
By the completion of the course, the students will be able to: 1. Familiarize with the crop-soil-atmosphere relationship. 2. Estimate crop evapotranspiration using theoretical and empirical methods. 3. Calculate irrigation water needs, flow rate, dose, coverage, and irrigation duration. 4. Design irrigation networks according to prespecified irrigation water distribution systems. 5. Apply irrigation methods: surface, sprinkler, and localized (drip irrigation). 6. Design irrigation and drainage networks. 7. Understand the origin and quality of irrigation water and soils by applying suitability criteria. 8. Design and understand the operation of irrigation pumps. 9. Familiarize with flow meters in irrigation systems. 10. Acquaint with the management of irrigation water and the environmental impacts of irrigation projects.

General abilities <i>Λαμβάνοντας υπόψη τις γενικές ικανότητες που πρέπει να έχει αποκτήσει ο πτυχιούχος (όπως αυτές αναγράφονται στο Παράρτημα Διπλώματος και παρατίθενται ακολούθως) σε ποια / ποιες από αυτές αποσκοπεί το μάθημα;.</i>

Αναζήτηση, ανάλυση και σύνθεση δεδομένων και πληροφοριών, με τη χρήση και των απαραίτητων τεχνολογιών
 Προσαρμογή σε νέες καταστάσεις Λήψη αποφάσεων
 Αυτόνομη εργασία Ομαδική εργασία
 Εργασία σε διεθνές περιβάλλον
 Εργασία σε διεπιστημονικό περιβάλλον
 Παράγωγή νέων ερευνητικών ιδεών

Σχεδιασμός και διαχείριση έργων
 Σεβασμός στη διαφορετικότητα και στην πολυπολιτισμικότητα Σεβασμός στο φυσικό περιβάλλον
 Επίδειξη κοινωνικής, επαγγελματικής και ηθικής υπευθυνότητας και ευαισθησίας σε θέματα φύλου
 Άσκηση κριτικής και αυτοκριτικής
 Προαγωγή της ελεύθερης, δημιουργικής και επαγωγικής σκέψης

With the successful completion of the course, the ability is cultivated for:

- Searching, analyzing, and synthesizing data and information, using the necessary technologies
- Independent work
- Critical thinking
- Planning and managing projects
- Respect for the natural environment
- Decision making
- Design
- Working in an interdisciplinary environment
- Generating new research ideas

3. COURSE DESCRIPTION

The course covers the basic principles of designing and operation of irrigation works. Emphasis is placed on the analysis and calculation of irrigation water needs, the irrigation water distribution systems, the irrigation methods and the origin and quality of irrigation water. The course is divided into three sections. Initially, an introduction is provided to the categories of Irrigation Engineering Projects, the necessary design files, and the economic elements that comprise them. The second section focuses on the calculation of irrigation water needs, through the analysis of the soil properties and specifically the characteristics related to soil moisture and its relationship with crops and the atmosphere (evaporation). The third section deals with the design of irrigation and drainage networks, initially at the crop level (including the irrigation methods of surface, sprinkle and drip irrigation), as well as the design of collective networks. Finally, reference is made to new technologies for covering irrigation needs, e.g., rainwater harvesting tanks, and the qualitative characteristics of irrigation water (quality classification and suitability criteria). The course focuses on designing technical projects that enable the rational management of water resources and the exploitation of surface runoff.

1. Introduction: Basic principles and definitions. Historic evolution of irrigation studies and works. Pre-study of irrigation works and geotechnical/economic assessment.
2. Crops and irrigation: Crop-soil-atmosphere relationships. Measurement of soil water capacity, useful soil water capacity, description of root zone systems - crop water uptake. Methods of computing reference crop evapotranspiration (physically and empirically based). Crop growth stages, crop coefficient and actual crop evapotranspiration.
3. Irrigation water requirements: Methodology of estimating the gross irrigation water requirements and the irrigation scheduling (irrigation dose, time, frequency and efficiency) including water to combat soil salinity.
4. Design discharge of irrigation networks: Design water supply of irrigation networks under the water distribution systems of continuous water supply, rotation and free demand (probability concept).
5. Surface irrigation methods: Basic principles and computational methods for the design and operation of surface irrigation systems (flood irrigation, limited diffusion or furrows). Assessment of topsoil surface irrigation water flow characteristics. Assessment of computational methods of surface irrigation and water reuse from surface irrigation water losses.
6. Sprinkler irrigation systems: Hydraulics, design and operation of sprinkler irrigation systems. Water distribution uniformity and types of sprinkler irrigation systems (e.g., portable, semiportable, permanent systems). Move-set and solid-set irrigation systems. Sprinkler system components (pumps, main and lateral lines, sprinklers) and performance characteristics. Hydraulic computations for the assessment of flow characteristics in pipes of individual and collective sprinkler irrigation networks. Specific sprinkler irrigation systems for environmental protection, and injection of fertilizers, chemical ingredients and fluid waste.
7. Local and trickle irrigation: Methods of local irrigation: trickle, sub-surface irrigation, fountain and spraying irrigation. Irrigation system components (e.g., drippers, microjets: technology and hydraulics. Uniformity of irrigation water distribution. Irrigation layouts. Hydraulic calculations for the design and good operation of network pipes due to small design discharges. Control systems of

hydraulic head for purely irrigation water and water mixed with chemicals and fertilizers. Pumps installations, cleaning filters, equipment of chemicals injection, flow and pressure meters, and automation equipment. Management and evaluation.

8. Pumps for crops irrigation systems: Description of typical parameters and efficiency characteristics for two or more pumps operating in series or parallel. Pump efficiency consequences from speed and diameter changing of an impeller. Pump efficiency curves and irrigation system required for determining the hydraulic head and operation discharge of one or more pumps. Criteria for selecting the most suitable pump or combination of pumps.
9. Advent and quality of irrigation water-environmental consequences Description of surface water sources for crop irrigation (rivers, lakes, central irrigation water distribution facilities, industrial and agricultural returns and urban waste), groundwater (subsurface aquifers) and irrigation wells. Suitability conditions and irrigation water quality criteria (e.g., salinity, toxicity, content of exchangeable sodium, biocides, carbonate anions, suspended materials). Classification systems according to the appropriateness. Supply rate of water resources and soil improvement. Environmental consequences and irrigation water legislation particularly for territorial waters and water appropriation.
10. Flow meters in irrigation systems: Discharge measuring methods and devices in irrigation systems and open channels. Discharges and design of measuring devices in special applications (e.g., ultrasonic meters with or without application of Doppler phenomenon, Pitot pipelines, etc.).
11. Drainage and drainage systems: Definition, necessity and factors influencing drainage. Drainage from soil surface and root zone of crops. Surface water drainage with trench networks and root zone drainage with underground closed drainage pipes-drainage networks. Drainage network design (layout, maximum flow, depth, equilibrium, dimensioning and technical works). Design under constant flow conditions (equivalent depth method) and unstable flow (Boussinesq equation). Hydraulic calculations of drainage pipes (pipelines and drainage ditches). Drainage water pumping (design, operation and maintenance). Relief of aquifer or artesian wells (design, construction, operation, maintenance and disposal of water). Economic, legislative and environmental issues. Return flow and sewage disposal.

4. TEACHING METHODS – STUDENT ASSESSMENT

TEACHING METHODS: <i>Πρόσωπο με πρόσωπο, Εξ αποστάσεως εκπαίδευση κ.λπ.</i>	Face-to-face	
TEACHING MEDIA: <i>Χρήση Τ.Π.Ε. στη Διδασκαλία, στην Εργαστηριακή Εκπαίδευση, στην Επικοινωνία με τους φοιτητές</i>	Use of ICT in Communication with Students: course schedule, Notes, Assignments (assignment of tasks by the instructor and submission of assignments by the students, through helios)	
COURSE ARRANGEMENT: <i>Περιγράφονται αναλυτικά ο τρόπος και μέθοδοι διδασκαλίας.</i>	ACTIVITY	IMPORTANCE
<i>Διαλέξεις, Σεμινάρια, Εργαστηριακή Άσκηση, Άσκηση Πεδίου, Μελέτη & ανάλυση βιβλιογραφίας, Φροντιστήριο, Πρακτική (Τοποθέτηση), Κλινική Άσκηση, Καλλιτεχνικό Εργαστήριο, Διαδραστική διδασκαλία, Εκπαιδευτικές επισκέψεις, Εκπόνηση μελέτης (project), Συγγραφή εργασίας / εργασιών, Καλλιτεχνική δημιουργία, κ.λπ.</i>	Lectures	3 hours X 13 weeks
	Study	50 hours
	Written Assignment	31 hours
<i>Αναγράφονται οι ώρες μελέτης του φοιτητή για κάθε μαθησιακή δραστηριότητα καθώς και οι ώρες μη καθοδηγούμενης μελέτης ώστε ο συνολικός φόρτος εργασίας σε επίπεδο εξαμήνου να αντιστοιχεί στα standards του ECTS</i>	OVERALL:	120 hours
STUDENT ASSESSMENT:	Language of Evaluation: Greek Written Examination 70% (Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving) Written Assignment 30% (Report / Essay, Oral Examination)	

5. TEXTBOOKS – BIBLIOGRAPHY

- *Suggested Bibliography:*

- Panagoulia, D. and Dimos, G., 2000. *Introduction to Land Reclamation Works. Notes for the students of the 9th semester of the Civil Engineering Department, NTUA. Athens 2000 [in Greek]*.
- Tsakiris, G., 2006. *Hydraulic Works, Design and Management Volume II: Land Reclamation Works. Symmetria Publications. Page count: 776. ISBN: 9602661712 [in Greek]*.
- Terzidis, G.A., Papazafeiriou, Z.G., 1997. *Agricultural Hydraulics. Ziti Publications. Page count: 501. ISBN: 9604314041 [in Greek]*.
- Ali, H., 2010. *Fundamentals of irrigation and on-farm water management (Vol. 1). Springer Science & Business Media*.
- Finkel, H.J., 2019. *Handbook of irrigation technology (Vol. 1). CRC press*.
- Waller, P. and Yitayew, M., 2015. *Irrigation and drainage engineering. Springer*.
- Laycock, A. ed., 2007. *Irrigation systems: design, planning and construction. Cabi*.
- *Additional instructor notes and PowerPoint presentations posted on Helios.*

- *Related Scientific Journals:*

- *Agronomy Journal*
- *Agricultural Water Management*
- *Hydrological Sciences Journal*
- *Hydrology Research*
- *Irrigation Science*
- *Journal of Agrometeorology*
- *Journal of Agricultural Engineering*
- *Journal of Applied Hydrology*
- *Journal of Applied Irrigation Science (Germany)*