Course Title	Environmental Water Resources Management				
Course Code	DLCLIMA515				
Course Type	Elective				
Level	MSc (Level 2)				
Year / Semester	2nd / 3rd				
Teacher's Name	George Papaioannou				
ECTS	7.5	**Lectures / week**		**Laboratories/week**	
Course Purpose	Environmental water resources management includes planning, developing, using, and protecting water resources in a way that considers environmental sustainability and is essentially a part of Integrated Water Resources Management. This sector is vital for preserving ecosystem health, supporting biodiversity, and ensuring sustainable water supply for various human activities. Management encompasses both surface and groundwater. Some of the key aspects of environmental water resources management are: 1. Sustainable use of water resources. Creating conditions of balance between human needs and ecosystems and ensuring water availability for the present and future. Achievement can be made through the use of water-saving practices and new techniques and methods for water use (reduction of overconsumption/ overexploitation). 2. Biodiversity Conservation. Water resources are essential for maintaining healthy ecosystems (e.g., rivers, lakes, wetlands, etc.). Establishing and maintaining environmental flows for conserving biodiversity and habitats is important. 3. Integrated Water Resources Management. Achieving integrated water resources management requires coordination of management across all sectors (e.g., agriculture, industry, urban water uses, etc.) and optimization in water use. In this context, the participation of various specialties, stakeholders, local communities, etc., in the decision-making process is necessary.				

	4. Monitoring and evaluation of water resources. Regularly assessing the quality and quantity of water resources and their incorporation into management strategies is critical. This course aims to acquire knowledge on Water Resources Management (WRM) and its interaction with the environment. The course focuses on providing the theoretical background for water resources management, their availability, monitoring, assessment of the water balance of a waterhsed, estimation of sectoral and total water demand, water system management, provision of examples related to water resources management and interaction with the environment, introduction to concepts such as uncertainty analysis and optimization of water resources systems, introduction to integrated Geographic Information Systems (GIS) with decision-making systems in water resources, introduction to nature-based solutions for water resources management problems, as well as basic concepts for natural disasters with an emphasis on floods and drought.
Learning Outcomes	The expected learning outcomes include, among others: • Familiarize trainees with all parameters involved in integrated water resources management and understand the fundamental principles governing environmental water resources management. • Familiarize trainees with Directive 2000/60/EC and River Basin Management Plans. • Apply research methods and develop the ability to solve water balance problems using water balance models. • Develop the ability to estimate crop water needs using different irrigation methods and crop change scenarios. • Understand concepts such as integrated water resources management, uncertainty, and optimization of water systems. • Develop a critical approach to integrated water resources management emphasizing the environment. Additionally, they will be able to analyze water systems, recognizing their opportunities and limitations critically. • Understand, recognize, and analyze the challenges related to water resources management.

	• Develop the ability for critical thinking regarding various water resource management approaches so that trainees can propose improvements or alternative solutions such as nature-based solutions.		
Prerequisites		**Corequisites**	
Course Content	• Introduction and Basic Concepts of Water Resources Management • Water Resources Crisis at National and Global Level • Inland Water Quality Monitoring • Inland Water Quantity Monitoring • Environmental Water Resources Management Applications - Habitat Improvement • Watershed Water Balance Estimation • Sectoral and Overall Water Demand Estimation • Nature-Based Solutions for Water Resources Management Problems • Water Resources Systems Uncertainty Analysis and Optimization • Geographic Information Systems and Decision-Making Systems in Water Resources • Floods and Drought		
Teaching Methodology	**Distance Learning.** The course will provide the theoretical background through synchronous and asynchronous communication methods. The set of learning activities is supported by an electronic communication and learning platform. The main learning activities of the course are as follows: 1. Study of the required course literature. 2. Presentations of content or main points or specific studies in various formats (PowerPoint, oral presentations, annotated presentations). 3. Formulation and resolution of questions in a specialized forum.		

	4. Questions, quizzes, exercises, position papers, and other self-assessments. 5. Preparation of course assignments. 6. Participation in six meetings – video conferences (including the final exams).
Bibliography	**Textbooks** Selected chapters from: • Alamanos, A., & Garcia, J. A. (2024). Optimization Applications in Water Resources Management. In Elgar Encyclopedia of Water Policy, Economics and Management (pp. 182–187). Edward Elgar Publishing. https://doi.org/10.4337/9781802202946.00049 • Herrera, P. A., Marazuela, M. A., & Hofmann, T. (2022). Parameter estimation and uncertainty analysis in hydrological modeling. In Wiley Interdisciplinary Reviews: Water (Vol. 9, Issue 1). John Wiley and Sons Inc. https://doi.org/10.1002/wat2.1569 (Uncertainty section) • Pandey, A., Chowdary, V. M., Behera, M. D., & Singh, V. P. (Eds.). (2022). Geospatial Technologies for Land and Water Resources Management. Springer. • Zolghadr-Asli, B., Bozorg-Haddad, O., Enayati, M. et al. A review of 20-year applications of multi-attribute decision-making in environmental and water resources planning and management. Environ Dev Sustain 23, 14379–14404 (2021). https://doi.org/10.1007/s10668-021-01278-3 • Tennøe, S., Halnes, G., & Einevoll, G. T. (2018). Uncertainpy: A Python Toolbox for Uncertainty Quantification and Sensitivity Analysis in Computational Neuroscience. Frontiers in Neuroinformatics, 12. https://doi.org/10.3389/fninf.2018.00049 (Introduction section) • Loucks, D. P., & van Beek, E. (2017). Water Resource Systems Planning and Management. Springer International Publishing. https://doi.org/10.1007/978-3-319-44234-1 (pp. 331-370) **Selected chapters from reports:** • European Parliament. DIRECTIVE 2000/60/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 October 2000 establishing

	a framework for Community action in the field of water policy. https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2000L0060:20130913:ENG:PDF • Ministry of Environment and Energy. Management Plans RBDs. (Sections: Institutional framework, Content of a RBDMP,) https://wfdver.ypeka.gr/en/management-plans-en/ • UN-Water Expert Group. (2019) Climate Change and Water UN-Water Policy Brief. https://www.unwater.org/sites/default/files/app/uploads/2019/10/UN_Water_PolicyBrief_ClimateChange_Water.pdf • CEO WATER MANDATE SECRETARIAT. (2017). What Do "Water Scarcity", "Water Stress", and "Water Risk" Actually Mean?. https://ceowatermandate.org/posts/water-scarcity-water-stress-water-risk-actually-mean/ • WWAP (United Nations World Water Assessment Programme)/UN-Water. 2018. The United Nations World Water Development Report 2018: Nature-Based Solutions for Water. Paris, UNESCO. (pp. 1-128) • Sonneveld, B.G.J.S. Merbis, M.D. Alfarra, A. & Ünver, O. and Arnal, M.A. 2018. Nature-Based Solutions for agricultural water management and food security. FAO Land and Water Discussion Paper no. 12. Rome, FAO. 66 pp. Licence: CC BY-NC-SA 3.0 IGO. (pp. 11-16) • UN Environment-DHI, UN Environment and IUCN 2018. Nature-Based Solutions for Water Management: A Primer. (pp. 1-24) • UNDRR & CRED. (2020). The human cost of disasters: an overview of the last 20 years (2000-2019). (pp. 1 - 28) • Cools, J., Mishra, A., & Verbist, K. (2023). Best practices on flood and drought risk management (R. Marteleira, Ed.). United Nations Educational, Scientific and Cultural Organization. (pp. 6 - 31) • World Bank. (2020). An EPIC Response: Innovative Governance for Flood and Drought Risk Management. World Bank. https://doi.org/10.1596/35754 • Duel, Harm, Henk Wolters, Ingrid Timboe, Judith ter Maat and John Matthews, 2022. HELP Guiding Principles for Drought Risk Management

under a Changing Climate. Catalysing actions for enhancing climate resilience. HELP report

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- Raška, P., Bezak, N., Ferreira, C. S. S., Kalantari, Z., Banasik, K., Bertola, M., Bourke, M., Cerdà, A., Davids, P., Madruga de Brito, M., Evans, R., Finger, D. C., Halbac-Cotoara-Zamfir, R., Housh, M., Hysa, A., Jakubínský, J., Solomun, M. K., Kaufmann, M., Keesstra, S., … Hartmann, T. (2022). Identifying barriers for nature-based solutions in flood risk management: An interdisciplinary overview using expert community approach. Journal of Environmental Management, 310, 114725. https://doi.org/https://doi.org/10.1016/j.jenvman.2022.114725
- Oral, H. V., Carvalho, P., Gajewska, M., Ursino, N., Masi, F., Hullebusch, E. D. van, Kazak, J. K., Exposito, A., Cipolletta, G., Andersen, T. R., Finger, D. C., Simperler, L., Regelsberger, M., Rous, V., Radinja, M., Buttiglieri, G., Krzeminski, P., Rizzo, A., Dehghanian, K., … Zimmermann, M. (2020). A review of nature-based solutions for urban water management in European circular cities: a critical assessment based on case studies and literature. Blue-Green Systems, 2(1), 112–136. https://doi.org/10.2166/bgs.2020.932
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Assessment	The course assessment includes continuous/formative assessment activities, self-evaluation, and summative/final assessment. Specifically, the assessment of this course includes the following: a final written examination, 2 assessment assignments, 2 evaluative online interactive discussions, weekly educational activities such as self-assessment activities. The following are graded: • Final examination (50%) • 2 assessment assignments (15% + 20% = 35%) • 2 online interactive activities (7.5% + 7.5% = 15%) All tasks (except for the final examination) are assigned and submitted through the online platform, and they also go through a plagiarism check via Turnitin. The instructor develops the final exam, and students should complete it using a special platform that is used exclusively for examinations. Students have 4 weeks to complete each online evaluative discussion (total duration of 8 weeks) and 5 weeks to submit each assessment assignment (total duration of 10 weeks). It is at the discretion of each instructor to decide whether to grant an extension for the submission of assignments.

Language	Greek / English