UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2023/2024
MASTER'S DEGREE (MSC)	ENGINEERING AND INNOVATIVE TECHNOLOGIES FOR THE ENVIRONMENT
SUBJECT	SUSTAINABLE MANAGEMENT OF WATER RESOURCES
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50372-Ingegneria per l'ambiente e territorio
CODE	20562
SCIENTIFIC SECTOR(S)	ICAR/02
HEAD PROFESSOR(S)	CANDELA ANGELA Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**CANDELA ANGELA** Monday 11:00 13:00 presso Sezione idraulica DICAM piano 2° Thursday 11:00 13:00 presso Sezione idraulica DICAM piano 2°

DOCENTE: Prof.ssa ANGELA CANDELA

PREREQUISITES	Basic knowledge of hydrology, hydraulic construction and environmental engineering, expecially of reservoir regulation.
LEARNING OUTCOMES	Knowledge and capacities of understanding: The student at the end of the Course will figure out the issues concerning the configuration and the optimal management of simple and complex water systems. The student will acquire the knowledge of the evaluation principles of financial, economic and environmental costs connected to the realization, extenction and modernization of a water system. The ability to apply knowledge and understanding: The student will be able to apply the methodologies of operational research to the study of water systems and to set the cost-benefits analysis of different design alternatives. Judgment capacity: The student will have the knowledge of the issues concerning the optimal management of simple and complex water systems and the knowledge of the evaluation principles of financial, economic and environmental costs. Communication skills: The student will acquire the ability to draft a report about the iter followed for the application of operational research methodologies to the study of water systems and to prepare the cost-benefits analysis of various design alternatives, with the support of graphics, figures and charts. Learning skills: The student will be able to identify the best design and management alternative among the different water schemes from both an economic and a functional point of view.
ASSESSMENT METHODS	The student will be tested orally by three or more questions on the subjects of the course as treated in the textbooks. The final exam aims at testing the student knowledge and subject comprehension and his . skill of understanding and solving autonomously real simple cases. The student will be reach the pass mark when he proves his knowdedge and comprehension of the course subjects at least in general terms. He has also to show enough practical capacity in solving real cases and furthermore expository capacity in order to transfer his knowledge to the examiner. Under this pass mark, the exam will be considered failed. On the contrary more the student will be able to interact with the examiner by his reasoning and expository capacity, showing to be able to go into details of the subjects of the course , more the valuation will be positive . The score of the exam will be : - Excellent : 30 - 30 and praise out of 30 - Very good: 26-29 out of 30 - Good : 24-25 out of 30 - Satisfactory: 21-23 out of 30 - Sufficient: 18-22 out of 30 - Unsufficent; below the minimum of 18 out of 30; the candidate do not pas the exam
EDUCATIONAL OBJECTIVES	The course has the purpose to provide the knowledge of the issues concerning the optimal management of simple and complex water systems and the knowledge of the evaluation principles of financial, economic and environmental costs. The methodologies of operational research and cost-benefits analysis will be applied to the study of water and wastewater systems and different design alternatives, to verify their financial, economic and environmental sustainability.
TEACHING METHODS	Lectures; Classroom exercises.
SUGGESTED BIBLIOGRAPHY	Jain S.K. e Singh V.P. (2003). Water Resources planning and management. Elsevier Science B.V., Amsterdam, The Netherlands. Water Resources Handbook, McGraw-Hill, New York. D. Campisi e R. Costa - Economia applicata all'Ingegneria- Carocci Editore P.J. Ossenbruggen – System analysis for civil engineering. J. Wiley and Sons, New York. R. K. Turner, D.W. Pearce ae I. Bateman - Economia Ambientale - Il Mulino Editore L. Ortolano – Environmental regulation and impact assessment. J. Wiley and Sons, New York. D.P.Loucks and E. van Beek - Water resources systems planning and management Unesco Publishing, Delft Materiale didattico distribuito durante il corso.

SYLLABUS

Hrs	Frontal teaching
4	INTRODUCTION TO THE COURSE: Classification of water resources. Evolution in water management. Simple and complex water systems. Water supply sources. Uses of water. Problems relating to the use of water. Integrated and sustainable management of water resources.

SYLLABUS

Hrs	Frontal teaching
6	INSTITUTIONAL FRAMEWORK REGARDING THE USE AND MANAGEMENT OF WATER: The main Italian laws: Consolidated Law of 1933, General Regulatory Plan for Aqueducts, L. 319/1976 et seq., L. 183/1989 et seq., L. 36/94 . Legislative Decree 152/99. State of implementation of the legislation in Italy and Sicily. European Water Framework Directive 2000/60/EC. Legislative Decree 152/2006. Water and basin planning. The planning process. Sector plans. Basin plan: aims and contents; cognitive framework, planning of interventions. Water Protection Plan. The hydrographic districts after Law 221/2015.
10	ASSESSMENT OF WATER RESOURCES AND DEMAND: Assessment of surface water resources: data collection, analysis and validation, hydrological analyses, duration curves, estimate of minimum viable flow. Stochastic models for the generation of synthetic hydrological series. Classification of water demands. Evaluation of applications for civil, irrigation and industrial uses. Multiple use water systems. Economic evaluation of water for agricultural, industrial, energy, civil and environmental uses.
6	WORKS FOR THE USE OF SURFACE WATER: Derivations from natural watercourses: intake works; fixed and mobile branch crosspieces; Retention dams. Articles for the operation of a regulating tank.
10	SIMULATION AND OPTIMIZATION MODELS OF WATER SYSTEMS: Operation problems in a water system. Regulating tanks. Simulation of a tank. Simulation of tank systems. Evaluation of the performance of a water system. Application examples. Generalities and role of mathematical modeling in the planning and management of water resources. Water system modeling methods. Optimization methods: linear, non-linear and dynamic programming. Application examples.

Hrs	Practice
16	Exercises and examples on water resources management.