UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Scienze Agrarie, Alimentari e Forestali
ACADEMIC YEAR	2022/2023
MASTER'S DEGREE (MSC)	AGROENGINEERING AND FORESTRY SCIENCES AND TECHNOLOGIES
SUBJECT	AGRONOMIC IRRIGATION AND PHYTODEPURATION TECHNIQUES
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50564-Discipline forestali ed ambientali
CODE	19124
SCIENTIFIC SECTOR(S)	AGR/02
HEAD PROFESSOR(S)	LICATA MARIO Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	88
COURSE ACTIVITY (Hrs)	62
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**LICATA MARIO** Monday 10:00 13:00 presso stanza del Dott. Mario Licata, Dipartimento di Scienze Agrarie, Alimentari e Forestali, Viale delle Scienze 13, Edificio 4, Ingresso L, Piano 2

DOCENTE: Prof. MARIO LICATA

PREREQUISITES	The attendance of the course “Agronomic practices with irrigation and phytoremediation of polluted waters” requires the knowledge of Agronomy,for the understanding of the main content and objectives of the course. The course provides no mandatory prerequisites, but the knowledge of some subjects is needed to understand the main technical and practical problems of the course and to provide rational solutions.
LEARNING OUTCOMES	a) Knowledge and understanding The course permits students to gain knowledge about the main irrigation agronomic practices and also the constructed wetlands systems for the treatment and reuse of wastewater in agriculture. The course also allows to manage the water resource in agriculture by exploiting the irrigation techniques with an agronomic approach and constructed wetlands systems. The understanding of the main contents of the course requires a specific technical language of this course. b) Applying knowledge and understanding The main aim of the course is to encourage the students to develop skills to plan specific farming practices through a rational use of water resources considering the traditional irrigation techniques and constructed wetlands for the treatment of wastewaters. c) Making judgements The course requires students to be able to independently assess the effects of the use of irrigation agronomic practices and constructed wetlands systems on the management of water resource in agriculture in order to improve the farming activities exploiting the scientific research. d) Communications The course requires that students have communication skills in order to transfer clearly information and technical solutions to professionals, entrepreneurs, administrators and commentators. It requires that the dissemination activity is also carried out towards to a non-expert public. e) Lifelong learning skills The course requires that students are able to study issues of the course by consulting scientific literature, scientific publications and popular magazines. It requires, also, the ability to transfer the technical knowledge gained following the course or specific meetings, in business and professional sector.
ASSESSMENT METHODS	The course includes a final exam in order to assess the level of learing and knowledge of the student throught an oral test. The oral test consists of an interview in order to check the skills and disciplinary knowledge provided by the course. Evaluation will be provided as a mark out of 30. The interview will include openended and semi-structured questions in order to verify the gained knowledge, the computing and presentation skills of the student. With regard to the evaluation of knowledge, students have to be able to make connections between the course contents. The evaluation of computing skills will be determined by the student's ability to provide independent judgments about the course contents, to understand the possible practical application of the course and to place the subject content within the target professional context. With regards to the evaluation of the computing capacities, a high quality of language will be required for the reference professional context. The highest score (30/30 with honours) will be awarded to the student who will prove to have a high capacity for judgment, a strong ability to put into practice the knowledge of the course through examples and/or models, a strong ability to provide solutions to the main problematic and to have a high quality the technical language. The lowest score (18/30) will be awarded to the student who will prove to have a low capacity for judgment, a poor ability to put into practice the knowledge of the course through examples and/or models, a poor ability to provide solutions to the main problematic and to have a low quality the technical language. In particular, the assessment method will be deemed insufficient in the event that the student demonstrates that he / she possesses an extremely lacking knowledge of the teaching topics and a poor ownership of the sectoral language. The evaluation score will increase proportionally and will reach intermediate levels between 18 and 30 with honours as the degree of knowledge demonstrated by the student on general and specific topics increases.
EDUCATIONAL OBJECTIVES	The aim of the course "Agronomic practices of irrigation and phytoremediation of contaminated waters” is to provide knowledge and specialist skills related to the agronomic management of water resources with the use of traditional irrigation systems and constructed wetlands systems. The main agronomic aspects of irrigation and phytoremediation of contaminated waters will be explained and the reuse of wastewaters in agriculture for irrigation purpose will be considered. At the end of the course, some case studies regarding to the use of constructed wetlands in agriculture will be shown. The understanding of the topics requires the knowledge of Agronomy. The training will consist of frontal teaching, practices and technical-educational event to visit a constructed wetland system for wastewater treatment.

TEACHING METHODS	TThe course consists of frontal teaching, practices and a technical-educational event in order to visit a constructed wetland system for wastewater treatment.
SUGGESTED BIBLIOGRAPHY	Testi di riferimento: a) Borin M. Fitodepurazione. Impianti e tecnologie per il trattamento dei reflui con le piante. Edagricole editore, Bologna, Italia. ISBN: 8850648308. b) Giardini. Agronomia generale, aziendale e ambientale. Patron editore, Padova, Italia. ISBN: 8855526383. Letture di approfondimento: a) Bresciani R., Masi F. Manuale pratico di fitodepurazione. Terra Nuova Edizioni, Firenze, Italia. ISBN: 8866810029. b) International Water Association. Constructed Wetlands for Pollution Control. Scientific and Technical Report No. 8. IWA publishing, 2000. London, UK. ISBN: 9781900222051. c) Romagnoli F. Fitodepurazione. Gestione sostenibile delle acque. Dario Flaccovio editore, Palermo, Italia. ISBN: 9788857901152. d) Pubblicazioni scientifiche inerenti gli argomenti di irrigazione e fitodepurazione.

SYLLABUS

Hrs	Frontal teaching
1	Presentation and main aims of the course. An agronomic approach for irrigation systems and the use of constructed wetlands for wastewater treatment and reuse in agriculture.
1	Soil suitability to irrigation practice. Relationships between soil and water. Soil water potential. Water movement in the soil. Soil infiltration rate.
3	Crop water requirements. Reference, potential and crop evapotranspiration. Direct and indirect methods for the estimate of evapotranspiration. Main factors affecting crop water consumption. Calculation of crop water consumption according to FAO method. The Penman-Monteith FAO method. Other methods. The lysimeters, an overview. The crop coefficients. Soil water balance.
2	Overview of irrigation practice and irrigated agriculture. Types of irrigation. Agriculture irrigation variables. Specific volume of water. Irrigation intervention time. Efficiency and effectiveness of irrigation Case studies.
4	General description of the main irrigation systems. Irrigation project. Case studies.
6	Agronomic management of water. Increase of crop water availability. Reduction of water losses in the soil. Elements of dryland farming for the optimization of water resources in agriculture. Deficit irrigation. Overview of satellite remove sensing to support management of irrigation.
1	Water quality for irrigation purposes. Chemical, physical and microbiological characteristics.
2	Wastewaters. Definitions, types and regulatory frameworks. General description of conventional systems for wastewater treatment. Natural treatment systems. The phytoremediation of wastewaters as system for the optimization of the use of water resources in agriculture. Indices of environmental quality and pollutant removal performance.
1	Classification of the main phytoremediation systems for the treatment of contaminated water. Wetlands and constructed wetlands. Extensive phytoremediation. The buffer strips. Case studies and applications.
3	Constructed wetlands for pollution control. Free Water Surface system (FWS) constructed wetland. Horizontal subsurface flow system (HSSF) constructed wetland. Vertical subsurface flow system (VSSF) constructed wetland. Case studies and applications. Phytoremediation of wastewater 2.0.
3	Plant species for constructed wetland systems: classification, morphological characteristics, pollutants removal efficiencies. Root macrophytes. Role and functions of macrophytes in the treatment of wetlands and constructed wetlands. Monospecies and polyspecies systems. Establishment and maintenance. Substrate selection and characteristics of the main constructed wetland systems. Classification of the main bacterial populations and role and functions of the microorganisms in the constructed wetlands systems.
5	Constructed wetlands for domestic and agro-industrial wastewaters (dairy, olive mill, winery, etc.) treatment. Case studies and applications.
4	The reuse of treated wastewater from constructed wetlands in agriculture: considerations and perspectives from an agronomic point of view. Case studies.

Hrs	Practice
12	Practices for various topics such as crop water requirements, evapotranspiration, soil water balance and calculation of crop coefficients. Practice on crop water management.The main mathematical models for the design of HSSF and VSSF constructed wetlands. The Kadlec & Knight and Reeds, Crites & Middlebrooks methods. Practices on design of FWS, HSSF, VSSF systems and hybrid systems for agricultural wastewater treatment.

Hrs	Others
14	Technical-educational events to visit an experimental filed of various irrigated herbaceous crops and to visit a constructed wetland system for domestic and/or agro-industrial wastewaters treatment.