UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Scienze della Terra e del Mare
ACADEMIC YEAR	2019/2020
MASTER'S DEGREE (MSC)	ANALYSIS AND ENVIRONMENTAL MANAGEMENT
SUBJECT	BIOINDICATORS AND BIOMARKERS
TYPE OF EDUCATIONAL ACTIVITY	C
AMBIT	21017-Attività formative affini o integrative
CODE	20541
SCIENTIFIC SECTOR(S)	BIO/05
HEAD PROFESSOR(S)	PARISI MARIA GIOVANNA Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	94
COURSE ACTIVITY (Hrs)	56
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**PARISI MARIA GIOVANNA** Monday 10:00 12:00 Viale delle Scienze, Edificio 1690128 Palermo Tuesday 11:00 13:00 Polo territoriale di TrapaniSedi di svolgimento delle attivita didattiche (Principe di Napoli, TP)Colloquio on line per appuntamento Wednesday 10:00 12:00 Viale delle Scienze, Edificio 1690128 Palermo

DOCENTE: Prof.ssa MARIA GIOVANNA PARISI

PREREQUISITES	Basic knowledge of the disciplines acquired during the three-year degree in General and Systematic Zoology, Chemistry and cell biology, Elements of biochemistry
LEARNING OUTCOMES	1. Knowledge and understanding: Through lectures and collegial discussions the student learns the methods and acquires the skills to describe, study and analyze bioindicators and biomarkers in the field of biomonitoring up to elaborate and / or apply original ideas also in a research context. 2. Ability to apply knowledge: starting from the scientific literature on responses to natural and anthropogenic stress, the student evaluates and quantifies the effects of the perturbations at different hierarchical scale of the biological organization. It will also show the ability to solve problems with new themes inserted in wider contexts. 3. Making judgments: Through questions and a constant in the classroom, the student is able to develop the autonomy necessary to interpret data to discuss critically, the ability to integrate knowledge and manage complexity, set out his observations and the deductions drawn and the conclusions reached. 4. Communication skills: Ability to explain the acquired skills in a clear and unambiguous way and to disclose them with scientific rigor. Acquisition of relational skills essential to collaborate in multidisciplinary studies in the laboratory and in the field 5. Learning skills: continue to study mostly autonomously, apply their skills in the workplace and provide for their own update
ASSESSMENT METHODS	The exam will be oral and will consist of an interview, aimed to verify possession of the skills and disciplinary knowledge provided by the course. There evaluation will be expressed in thirtieths. The questions will tend to verify a) the acquired knowledge, through the ability to establish connections between the course content; b) the processing capabilities, through the capacity of place the disciplinary contents within the professional context, c) the possess an adequate exhibition capacity. EVALUATION CRITERIA - evaluation: excellent, grade: 30 - 30 and praise, excellent knowledge of the course topics, excellent ownership of language, excellent analytical skills, the student is able to apply knowledge to solve the proposed problems; - evaluation: very good, rating: 26 29, good knowledge of the topics of the course and analytical ability, full ownership of language, the student is able to apply the knowledge to solve the proposed problems; - evaluation: good, grade: 24 25, good knowledge of the main topics of the course, discrete language property, with limited ability to independently apply the knowledge to the solution of the proposed problems; - evaluation: satisfactory, grade: 21 23, knowledge partial of the main topics of the course, satisfactory language property, poor ability to autonomously apply the acquired knowledge; - evaluation: sufficient, grade: 18 20, minimum basic knowledge of main topics of teaching and technical language, little or nothing ability to autonomously apply the acquired knowledge
EDUCATIONAL OBJECTIVES	The course aims to provide the knowledge of the functional mechanisms underlying the interactions between animals and the environment, with particular reference to the marine environment, and to define the parameters of stress induced both by natural variables and by human activities The basics are provided for monitoring the quality of the environment and the identification of biomarkers in biological monitoring programs and environmental impact assessment. Students will be directed to the knowledge of descriptors bioindicators of natural systems and biomarkers at different spatial scales to understand the responses to chemical, physical and anthropic disturbance factors in a multidisciplinary context. Finally, methods for the detection and evaluation of molecular markers to be used in the study of adaptive molecular evolution and responses to stressors will be studied. Students will be encouraged to learn the use of free software, in the study of biomarkers and in professional applications
TEACHING METHODS	The teaching will be developed by the teacher in relation toher competence and the integration of lessons and laboratory experience. Specific study material will be provided as well as presentations of the lessons.
SUGGESTED BIBLIOGRAPHY	Cavalli. Il monitoraggio ambientale. Morgan Ottaviani. Compendio di immunobiologia comparata. Piccin Approfondimenti: -Slides, lavori pubblicati su riviste scientifiche del settore, report tecnico-scientifici.

SYLLABUS

Hrs	Frontal teaching
4	Animal models. Biological environmental monitoring. Species adopted in biomonitoring. Biomarkers and levels of biological organization. Biomarkers of exposure and effect.
6	Environmental pollutants (toxic solvents, alcohols, pesticides). Definition of xenobiotic. Solubility of xenobiotics. The enzymes of xenobiotic metabolism and their localization. Free radicals: Definition of free radical and chain reaction. Reactive oxygen species (ROS). Oxidative stress
8	Biomarkers classification: Metabolic products, protein and enzymatic responses. Biomarkers of genotoxicity, histopathological and morphological alterations, behavioral biomarkers.
4	Macroinvertebrates and vertebrates as a tool for the evaluation of anthropogenic disorders and stress environmental factors in the aquatic ecosystem
4	Species in biomonitization. Gradients in biodiversity and "hot spots". Alien species and changes in biodiversity
2	Biomarkers and communities. Biotic indexes.
6	Molecular marker technology. Population and bioindicator markers. Variation rates of DNA. Analysis methods and techniques for the determination of molecular and biochemical markers.
6	Assays of acute and chronic toxicity. Biosages and biosensors.

Hrs	Practice
16	Construction of an experimental plan. Applications of scientific methods to the study of environmental biomonitoring. Phyla model specimens of interest. Rating of biomarkers in the laboratory on bioindicator organisms. Bioinformatics applications.