Università degli Studi di Milano - Bicocca
DEPARTMENT OF EARTH AND ENVIRONMENTAL SCIENCES

MARINE SCIENCES

Student Guide
Academic Year 2020/2021

MASTER'S PROGRAMME

MARINE SCIENCES

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Master's Programme in

MARINE SCIENCES - SCIENZE MARINE

Ministerial Decree nr. 270 of 22/10/2004
Course Regulation – Academic Year 2020/2021

MARINE SCIENCES

Synopsis

Original programme name:	**MARINE SCIENCES - SCIENZE MARINE**
Course name in English:	**MARINE SCIENCES**
Class	**LM-75**
Primary Department:	**DIPARTIMENTO DI SCIENZE DELL'AMBIENTE E DELLA TERRA (DEPARTMENT OF EARTH AND ENVIRONMENTAL SCIENCES - DISAT)**
Normal Course duration:	**2 years**
Credits:	**120**
Address of the Master's Programme:	**Piazza della Scienza, 1 e 4 – 20126 – MILANO (MI)**
Website:	elearning Marine Sciences
Degree awarded:	**Master's Degree in MARINE SCIENCES - SCIENZE MARINE**
Joint degree:	**Yes**
Partner universities:	**The Maldives National University**

INTRODUCTION

The Master's Programme in Marine Sciences - Scienze Marine (LM-75) is an international programme jointly established with the Maldives National University.
The postgraduate programme provides advanced level instruction to prepare students for professional careers requiring high-level qualifications in the field of Marine Sciences. The Faculty is made up of experts from the Università degli Studi di Milano-Bicocca, the Maldives National University, as well as other non-Italian universities and research organizations.

The programme has a duration of two years. The Master's Degree in Marine Sciences-Scienze Marine carries 120 University Education Credits (CFUs), and entails 12 exams, to be passed in compliance with the Italian law. The Master's Degree is jointly awarded by the Università degli Studi di Milano-Bicocca and the Maldives National University.

The official language of the Master's Degree course is English.

SPECIFIC AIMS AND STRUCTURE OF THE PROGRAMME

The Master's programme fully complies with the European standards for Environmental Sciences, delivering training with particular focus on marine biology, chemistry, ecology, Earth sciences, and socio-economic and legal aspects pertaining to the marine environment. Emphasis is placed on the study and assessment of natural processes and human activities impacting the oceans, from the perspective of the sustainable management. Special focus is given to integrated coastal management and maritime spatial planning (MSP), using advanced IT tools together with field and laboratory analyses as part of an interdisciplinary approach to in-depth assessments of marine habitats. This interdisciplinary approach to the complex interactions between the natural environments - the geosphere, hydrosphere, biosphere and atmosphere - and human activities in

the various oceanic settings, allows students to assess and envisage appropriate use of natural resources in compliance with the European Marine Strategy.

The Master's Programme is designed to build on the students' knowledge, providing in depth training in specific areas of study. Students will be prepared to use the latest methods and technologies in Environmental Sciences to collate a range of different data from a variety of sources.

The Master's Programme trains graduate students to independently develop solutions and strategies, with particular focus on the following:
- study and analysis of the natural processes in the marine ecosystem, including all chemical, biological, environmental, and Earth science aspects, and related risks;
- study and analysis of human interaction with the marine system, involving socio-economic and legal considerations, with a view to developing sustainable management policies and offsetting human-induced hazards to the coastal and oceanic environment.

The learning activities are aimed to ensure:
- a solid grounding on the marine environment (compulsory activities);
- specialist knowledge for the identification and development of specific methods for in-depth investigation and data analysis in the marine system (compulsory, multiple-choice, student-selected activities);
- knowledge of scientific methods and conceptual tools geared to identify, assess, manage, and avert risks for the marine environment and coastal populations (compulsory, multiple-choice, student-selected activities);
- the ability to apply the principles of sustainability and environmental ethics to tackle monitoring, control and management problems concerning the structure and functioning of marine and coastal environments, also in relation to human activities (compulsory, multiple-choice, student-selected activities);
- the skills to assess resources and environmental impacts using models and methods available to natural sciences, social economics, legal studies and environmental planning (compulsory, multiple-choice, student-selected activities).

The following activities will also support the achievement of the learning aims:
- individual study of specific subjects with the aid of academic literature and specialist international reviews;
- oral and/or written reports and individual or group seminars in English;
- independent hands-on use of specialist tools – IT systems, specific software – in institutional laboratories and in the field, completing retrieval and data-processing of data available from online databanks;
- extramural activities such as internships/placements with companies, public administration facilities and laboratories, as well as study periods at non-Italian universities within the framework of international agreements.

The Master's Degree course delivers teaching based on the scientific and cultural expertise available within the University and in light of specific requests from the labor market. The overall aim of the course is to create experts with specialist skills in a range of fields, such as:
1. Ecology and Marine Biology,
2. Earth Sciences,
3. Human and Natural Ecosystems,
4. Maritime Sociology.

Expected learning outcomes are expressed with European Descriptors (Min. Decree 16/03/2007, art. 3, para. 7)

Knowledge and understanding
The knowledge and understanding gained during the Master's Programme builds on the competences gained during the first level (Bachelor's) Programme, enabling graduate students to develop and apply methods of analysis, assessment and management in the marine environment. More specifically, graduates with a Master's Degree will:
- be fully conversant with the scientific method and have a holistic understanding of the environment, especially the marine environment and related disciplines such as chemistry, bio-ecology, Earth Sciences, technology and assessment methods;
- be fully conversant with the methods of analysis used in the different disciplines and how differently sourced data can be represented and integrated into broader regional information systems;
- be able to assess data and information regarding marine ecosystems and understand the interaction between the natural world and the different aspects of human activity, with particular focus on the attendant social, legal and economic issues (legal and economic disciplines).

Knowledge and critical understanding are acquired by attending face-to-face classroom lectures, hands-on practical and laboratory sessions, seminars, internships/placements, and with individual study. The knowledge and skill sets acquired will be assessed by examination.

Skills
Graduates will acquire an in-depth understanding of environmental issues. They will be able to apply the innovative, interdisciplinary skills to solve environmental problems. More specifically, graduates will be able to:

- operate autonomously in a managerial capacity in the marine, coastal or laboratory environment;
- apply assessment methods and investigation techniques to coastal and marine environments using tools from a range of scientific disciplines such as chemistry, biology, Earth sciences, ecology, legal studies and economics;
- plan monitoring, control and management activities in the marine environment and nearby coastal areas with a view to safeguarding humanity and the ecosystem from natural and manmade risks;
- apply ethical and sustainability criteria to assess human impact on the marine environment and the quality of its natural resources;
- promote and coordinate activities to support the environmental policies of public administrations and private bodies, and contribute to raising public awareness of the results of man's interaction with the environment;
- actively participate in integrated coastal management and successful maritime spatial planning, applying their expertise in environmental impact and strategic environmental risk assessments, pollutant control measures and treatment plant management, remediation programs, waste disposal management, and pollution cleanup techniques.

The skills are gathered by attending face-to-face classroom lectures, hands-on practical and laboratory sessions, seminars, internships/placements, and with the preparation of a final dissertation.
Learning outcomes and the skill sets acquired will be assessed by examinations and a final dissertation.

Responsibility and autonomy
Graduates will be able to work independently in positions of responsibility in the field of Marine Sciences. During the course, they will be trained to characterize and assess the reliability of the gathered information, the level of uncertainty presented by data and assessments, and the complexity of the models available to solve specific problems. As a result, graduates will be able to make independent judgments regarding problems and put forward solutions even on the basis of limited or incomplete information. In addition, graduates will acquire an ability to assess the environmental and socio-economic consequences of choices and possible solutions. Learning objectives are attained by personal study and in-class discussion of real cases, internships, and preparation of the final dissertation. Achievement of the learning goals will be assessed by examination.

Communication skills
Graduates will be trained to communicate the results of their assessments and proposed solutions succinctly and effectively, both to a specialist public, and to a general audience. They will learn how to dialogue with experts from other sectors, recognizing and appreciating complementary views.
Graduates will be expected to prepare written dissertations on independently-selected subjects, as well as make oral presentations at seminars on specified topics. Written and oral communication skills will be assessed by examination.

Learning skills
The course will train graduate students to locate and make use of the main sources of data and information, in order to build their base of knowledge and enable them to tackle environmental and social problems in the marine and coastal environment.
Graduate students will learn a scientific method that will serve as a tool for objective-oriented, independent activity or teamwork.
Learning skills will be a focus throughout the course. The level of achievement will be assessed by examinations and in the final dissertation.

The Programme offers three possible tracks, detailed in the following.

Marine Biological Sciences

Graduates with a Master's Degree will have an in-depth knowledge in marine biology and ecology, as well as capabilities in sampling and analyzing the biological/ecological features of a given environment and assessing risks and hazard levels in marine and coastal areas. The course will also prepare graduate students in the biological assessment of water resources and their management.
The acquired knowledge and skills will allow graduates to conduct basic and applied research in the marine sector, including aspects related to the biosphere in relation with the hydrosphere, the geosphere, and the atmosphere.

The Master's Programme offers the following classes in the field of marine biology and ecology:

- Fundamentals of Marine Biology, BIO/5 - 6 credits
- Biodiversity and Marine Ecology, BIO/07 -12 credits
- Marine Invertebrate Zoology, BIO/05 – 6 credits
- Marine Vertebrate Zoology, BIO/05 – 6 credits
- Coastal and Marine Botany, BIO/01 – 6 credits
- Management of Aquatic Resources: Fisheries, BIO/07– 6 credits

- Marine Molecular Biology, BIO/11 – 6 credits
- Marine Environmental Microbiology, BIO/19 – 6 credits

Marine Geological Sciences

Graduates will have knowledge and understanding of the geomorphology and geophysics required to conduct marine geological and geophysical characterization surveys in order to assess risks and hazards in the continental shelves and slopes. Geobiology expertise, including sea-bed and water-column sampling techniques, will enable graduates to assess the interaction between the biosphere, hydrosphere, and geosphere. Graduates will gain an understanding of biogeochemical flows that allow comparison of present-day and past marine environments, also as a function of ongoing climate change.
The knowledge and analytical capability acquired in the Master's Programme may be applied for conducting basic and applied marine environmental research in order to draw up geomorphological, bathymetric, sediment and geological surface maps, and to provide the geophysical, sediment and geomathical data needed for detailed habitat maps. Graduates will also be able to contribute significant data to analyze changes to marine ecosystems during the Pleistocene and Holocene. They will also be able to contribute to future scenario forecasting.

The Master's Pogramme offers the following courses in the field of Marine Geology and Oceanography:

- Fundamentals of Marine Physical Geography, GEO/04 - 6 credits
- Physics of the Sea, FIS/06 - 6 credits
- Geobiology, GEO/01 – 6 credits
- Biofacies, GEO/01 – 6 credits
- Paleoceanography and Paleoclimatology, GEO/01 – 6 credits
- Applied Geomorphology and Habitat, GEO/04 – 6 credits
- Ocean Monitoring and Data Analysis, GEO/12 – 6 credits
- Coastal Risks and Dynamics, ICAR/02 – 6 credits
- Applied Marine Geology, GEO/01 – 6 credits

Human and Natural Ecosystem

Graduates will have knowledge and skills in the social, legal, anthropic and political processes that have a bearing on marine, coastal and island regions and marine life. They will be familiar with the tools and models used in spatial analyses and social research, with emphasis on geopolitical issues regarding the sea, environmental change, resource protection, tourism, human ecology, island and coastal system, the law of the sea, and maritime sociology. Graduates will be able to understand and interpret these issues within the framework of the continual (and complex) processes of transformation, that marine, coastal and island regions are presently undergoing. They will also be able to understand the specificities of maritime life and manage the underlying complexities.
Students will learn to operate with concepts deriving from different disciplines, enabling them to understand and work with the social and environmental interactions that characterize marine, coastal and island regions, namely: the geopolitics of the sea, risk management, the safeguard of anthropic systems, socio-environmental resilience, the impact of tourism on coastal areas, and the specificity and complexity of the social relations inherent to maritime activities. This body of knowledge can be applied in a range of professional fields such as international relations, legal contexts and marine resources management.

The Master's Degree offers the following courses in the field of Human and Natural Ecosystems:

- Chemistry of the Marine Environment, CHIM/12 - 6 CFU
- Coastal and Marine Hazard and Resilience, M-GGR/02 – 6 CFU
- Environmental Justice and Geopolitics of the Sea, M-GGR/02 – 6 CFU
- Human geography of Small Island Systems, M-GGR/01 – 6 CFU
- International Law of the Sea, IUS/13 - 6 CFU
- Ocean Resources Law and Policy, IUS/10 – 6 CFU
- Coastal and Maritime Tourism, M-GGR/02 – 6 CFU
- Maritime Sociology, SPS/08 – 6 CFU (NOT AVAILABLE IN ACADEMIC YEAR 2019-2020)

CAREERS AND OPPORTUNITIES

Career opportunities for graduates in Marine Sciences include positions as marine environment analysis and management experts, marine biologists and ecologists, marine and coastal resources experts, marine and coastal environmental policy experts, and human relations experts in maritime activities.

Functions

Graduates in Marine Sciences can find employment in both the public and private sectors of the national and international job markets, in the assessment and management of marine systems, under varying degrees of anthropic pressure.
The public sector offers diverse employment opportunities, ranging from jobs with central authorities, such as ministries and national research organizations, to posts with regional entities and different types of local administrations and public bodies. Graduates will be qualified to occupy positions requiring an ability to assess the specific measures needed in a given environmental system in light of cost/benefit parameters and socio-economic considerations.

In the private sector, companies producing goods and services offer positions of responsibility involving the organization, assessment, and management of all issues connected with the interaction between the company production and the coastal marine systems.

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Competences

The course will provide training in the following sectors:
- Natural resources: management of reserves and protected areas, tourism cultural training programs;
- Dissemination of scientific information;
- Coastal protection: regional planning, advisory services on coastal erosion, depletion of biodiversity on account of anthropic activity;
- Fisheries and aquaculture: provision of expert consultancy services on fishing activities and fish farming;
- Maritime spatial planning: advisory services on natural, social, legal and regional planning issues. Focus on: implementation of experimental projects, the use of key lab analysis techniques, data analysis, field sampling, national and international environmental safeguard regulations, specialist knowledge of species and habitats protected by national and international laws, expertise in key environmental management issues and the legal instruments covering them, environment characterization and impact assessment techniques, analysis of the specific social relations arising in the maritime transport and offshore infrastructure sector.

Job Opportunities

The Master's Degree opens up job opportunities in both the public and private sectors. In the public sector, graduates can carry out scientific research in universities and research institutions, applied research and risk monitoring services with ministerial or local bodies with responsibility for the management of marine and coastal areas, consultancy on environmental issues and protected areas, and dissemination of scientific information.

In the private sector, there are employment opportunities with companies producing good and services offerings positions of responsibility involving the organization, assessment, and management of all issues involving interaction of company production operations with coastal marine systems. In particular, there are employment possibilities in: environmental consultancy and impact assessment of coastal and offshore infrastructure; management responsibilities in laboratories conducting environmental quality and food safety controls; advisory services on anthropic activities in coastal and marine areas; and scientific dissemination services.

Graduates with a Master's Degree in Marine Sciences – Scienze Marine are admitted to the state examination for accessing those professional bodies with this statutory requirement.
On the basis of the Italian ISTAT system of categorization of professions, Marine Scienes graduates may be employed in the following professional categories:

Program		Category		Professional Unit	
2.3.1	Life Science specialists	2.3.1.1	Biologists, Botanists, Zoologists and allied professions	2.3.1.1.1	Biologists and allied
2.3.1	Life Science specialists	2.3.1.1	Biologists, Botanists, Zoologists and allied professions	2.3.1.1.6	Zoologists
2.3.1	Life Science specialists	2.3.1.1	Biologists, Botanists, Zoologists and allied professions	2.3.1.1.7	Ecologists
2.6.2	University researchers and graduate technical operators	2.6.2.2	Researchers and graduate technical operators in life sciences and health	2.6.2.2.1	Researchers and graduate technical operators in the biological sciences

ADMISSION RULES

Applicants to the Master's Degree in Marine Sciences - Scienze Marine must possess a first-level, three-year (Bachelor's) university degree or diploma, or a recognized qualification from a non-Italian institution.

More specifically, admission to the Master's Degree course in Marine Sciences - Scienze Marine is subject to applicants being in possession of at least 18 credits (CFUs), testifying to a basic grounding in the following disciplines:

- Chemistry and allied areas (CHIM/01, CHIM/02, CHIM/03, CHIM/06),
- Biology and allied areas (BIO/01, BIO/05),
- Earth Sciences (GEO/04, GEO/07),
- Ecology and allied areas (BIO/03, BIO/07).

The English language skills - equal to a B2 level - of candidates must also be certified by the University or by an institution accredited by the University.

ADMISSION PROCESS

Assessment of applicants' suitability to attend the course will be carried out by means of a written examination (questionnaire) and an interview to evaluate their basic knowledge of geology, biology, chemistry and geography, all necessary prerequisites to complete successfullythe proposed programme. The preliminary exam and interview are also an opportunity for the admission committee to indicate areas requiring further study for each applicant, and suggest preparation courses and/or personalized study plans. Should candidates have significant knowledge gaps, they will be advised on the particular topics requiring further study in order to be accepted in the Master's Programme. Both the written examination and ithe nterview will be conducted in English. Dates and details will be posted on the Master's Programme website: elearning Marine Sciences.

ORGANIZATION OF THE PROGRAMME

The courses are geared to investigating a range of environmental issues such as: marine environment sustainability; sustainability of human activities and their effects on the marine environment; land-use management; assessing and managing marine resources; assessing the quality and remediation of coastal and marine environments; assessing the hazards posed by human activities; management of the consequences of climate change.

The Master's degree in Marine Sciences - Scienze Marine is issued after obtaining 120 credits (CFU), as follows: 48 credits from compulsory core courses that provide common interdisciplinary knowledge and competence in the field of environmental studies; 4 multiple-choice courses (2 in the first year and 2 in the second year) for a total of 24 credits; 12 credits from student-selected learning activities, 4 credits acquired with internships/placements pertinent to the preparation of the student's final dissertation, to be carried out in Italian and/or international laboratories, companies and institutions; 4 credits earned in the area of "further language skills". The final dissertation provides 28 credits.

COURSES

1st YEAR

COMPULSORY CORE COURSES

- Chemistry of Marine Environment, CHIM/12 - 6 credits –1 exam
- Fundamentals of Marine Biology, BIO/05 - 6 credits – 1 exam
- Fundamentals of Marine Physical Geography, GEO/04 - 6 credits – 1 exam
- Biodiversity and Marine Ecology, BIO/07 -12 credits – 1 exam
- Physics of the Sea, FIS/06 - 6 credits – 1 exam
- International Law of the Sea, IUS/13 - 6 credits – 1 exam

MULTIPLE-CHOICE COURSES

Students must choose 2 of the following courses:
- Marine Invertebrate Zoology, BIO/05 – 6 credits – 1 exam
- Marine Vertebrate Zoology, BIO/05 – 6 credit – 1 exam
- Geobiology, GEO/01 – 6 credits – 1 exam
- Biofacies, GEO/01 – 6 credits – 1 exam

- Environmental Justice and Geopolitics of the Sea, M-GGR/02 – 6 credits – 1 exam
- Human Geography of Small Island Systems, M-GGR/01 – 6 credits – 1 exam
- Applied Geomorphology and Habitat, GEO/04 – 6 credits – 1 exam
- Marine Environmental Microbiology, BIO/19 – 6 credits – 1 exam
- Ocean Resources Law and Policy, IUS/10 – 6 credits – 1 exam

2nd YEAR

COMPULSORY CORE COURSES

- Coastal and Marine Hazard and Resilience, M-GGR/02 - 6 credits – 1 exam

MULTIPLE-CHOICE COURSES

Students must choose 2 of the following courses:
- Coastal and Marine Botany, BIO/01 – 6 credits – 1 exam
- Management of Aquatic Resources: Fisheries, BIO/07 – 6 credits – 1 exam
- Marine Molecular Biology, BIO/11 – 6 credits – 1 exam
- Applied Marine Geology, GEO/01 – 6 credits – 1 exam
- Paleoceanography and Paleoclimatology, GEO/01 – 6 credits – 1 exam
- Coastal Risks and Dynamics, ICAR/02 – 6 credits – 1 exam
- Ocean Resources Law and Policy, IUS/10 – 6 credits – 1 exam
- Coastal and Maritime Tourism, M-GGR/02– 6 credits – 1 exam
- Maritime Sociology, SPS/08 – 6 credits – 1 exam
- Communication Skills and Interpersonal Relation Management, M-PSI/08 – 6 credits – 1 exam
- Ocean Monitoring and Data Analysis, GEO/12 – 6 credits – 1 exam

OTHER ACTIVITIES

- Practical training – 4 credits
- Further language skills – 4 credits
- Student-selected activities – 12 credits
- Final examination – 28 credits

Compulsory core courses

The programme has compulsory core courses covering the fields of “Biology” (6 credits), “Chemistry” (6 credits), “Earth Sciences” (6 credits), “Ecology” (12 credits), “Agricultural science, technologies and management” (6 credits), and “Legal, economics and evaluation methods" (12 credits).

Multiple-choice courses

The programme also includes “related or supplementary” learning activities designed to complete students’ specialist training in fields such as Ecology and Marine Biology, Earth Sciences applied to the seas and oceans, the Geography of Marine, Coastal and Island Regions, and Maritime Sociology.
Courses are offered in the following areas: BIO/01 (6 credits), BIO/05 (12 credits), BIO/07 (6 credits), BIO/11 (6 credits), BIO/19 (6 credits), GEO/01 (24 credits), GEO/04 (6 credits), GEO/12 (6 credits), ICAR/02 (6 credits), IUS/10 (6 credits), M-GGR/01 (6 credits), M-GGR/02 (12 credits), SPS/08 (6 credits), M-PSI/08 (6 credits).

Student-selected activities

Students can earn 12 credits with optional learning activities, choosing either an internship pertinent to the preparation of the student’s final dissertation, to be carried out in Italian and/or international laboratories, companies, bodies and institutions with which the University has stipulated specific agreements, or, as an alternative, courses offered by the University’s various Master’s Programmes. The student-selected learning activities are an integral part of the course and as such must be approved by the Teaching Coordination Council as consistent with the Master’s Degree Course. It should be noted that pursuant to the laws in force regarding the total number of examinations required to obtain the Master’s Degree, the evaluation obtained by students for their own-choice learning activities will count towards one examination only.

Further language skills

4 credits for “further language skills” can be earned as described below:

Italian students:

- passing a University foreign language examination, the equivalent of a B2 level, in either French, Spanish or German or
- passing the University's proficiency English language examination, the equivalent of a C1 level.

In both cases, students already in possession of language proficiency certificates testifying the language competence equivalent to or higher than a B2 level for French, Spanish or German, or equivalent to or higher than a C1 level in English, will be exonerated from taking the language exams and the credits already acquired will be recognized by the University for the purposes of the Master's Programme.

Non-Italian students:
- passing the University's Italian language examination.

Details of the language examinations are established by the University and will be made available on the University website: https://www.unimib.it/didattica/lingue-unimib.

Teaching formats

Achievement of the required competence and professional skill sets by students is measured in university education credits (CFU). Credits represent the learning outcomes achieved by a full time student and are earned through completions of the learning activities delivered by the Master's Programme, individual study, and other personal learning activities. One credit corresponds to 25 hours of work for an average student, calculated as hours of classroom lessons, exercises, seminars, internships, fieldwork and individual study.

Teaching will be exclusively in English and will be delivered in a blended learning/mixed-mode format (both as face-to-face classroom and remote-teaching practices) as follows:

- frontal lectures (in the classroom, videoconference, streaming), supported by multimedia audio-visual teaching aids;
- blended learning;
- exercises (also in blended learning);
- seminars;
- fieldwork.

Depending on the type of teaching activity, the hour/credit ratio is as follows:

- face-to-face classroom lectures: 1 credit = 7 hours
- exercises: 1 credit = 12 hours
- fieldwork: 1 credit = 10 hours

These learning activity hours must be integrated with individual study such that each credit corresponds to a total of 25 hours of work.

Internships and preparation of the final dissertation will have the following hour/credit ratio:

- internships: 1 credit = 25 hours
- preparation of final dissertation: 1 credit = 25 hours

During the COVID-19 restrictions the lessons will be recorded and available online, with some live events that will be planned and communicated on e-learning.

Assessment of learning outcomes

Examinations may be:
- oral examinations
- oral and written examinations

Examinations are graded out of a maximum of 30, with pass grades ranging from 18 to 30. Internships and placements shall be subject to an "approval" by the responsible faculty member.

During the COVID-19 restrictions the oral exams will be exclusively through the WebEx platform. A public link will be posted on the e-learning page of the teaching, for the access of virtual public.

Attendance

Attendance of the Master's Course is compulsory for practical learning activities (classroom exercises and/or blended learning and field work). Attendence of at least 75% of the hours planned for each practical learning activitiy is required for being admitted to the related exam.

Study plan

The study plan comprises compulsory learning activities, multiple-choice courses selected among the list of related courses, and activities chosen independently by the student in compliance with the course regulations.
Students are automatically assigned a statutory study plan when they enroll in the first year. Students must then submit their own personal study plan, including an indication of the multiple-choice courses and student-selected activities they intend to take.
Individual study plans must be approved by the Faculty Committee.
Procedures and deadlines for submitting study plans are decided by the University. Students may take exams relating to the learning activities included in their last approved study plan.
Additional information can be found in the University's Regulations for Students.

Compulsory core courses

Students are advised to give priority to the compulsory core courses of the first year.

Guidance and tutoring

Tutoring by Faculty involved in the course is offered to students, especially in the first academic year, to provide counseling on the choice of courses.

Schedules for learning activities and exam sessions

The courses are delivered in two semesters, generally during the following periods:
- First semester: From October to January;
- Second semester: From March to June.

At least five exam sessions will be scheduled during the academic year in the periods when teaching is temporarily suspended. Examination sessions are indicatively scheduled as follows: 1 exam session at the end of the first semester (February), 2 sessions at the end of the lessons of the second semester (June/July), 2 sessions in September. Up to 2 extraordinary exam sessions may be held upon motivated request.

The course timetable, exam session calendar – location, room and time – will be published on the website:
http://gestioneorari.didattica.unimib.it/PortaleStudentiUnimib/index.php?view=home&_lang=en

Agreements on international student mobility

In the framework of special agreements, the Faculty promotes study periods for traineeship or for the preparation of the final dissertation in other European countries with the support of the Erasmus Traineeship Programme (minimum 2 months abroad).

The EXTRA-UE Exchange Programme supports periods of study for traineeship and/or preparation of the final dissertation outside European countries (minum one month abroad).

The Erasmus commission is coordinated by Prof. Rodolfo Gentili.

Details of the opportunities available to Marine Sciences students can be found at the following page: https://elearning.unimib.it/mod/page/view.php?id=217834

FINAL EXAMINATION

The final examination consists of a final dissertation, written by the student under the guidance of a supervisor, and presenting original scientific data. The final dissertation must be written and discussed in English.

Final examination procedure

The final dissertation will have an experimental approach and deal with a specific topic connected with the marine environment, also with reference to the experience acquired during the internship period.

The final dissertation will be discussed at a public session, which may also be conducted via teleconference or videoconference, in front of a commission composed of Faculty members. The overall assessment for the entire student's curriculum will be expressed on a 110-point scale, with eventual cum laude honors.

For the admission to the final dissertation, students must have earned the requisite number of credits for the training activities making up the course, which, together with the credits assigned for the final dissertation, will total 120 credits.

CREDIT TRANSFER AND RECOGNITION

Students transferring from another programme may submit a request for previously earned credits (CFUs) to be recognized as valid for the new programme. The request will be examined by a special committee appointed by the Faculty Committee. Credit recognition will depend on the extent to which the previous course aligns with the new course the student intends to attend. Partial recognition of a teaching activity may be awarded.

In compliance with Min. Decree 270/2004 and Law 240/2010, universities may recognize as CFUs individually certified professional skills and abilities and other skills and abilities acquired during post-secondary learning activities that the university helped design and deliver, for a maximum of 12 credits, taking into account both first-level (Bachelor's) and Master's Degrees.

Any request to recognize such credits must be approved by the Faculty Committee.

SUPPORTING RESEARCH ACTIVITIES

National and international multidisciplinary research is carried out by the University in the following areas:
- Physics: Environmental Physics, Atmospheric Physics, Physics of the Sea, and Physics of Climate.
- Chemistry: Chemical Physics of the Environment; Computational Chemistry; Low Environmental-impact Processes; Environmental Chemistry; Atmospheric Chemistry; Analysis and Reactivity of Organic Micropollutants.
- Earth Sciences: Marine Geomorphology; Geosphere-biosphere Interaction, Conservation Paleobiology; Risk Assessment of Exogenous and Endogenous Processes; Climate Change; Geographic Spatial Analysis; Geographic Information Systems Applied to Environmental Processes.
- Ecology: Marine Ecology; Landscape Ecology; Marine Biodiversity; Marine Resource Management.
- Biology: Environmental Botany; Marine Invertebrate Zoology; Bio-indicators and Biodiversity; Fauna Monitoring and Management; Ecological Networks; Environmental Microbiology.
- Law: International Law; Maritime Law; Environmental Law.
- Geography, Sociology and Psychology.

The Department of Earth and Environmental Sciences (DISAT) conducts numerous national and international research projects. For details, see the website: www.disat.unimib.it

CONTACTS

The address of the Master's Programme in Marine Sciences - Scienze Marine is:
Dipartimento di Scienze dell'Ambiente e della Terra (Department of Earth and Environmental Sciences) – Edificio U1 e U4 – Piazza della Scienza, nr. 1 e 4 – zip code. 20126 Milan, Italy.

Director of the Master's Programme:
Prof.Daniela Basso

Director of the School of Science:
Prof. Alessandro Russo

Director of the Department of Earth and Environmental Sciences (Scienze dell'Ambiente e della Terra):
Prof. Andrea Zanchi

Segreteria didattica Marine Sciences: Dott. Roberto Tretola, U1, first floor, room 1018.
E-mail: didattica.ms@unimib.it

More information can be found at: http://elearning.unimib.it/course/index.php?categoryid=3629.

DISCLAIMER

These Regulations are subject to minor amendments. More specifically, elective courses will be delivered only if the minimum number of student enrolments is reached.

Syllabi published in the following pages may be subject to change

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We recommend you to regularly check the programme's e-learning website at https://elearning.unimib.it/course/index.php?categoryid=3626 for updated information on syllabi and other relevant topics.

MARINE SCIENCES

Syllabi
1st YEAR

Course	Course Code	Course Credits	Course Year
CHEMISTRY OF MARINE ENVIRONMENT	**F7502Q001**	**6**	**1**

Lecturer: Dott. Luca Ferrero

Aims

The course aims to provide students with knowledge about the processes and mechanisms that regulate the chemical composition of the sea and oceans.

Contents

The course provides an understanding of the chemical composition of seawater. Equlibrium and steady state conditions in aqueous solution are discussed. A particular attention is given to priority pollutants.

Detailed program

Properties of Water. Isotopes in seawater. Salinity and major constituents of seawater. Air-sea exchange of gases. Equilibrium and steady state models. Acid-base reactions. pH, chemical composition, buffer intensity in seas and oceans: CO_2,HCO_3^-, CO_3^{2-} equilibria in oceans and seawater. Log C – pH diagrams. Acidity and alkalinity. Concept of ocean acidification. Solubility, solubility-pH diagrams. Trace metals; metal ions speciation. Organic matter in the sea. Nutrients. Microplastics. Organic pollutants (i.e. hydrocarbons, pesticides, dioxins and PCBs, flame retardants, and endocrine substances). Atmospheric-ocean interaction: marine aerosols and their photochemistry and atmospheric aerosol as a source of nutrients. Geo-engineerng climate and the oceans.

Prerequisites

Basics of inorganic and organic chemistry.

Teaching form

Frontal lessons.

Textbook and teaching resource

Slides and two textbooks:
1- An Introduction to the Chemistry of the Sea, 2nd ed., Michael EQ Pilson, Cambridge University Press, 2013.
2- Chemical Oceanography, 4th Ed., Frank J. Millero, CRC press, Taylor & Francis Group, 2013

Semester

Second semester.

Assessment method

Oral exam with written parts. The written parts are part of the oral exam during which the students have to demonstrate the capability to mange the most important chemical equilibrium equations concerning the chemistry of the sea.

Office hours

Office at 3rd floor of U1 building (Piazza della Scienza 1, Milano). Office hours usually 10:30-12:30 a.m. on tuesdeay.

MARINE SCIENCES

Course	Course Code	Course Credits	Course Year
FUNDAMENTALS OF MARINE BIOLOGY	**F7502Q037**	**6**	**1**

Lecturers:
Dott. Davide Maggioni, Dott. Davide Seveso

Aims

This course examines different biological and ecological aspects and processes of ocean ecosystems. Topics include the distributions, abundances, life habits and interactions of marine organisms characterizing the main zones and the different systems of the marine environment. The impact of multiple stressors and the problems affecting the marine habitats are also discussed.

Contents

Processes of marine organisms, Marine systems and habitats, Functioning of Marine Ecosystems

Detailed program

Introduction to the course

What is marine biology and why it matters; history of marine biology; the scientific method

Patterns in the marine environment

Biogeography, biodiversity, abundance and size

The marine environment

World oceans; structure of the ocean floor; chemical and physical properties of seawater; ocean circulation; life in a fluid medium; primary and secondary production

Classification and characteristics of the marine environments

General classification of marine environments; benthic life habits; benthic environments: tidelands (rocky shores, soft-substratum shores, marshes, mangroves, estuaries); sea grass beds, seaweed and kelp forests, rocky reefs, coral reefs; continental shelf seabed; deep sea; polar regions; pelagic environments and pelagic life habits

Introduction to impacts

Fisheries and aquaculture; pollution and climate change; conservation

Present and future of marine biology

Main recent lines of research in marine biology

Seminars

Prerequisites

None.

Teaching form

Lessons (4 credits - Dr. Maggioni Davide)
Tutorials (2 credits – Dr. Seveso Davide)

During the COVID-19 restrictions the lessons will be recorded and available online, with some live events that will be planned and communicated on e-learning

Textbook and teaching resource

PowerPoint slides, scientific papers
Marine Biology: Function, Biodiversity, Ecology (3°edition). Jeffrey S. Levinton, Oxford University Press
Marine Ecology: Processes, Systems, and Impacts (2° edition). Michel J. Kaiser et al., Oxford University Press
Marine Biology (10° edition). Peter Castro & Michael E. Huber, McGraw Hill Higher Education

Semester

First semester.

Assessment method

Oral examination
Mark range: 18-30/30

During the Covid-19 restrictions the oral exams will be exclusively through the WebEx platform. A public link will be posted on the e-learning page for the access of virtual public

Office hours

By appointment by sending an email to the teacher.

MARINE SCIENCES

Course	Course Code	Course Credits	Course Year
FUNDAMENTALS OF MARINE PHYSICAL GEOGRAPHY	**F7502Q038**	**6**	**1**

Lecturers:
Prof.ssa Alessandra Savini

Aims

Provide knowledge on the processes that form and shape coastal and submarine landforms, controlling their short-term and llong-term evolution through time. Provide a basic knowledge about seafloor mapping techniques and methods for submarine geomorphological mapping.

Contents

- Data and methods in Marine Geomorphology. Seafloor mapping, seafloor sampling and visual surveys: tools and survey design.
- Coastal landforms and processes. Beach and nearshore systems, coastal sand dunes, delta and estuaries, barrier systems. Rocky coasts and coral reefs.
- Submarine landforms and processes. Drivers of seafloor geomorphic change in submarine environment (tectonic, sedimentology, oceanography and biology). Continental shelf landforms, submarine landslides, submarine canyons and gullies, channel and fans, contouritic drifts, oceanic islands and seamounts, mid-ocean ridges, fluid-escape features, abyssal hills and plains, trenches, bioconstructions.

Detailed program

Frontal lectures (4 CFU - 28 hours):
Introduction: Marine Phyisical Geography, Oceanography and Marine Geomorphology.
Research methods in submarine geomorphology. Seafloor mapping, seafloor sampling and visual surveys: tools and survey design
Geomorphology of the ocean seafloor. A global map of the ocean seafloor and classification of large-scale submarine landforms (continetal margins, oceanic islands and seamounts, mid-ocean ridges, abyssal hills and plains, trenches).
Drivers of seafloor geomorhpic changes in submarine environments. Winds and ocean circulation (effects on coastal and submarine landforms). Waves and tides. Sea-level changes (geomorphological indicators). Submarine sedimentary processes, environments and landforms: Continental shelf landforms, Contourites, sediment waves and bedforms, resedimentation processes, submarine slides, submarine canyons and gullies, channel and fans. fluid escape features.
Coastal systems: terminolgies and classification of coastal systems. Delta, estuaries and beaches. Rocky coasts and coral reefs.

Laboratory lectures (2 CFU - 24 hours):
Submarine geomorphological mapping: techniques and methods for data acquisition and processing.

Prerequisites

Fundamentals of Mathematics, Physics and Chemistry.

Teaching form

- Lessons: 4 credits

- Tutorials: 2 credits

During the COVID-19 restrictions the lessons and the tutorials will be recorded and available online, with some live events that will be planned and communicated on e-learning.

Textbook and teaching resource

- Alan P. Trujillo & Harold V. Thurman. Essential of Oceanography. Pearson
- Micallef A., Krastel S., Savini A. Submarine Geomorphology. Springer
- D.A.V. Stow, H.G. Reading, Collinson J.D – Deep Seas. In: H.G. Reading, Sedimentary environment: Processes, Facies and Stratigraphy (Cap. 10). Blackwell Science.
- NC Mithcell. Submarine Geomorphology. Elsevier
- G. Masselink & Hughes M.G. An introduction to coastal processes and geomorphology. Cambridge
- A selection of scientific journal articles will be provided by the teachers.

Semester

First semester.

Assessment method

Oral examination.

Office hours

Thursday 10:30-12:30 am.

MARINE SCIENCES

Course	Course Code	Course Credits	Course Year
BIODIVERSITY AND MARINE ECOLOGY	**F7502Q004**	**12**	**1**
Course Part I: BIODIVERSITY **Course Part II: MARINE ECOLOGY**		**6** **6**	

Lecturers:
Prof. Paolo Galli, Prof.ssa Shazla Mohamed, Dott. Simone Montano, Dott. Davide Seveso

Aims

This course examines biological aspects of ocean ecosystems and the physical processes that regulate them. Topics include the distributions, abundances, and interactions of marine organisms; interactions between organisms and the transformation and flux of energy and matter in marine ecosystems; and aspects of physiology related to marine species distributions, abundances and roles.
Lectures facilitate understanding
1) the complex nature of the process that affect and control marine biodiversity;
2) become familiar with multiple definitions and measures of marine biodiversity;
3) identify threats to marine biodiversity and what mechanisms are developing to identify and manage biodiversity loss;
4) of the impact and rapid spread of non-indigenous marine species, methods of introduction and spread, and current control measures;
5) gain knowledge of how major fisheries management programs relate to biodiversity loss and conservation.
6) measure the success/failure of current action strategies, such as Marine Protected Areas, by applying lessons learned and incorporation of emerging methods and data sources.

Contents

Course part I
Introduction to Marine Biodiversity; Biodiversity of Plankton, Benthos and Nekton; Spatial and Temporal Patterns of Marine Biodiversity; Global threats and for global Biodiversity and Anthropogenic Impacts; Coral Reef's biodiversity; Marine fisheries and Biodiversity.

Course part II
Processes of Marine Organisms and Systems, Primary Production in Marine Environments, Structure and Dynamics of Marine Communities, Functioning of Marine Ecosystems.

Detailed program

Syllabus Course part I: Biodiversity

1- Introduction to Marine Biodiversity

Definition of Biodiversity , Who "owns" Biodiversity? How is it measured and why is it important: Genetic diversity; how is it defined/measured? genes, populations; Species diversity; how is it defined/measured?; Ecosystem diversity; Functional diversity; The magnitude of the known marine biodiversity

2- Marine Biodiversity – Plankton, benthos, nekton

Planktonic diversity classification by size, distribution, lifestyle, general description of the realm, major taxa, magnitude of diversity and biodiversity functioning; Benthos diversity classification by size, distribution, habitat, lifestyle, feeding behaviour. General description of the realm, major taxa, magnitude of diversity and biodiversity functioning; Nekton diversity classification by, size, distribution, habitat, lifestyle, feeding behaviour. General description of the realm, major taxa, magnitude of diversity and biodiversity functioning.

3- Spatial and Temporal pattern of Marine Biodiversity and Conservation of the Ocean

Spatial and temporal patterns

Factor in Biodiversity (speciation-extinction); Biogeographic factors; Major gradient of species diversity (latitudinal, longitudinal, bathymetric); Explanation of regional diversity differences; Expansion and Extinction in the Past; How extinctions change biodiversity: (a) Two kinds of extinctions; natural, induced – extinction rate-(b) The implications of extinction-(c) Earth's past mass extinction events - (d) The current mass extinction event - (e) Generalizations we can draw from past extinction events.

Conservation of marine biodiversity

Value of Marine Biodiversity; Why is important? Ecosystem function and services; The shifting baseline concept; What is an endangered species; The IUCN red list; CITES; Conservation strategies (MPAs)

4- Global Threats for Global Biodiversity and Anthropogenic Impacts

Threats to Marine Biodiversity

Human effects on Marine Environment; Pollution (toxic metals, pesticides, herbicides); the problem of the Plastic; Biological Invasion; Nutrients and Eutrophication; Global Environmental Change and the Ocean.

The Hidden Diversity of the Coral Reef

The Holobiont (members and habitats); The coral probiotic Hypothesis; The Hologenome theory of evolution; The coral Symbiome; Impact of Environmental stress on the coral Symbiome

The coral diseases

Terminology and definitions; History and actual distribution; Koch's postulates; Skeleton Eroding Band, Brown Band Disease, White Syndrome, Ulcerative White Spot, Black Band Disease, Tumors; Divers of coral disease outbreaks; Vectors and Reservoirs; Management issue and Actions

5- Marine Fisheries and Biodiversity

Fisheries and food from the Sea

What is a fishery; Stock - a key concept; Fishing techniques and their effects (Longline fishery, Purse seine, Trawls, Gill nets); Magnitude and Impacts

Marine Fisheries and Biodiversity – Overfishing

Definitions; Vulnerable resource species; The case: Terranova Grand banks; The impact of the overfishing; The case of Tuna fisheries; The waste; The food fraud; Illegality: shark finning, flag of convenience, IUU definitions

Marine Fisheries and Biodiversity – Fishing Management

Aged-based population; Closures and quotas- quotas and Individual transferable quotas; Mariculture; MPAs;

The roles of consumers.

Syllabus Course part II: Marine Ecology

1 - Processes in Marine Ecosystem

Ecological and Evolutionary Principles of Marine Biology
Ecological interactions; Interactions on the scale of individuals; The population level; The community level: structure and interspecies interactions; The ecosystem level

The Chemical and Physical Environment
Measures of physiological performance; Temperature; Salinity; Oxygen; Light

Reproduction, Dispersal, and Migration
Ecological and evolutionary factors in sex; Reproduction, demography, and life cycles; Migration; Larval dispersal at different scales

Primary Production Process and Critical Factors in Plankton Abundance
Photosynthetic marine organisms; Light and photosynthesis; Patchiness of the plankton; The seasonal pattern of plankton abundance; Water column parameters and the spring diatom increase; Nutrients required by phytoplankton; Rate of nutrient uptake; Harmful algal blooms; Phytoplankton succession and the paradox of phytoplankton coexistence; Global trend of primary production; Measuring primary productivity; Zooplankton grazing in the sea

Food Webs and Microbial Ecology – The Decomposition Process
Food chains and food webs; Decomposition process; Key organisms in the oceanic microbial food webs; Microbial food webs dynamics; The seasonal cycle of production and consumption

2 - Systems in Marine Ecosystem

Seaweeds and Kelp Forests
Morphology; Production and life cycle; Classification; Factors affecting growth; Kelp forests

Seagrass Meadows
Morphology; Adaptations to marine life; Distribution, taxonomy and evolution; Factors affecting growth; Succession; Seagrass Ecology and Functions; Seagrass grazing; Decline of seagrasses and restoration

Mangrove Forests
Classification; Zonation; Adaptations and reproduction; Associated organisms; Functions and services; Impacts on mangrove forests

Coral Reefs
Coral polyp; Symbiosis with zooxanthellae and calcification; Coral growth and reproduction; Factors limiting the growth; Distribution of coral reefs; Coral reef development and types; Zonation; Biological interactions in coral reef ecosystem; Bioerosion and corallivory

The Water Column: Marine Vertebrates and Other Nekton
Cephalopods; Fish; Mammals; Marine birds and reptiles

Prerequisites

None.

Teaching form

- Lessons: 4 + 4 credits
- Tutorials: 2 + 2 credits

During the COVID-19 restrictions the lessons will be recorded and available online, with some live events that will be planned and communicated on e-learning

Textbook and teaching resource

- Lesson slides (power point presentations)
- Marine Biology: Function, Biodiversity, Ecology (3°edition). Jeffrey S. Levinton, Oxford University Press
- Marine Ecology: Processes, Systems, and Impacts (2° edition). Michel J. Kaiser et al., Oxford University Press
- Scientific Papers

Semester

First semester.

Assessment method

Oral examination (18-30/30)

During the Covid-19 restrictions the oral exams will be exclusively through the WebEx platform. A public link will be posted on the e-learning page for the access of virtual public

Office hours

Monday 08:30-10:30 (Biodiversity)
Monday 10.30-12.30 (Marine Ecology)

Lab. 2030 (U3) – 0264483433
Office R032 (U9) – 0264483308

Course	Course Code	Course Credits	Course Year
PHYSICS OF THE SEA	**F7502Q005**	**6**	**1**

Lecturer:
Prof.ssa Claudia Pasquero

Aims

Provide basic knowledge of the physics of the oceans. Show the usefulness of mathematical and physical models for the description and the understanding of geophysical fluid dynamics.

Contents

In the first part of the course fundamental physical properties of the ocean will be introduced. The second part will be basic geophysical fluid dynamics, with the discussion of solutions to approximations relevant for the description of the ocean circulation and waves. In the laboratory sessions, experiments and problems will be presented to better visualise and understand the main topics of the course.

Detailed program

Ocean Physics: Light and sound propagation. Temperature and salinity. Equation of state. Stratification. Tracer distribution. Heat fluxes. Water masses. T-S diagrams.

Oceanic Dynamics: Navier-Stokes equation. Mass conservation. Hydrostatic approximation. Geostrophic. Thermal wind equation. Vorticiity. Boundary layer. Large scale circulation and winds. Subtropical and subpolar gyres. Western boundary currents. Gravity waves. Rossby and Kelvin waves. Turbulent fluxes.

Labortatory sessions: Geophysical fluid dynamical experiments. Oceanographic problem solving.

Prerequisites

None.

Teaching form

Frontal lecture. Lab.During the COVID-19 emergency the classes will be partially in presence and partially (mainly) from remote (registered and uploaded on the elearning web page). Lab sessions will be broadcasted in real time.

Textbook and teaching resource

- Stewart, “Introduction to Physical Oceanography”, freely available on line.
- Marshall and Plumb “Atmosphere, Ocean, and Climate Dynamics”, Academic Press (2008)
- Vallis “Atmospheric and Oceanic Fluid Dynamics”, Cambridge UNiv. Press (2006)

Semester

First semester.

Assessment method

Oral exam: candidates will be asked questions regarding the topics discussed in class. During the COVID-19 emergency oral exams will be online, through the Webex platform. A public link will be provided on the elearning webpag

MARINE SCIENCES

Course	Course Code	Course Credits	Course Year
INTERNATIONAL LAW OF THE SEA	**F7502Q044**	**6**	**1**

Lecturer:
Dott.ssa Ilaria Tani

Aims

The aim is to provide students who have a scientific background with some basic knowledge of the international legal regime that presently applies to marine spaces, with particular emphasis on the protection of the marine environment.

Contents

The legal regime of the seas at the world basis, as resulting from the 1982 United Nations Convention on the Law of the Sea.

A regional system for the protection of the marine environment, as resulting from the 1976-1995 Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean.

Detailed program

1. The international legal dimension of the sea under the United Nations Convention on the Law of the Sea (Montego, 1982):

- internal maritime waters;
- territorial sea;
- exclusive economic zone;
- high seas;
- seabed beyond national jurisdiction as common heritage of mankind.

2. Maritime boundaries.

3. The protection of the marine environment (ecosystems and species):

- pollution from ships;
- pollution from land-based sources;
- pollution from dumping;
- pollution from mineral exploitation activities on the seabed;
- the establishmebnt of marine protected areas.

4. Regional co-operation in the Mediterranean Sea:

- the Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean and its Protocols;
- the Agreement on the Conservation of Cetaceans of the Mediterranean Sea, the Black Sea and the Contiguous Atlantic Area;
- the General Fisheries Commission for the Mediterranean.

Prerequisites

None.

Teaching methods

Oral classes with active involvement of students, who will be working directly on the relevant legal instruments. During the COVID-19 emergency, the classes will be partially in presence and partially (mainly) from remote (registered and uploaded on the e-learning web page).

Textbooks and Reading Materials

A number of papers and the relevant legal texts are collected in a syllabus that is distributed to the students.

Semester

First semester.

Assessment method

The exam consists of one question cast by ballot among a list of questions previously circulated through the students' e-mailing list. The list of questions covers the entire programme of the course and, therefore, students are expected to be able to expound all topics addressed in class.
The exam takes into account the following elements:
- knowledge of the substance;
- consistency and completeness in the exposition;
- correct use of legal terminology;
- ability to express oneself in a clear and concise manner.

The grade is not subject to discussion or negotiation.
The student may decide to withdraw from the exam before or immediately after the grade has been stated.

Office hours

By appointment.

Course	Course Code	Course Credits	Course Year
MARINE INVERTEBRATE ZOOLOGY	**F7502Q011**	**6**	**1**

Lecturer:
Dott. Andrea Galimberti, Dott. Davide Maggioni

Aims

This course examines a wide panel of topics related to marine invertebrates and their symbiotic, environmental, and functional roles and interactions. The aim of the course is to provide concepts and applications in a context of modern zoology. Apart from classic systematics and base concepts for each invertebrate phylum, the course program covers many applicative issues related to these animals, ranging from bioprospecting activities to management and control of invasive species and cryptic ones.

Contents

Zoology deals with the study of animals (in this specific cours, the invertebrate ones). There could be many ways to treat such a wide topic. In this course, the systematics aspects are reduced to the very essential aspects, while more detailed information will be provided concerning the structure, biodiversity and interactions typical of each invertebrate phylum. Bioprospecting and conservation issues will be also discussed.

Detailed program

INTRODUCTION TO MARINE INVERTEBRATE ZOOLOGY [A. GALIMBERTI]
- Importance of zoology
- Basic concepts (bauplan, evolution, diversity and interactions)

MOLECULAR PHYLOGENTICS AND THE INVERTEBRATE TREE OF LIFE [D. MAGGIONI]
- From organisms to sequences to phylogenies
- A perspective on invertebrate phylogeny

MARINE INVERTEBRATE PHYLA: SYSTEMATICS AND PRINCIPAL CHARACTERISTICS [A. GALIMBERTI AND D. MAGGIONI]
- Protozoa
- Parazoa (Porifera and Placozoa)
- Eumetazoa and Radiata
- Xenacoelomorpha
- Platyhelminthes and Nemertea
- Rotifera and Nematoda
- Gastrotricha, Entoprocta, Cycliophora
- ‘Mesozoa’, Gnathifera
- Mollusca
- Annelida
- Arthropoda
- Scalidophora
- Lophophorata
- Ambulacraria
- Invertebrate Chordata

APPLICATIVE ZOOLOGY: E-DNA AND MOLECULAR-BASED ADVANCES IN THE STUDY OF MARINE COMMUNITIES [A. GALIMBERTI]

A FOCUS ON CNIDARIA [D. MAGGIONI]
- Origin and evolution
- Life cycles and reproduction
- Symbioses involving cnidarians
- Seminar

Prerequisites

None.

Teaching form

Frontal lessons.

Textbook and teaching resource

PDF lessons, videos, and supporting scientific papers provided on the e-learning platforms.

Semester

Second semester.

Assessment method

The verification of the knowledge aquired during the course will consist in an oral examination at the end of the course. There will be not intermediate tests. The examination will start with the critique discussion of a scientific article chosen by the student (and previously approved by the teacher), concerning the general issues treated in the lessons. The examination will continue with the discussion of the arguments included in the program of the course..

Office hours

Upon request by email to the teachers.

Course	Course Code	Course Credits	Course Year
MARINE VERTEBRATE ZOOLOGY	**F7502Q012**	**6**	**1**

Lecturers:
Dott. Alessandro De Maddalena, Dott.ssa Elena Agnese Valsecchi

Aims

The course aims to allow students to:
1) recognize and be able to classify the major groups of marine vertebrates in the wild;
2) learn specialized terminology and basic concepts of the zoology of these groups of organisms;
3) understand selected external and internal structures which allow adaptation to the aquatic environment;
4) learn about methodologies of study of these classes of organisms in the wild and measures taken for their conservation.

Contents

The course covers marine vertebrates' systematics, evolutionary history, anatomy, physiology, behavior, conservation and research.

Detailed program

This course is an introduction to the biology of marine vertebrates. It is structured in two modules, the first dealing with fish sea birds (run by Dr De Maddalena) and the second (run by Dr Valsecchi) regarding marine mammals and marine reptiles. Both sections cover a sampling of various taxonomic groups, their evolutionary relationships and biology including anatomy and physiology, adaptation to the aquatic environment (for marine mammals and marine reptiles), behavior, ecology and conservation.

Prerequisites

Basic biology notions.

Teaching form

42 hours (21 + 21) frontal lessons (anti-COVID measures allowing)

Textbook and teaching resource

Source material can be found in the following books:
- "Sharks of Maldives" by De Maddalena A, Editoriale Magenes
- "FishBase", Froese R and Pauly D, www.fishbase.org
- "The Diversity of Fishes. Biology, Evolution and Ecology" by Helfman G.S., Collette B.B., Facey D.E., and Bowen B.W., Wiley-Blackwell Publishing
- "Marine Mammals Evolutionary Biology" by Berta A and Sumich JL, Academic Press
- "Biology of Marine Mammals" by Reynolds JE and Rommel SA, Melbourne University Press
- "Marine Mammals of the World. Systematics"

Semester

Second semester.

Assessment method

Oral and written exam.
It will be carried out first the oral exam (normally 10 questions, 5 for each section: Marine Mammals and Reptiles, Fish and Marine Birds). The written test will be followed, on the same day, by few question from both Prof. Valsecchi and Prof. De Maddalena.

Office hours

Mondays from 11.00am till noon.

Course	Course Code	Course Credits	Course Year
GEOBIOLOGY	**F7502Q013**	**6**	**1**

Lecturers:
Prof.ssa Daniela Basso, Dott. Giovanni Coletti

Aims

To provide the main concepts for understanding the interactions and the coevolution of biosphere, hydrosphere and geosphere.
To acquire the conceptual and operative knowledge for the study and interpretation of the modern marine environments and their reconstruction in the geological record, including the recent past.

Contents

Coevolution of geosphere and biosphere, principles of biomineralization, biogenic carbonates, bioconstruction and habitat engineers, sediments and benthos, benthic zonation, introductory biogeochemistry and proxy data in natural archives, past and ongoing global changes.

Detailed program

Lessons: The benthos in the geologic history. Extinctions and major events in the Earth history. The appearance of organic calcification and the biomineralization. Photosynthesis and chemosynthesis. Ocean chemistry and biomineralization. The evolution of biogenic builders in the Phanerozoic. The modern bioconstruction: structures, biological associations, ecological factors of control and distribution. Habitat engineers. Diagnosis, significance and distribution of the major benthic associations and related sediments. Benthic zonation in the present-day oceans as key to understand the geological record. The benthos in the geomorphology and evolution of carbonate platforms. Biocoenoses, communities, associations and interpretation of fossil assemblages on the basis of the biostratinomic processes. The chemical environment at the water-sediment interface. Identification and interpretation of the most important ichnofacies. Biogeochemical proxies and natural archives. The ongoing global change and the geobiological feed-back.

Laboratory: Geobiological analyses of carbonate sediments and fossil–bearing material and their interpretation.

Prerequisites

Fundamentals of Marine Biology, Ecology and Physical geography. General Palaeontology is also suggested

Teaching form

Lessons: 5 credits
Tutorials: 1 credit

During the COVID-19 restrictions the lessons will be recorded and available online, with some live events that will be planned and communicated on e-learning

Textbook and teaching resource

The lectures and some suggested readings will be provided by the teacher.
Useful books: Fundamentals of Geobiology, Knoll et al (Eds) ISBN 978-1-4051-8752-7.

Semester

First semester.

Assessment method

Oral examination

The first question, exclusively for the students of Geological Sciences who select this course, is aimed at assessing their knowledge of the main subdivision of the geological time. A negative result for this first question corresponds to immediate rejection.

The final mark is composed by the oral marks plus up to 1 point for the practicals.

Marks are given as n/30. Minimum positive value is 18/30.

During the Covid-19 restrictions the oral exams will be exclusively through the WebEx platform. A public link will be posted on the Geobiology e-learning page for the access of virtual public.

Office hours

To make an appointment, please contact the teacher: daniela.basso@unimib.it

Course	Course Code	Course Credits	Course Year
BIOFACIES	**F7502Q014**	**6**	**1**

Lecturers:
Prof.ssa Daniela Basso, Prof.ssa Elisa Malinverno

Aims

Benthic facies and applied marine paleoecology

To provide technical skills to plan, analyse and interpret the results of the paleontological and paleoecological investigation. To provide the rationale and the methods for the use of palaeoecology in the reconstruction of recent environmental changes in transitional and marine coastal areas, on the basis of the interplay between natural change and history of the anthropogenic impact. Ability to identify and interpret some common macrobenthic facies, and taphofacies. Ability to manage the commonest multivariate methods of statistical analyses for the interpretation of benthic associations.

Microfacies; the Pelagic Environment

Knowledge of the microfossil groups which are useful to define a paleoenvironmental and biostratigraphic framework from different oceanographic settings. Taxonomic bases for the identification of the main planktonic species. Application of microfossil assemblage for paleoecological reconstructions. Environmental Micropaleontology. Taphonomy.

Contents

Benthic facies and applied marine paleoecology

Identifying biofacies as a tool for paleoenvironmental definition. Applications and examples. Introduction to applied marine paleoecology: rationale, sampling strategies, case histories. Multivariate statistics applied to paleoecological analysis. Observations, laboratory analyses and techniques.

Microfacies; the Pelagic Environment

Recognition of biofacies for the definition of the pelagic paleoenvironment in different oceanographic settings. Bases of plankton taxonomy. Taphonomy. Applications and examples from present-day and past environments.

Detailed program

Benthic facies and applied marine paleoecology

Lessons: Sampling strategies and techniques for the study of marine and transitional benthic associations, death and fossil assemblages. Taphonomic processes and their effects on macrobenthos. Applied marine paleoecology: rationale, case histories. Multivariate statistics for benthic paleoecology.

Laboratory: Identification of key species within the main macrobenthic groups (mollusks, brachiopods, corals, calcareous algae, bryozoans). Quantification of the sedimentary contribution of the components of the benthic association. Macrobenthic facies analysis and identification of the paleoenvironment. Laboratory techniques and analyses for the study of marine and transitional benthic associations, death and fossil assemblages. Observations of the effects of the biostratinomic processes on shelled macrobenthos. Preparation, elaboration, and interpretation of multivariate

paleobiological data.

Microfacies; the Pelagic Environment

Lessons: Microfossils and oceanic (paleo)environments. Taxonomic bases for the identification of the main plankton groups. Plankton paleoecology and biogeography. Biofacies in the pelagic environment: sedimentary environment and diagenesis. Bases for the definition of a biostratigraphic framework for pelagic sedimentary successions. Examples from the present-day environment and from the geological record.

Laboratory: Identification, through binocular and polarized light microscope, of key species within the main microfossil groups (calcareous nannofossils, diatoms, silicoflagellates, foraminifera). The laboratory classes will be devoted to: a) the recognition of biofacies and the identification of paleoenvironments (coastal zone, continental shelf, continental slope, abyssal plain) in different settings (mid-ocean oligotrophic gyre, upwelling zones, areas with strong continental input, polar zones); b) the identification of biozones through the recognition of biostratigraphic markers for selected time frames.

Prerequisites

Paleontology, Geobiology

Teaching form

Lessons

Laboratories

During the COVID-19 restrictions the lessons will be recorded and available online, with some live events that will be planned and communicated on the e-learning page of the course

Textbook and teaching resource

Slides and scientific papers provided by the Lecturers

Semester

Second semester

Assessment method

2 self-assessment tests, to be done through the e-learning platform, with multiple choice or true/false questions, to be successfully completed before the oral examination
Written reports on the lab activities.
Oral examination: two open questions on the themes explained in classes (one on benthic facies, one on planktonic facies)
Grading: weighted average of all grades, in /30.
During the Covid-19 restrictions the oral exams will be exclusively through the WebEx platform. A public link will be posted on the e-learning page of the course for the access of virtual public

Office hours

Monday and Thursday 9:00 AM - 12.00 A.M. upon appointment

Course	Course Code	Course Credits	Course Year
ENVIRONMENTAL JUSTICE AND GEOPOLITICS OF THE SEA	**F7502Q039**	**6**	**1**

Lecturers:
Prof.ssa Elena Dell'Agnese, Dott. Francesco Zampieri

Aims

Understanding of the main questions raised by studying oceanic and transnational spaces in a critical geopolitics perspective.

An advanced ability to critically analyze and interrogate scholarship and discourse framing the oceans, and the geopolitical dynamics underway to conquer sea-power.

An understanding of the major challenges (acidification, oil and gas drilling, overfishing, and, in the long term, deep-sea mining, bioprospecting, and geo-engineering) posed by the deep seabed.

An engagement with the challenges of inter-disciplinary study and research.

Contents

After a short introduction to the most recent theoretical approaches to political geography and critical geopolitics, the course focuses first on the historical representation of the ocean as a "political and social space" and on how the sea can be framed by international geopolitical discourse, in relation to the processes of territorialisation, geo-power and extra-territoriality of marine spaces. The second part relates to the geopolitics of the deep see and in particular it focuses on the definition, value, ownership, access, health and future state of the resource-rich and highly contested sub-surface ocean.

Detailed program

Part I - Political geography of the sea (Elena Dell'Agnese)

The political geography of the sea: a classical approach (maritime boundaries and Law of the Sea, transport and trade, strategy and warfare)

A (critical) political geo-graphy of the sea? thinking about the sea / representing the sea / exploiting the "geopolitical features" of the sea

Geo-graphy and the power of representation /Dividing (and naming) the ocean sea: the East Sea/ Sea of Japan issue

The territorialisation of the sea /Territorial claims and islands disputes: the Dokdo-Takeshima issue

Geographical definitions and island disputes: the Sankeku-Diaoyu issue/ climate change and vanishing islands/reefs: Okininotori: a shima, or a reef'?

A classical approach to the geopolitics of the sea/ the myth of sea power: A.T. Mahan theoretical positions / China as a maritime power and the South China Sea competition (Spratly, Paracel and more)

Sea power, sea nodes and islands as U.S. bases: The Hawai'i and Pearl Harbor, Midway and Wake, Guam

Sea power, sea nodes and islands as overseas U.S. bases/ bases of empire and lily pads: Guantanamo, Micronesia and Marshall Islands, Okinawa, Diego Garcia

LSMPAs (Large Scale Maritime Protected Areas): conservation or geopolitics?

Extra-territoriality 1: Pirates as enemies of all nations The golden age of piracy and the "pirate commonwealth" against the "world political map", pirates of today, popular geopolitics of "pirates"

Extra-territoriality 3: Seasteading: "How Floating Nations Will Restore the Environment, Enrich the Poor, Cure the Sick, and Liberate Humanity from Politicians" (maybe)

Extra-territoriality 2: Cruising ships: Cruise tourism as an example of globalization? (History and Development, Crews, Employment, exploitation)

Part II – Geopolitics of deep oceans (Francesco Zampieri)

The tragedy of the commons

Harvesting the Commons: the Oceanic frontier and the devolution of the seas

Deep oceans: potential and problems

The deep seabed governance: the United Nations Convention on the Law of Sea (UNCLOS) and the International Seabed Authority (ISA)

The deep seabed governance

The deep seabed governance: the mining regime

Claiming the commons: Sovereignty and the deep seabed

Claiming the commons: the Arctic deep seabed

Protecting the commons

Climate change and the future of the deep oceans

Prerequisites

An adequate grasp of the perspectives of the relevant social sciences (geography, politics, economics, law, and sociology).

Capacity of working according to multidisciplinary and interdisciplinary perspectives.

Teaching form

asynchronous lectures

Textbook and teaching resource

Part I - Political geography of the sea (Elena dell'Agnese)

1. Political geography, geopolitics, critical geopolitics.

- The political geography of the sea: a classical approach (maritime boundaries and Law of the Sea, transport and trade, strategy and warfare)
- Glassner M.I., The new political geography of the sea, Political Geography Quarterly, 1986, pp. 6-8
- A (critical) political geo-graphy of the sea? (thinking about the sea / representing the sea / exploiting the "geopolitical features" of the sea)
- Steinberg, P.E. (1999) Navigating to Multiple Horizons: Toward a Geography of Ocean-Space, The Professional Geographer, 51, 3, pp. 366-375

2. Geo-graphy and the power of representation: The geo-graphy of the ocean sea

- Dividing (and naming) the ocean sea
- Steinberg, P.E. (1999), Lines of divison, lines of connection: Stewardship in the world ocean,

Geographical Review 89, 2, pp. 254-264
- The East sea/ Sea of Japan case study
- Chi Sang-Hyun, One feature, two names and many issues: The political geographies of naming the sea between Korea and Japan, eastsea1994.org/data/bbsData/14912842071.pdf

3. The "political geography of the sea": the territorialisation of the sea
- Territorial claims and islands disputes (Dokdo-Takeshima)
- Suk Kyoon Kim (2008), Understanding Maritime Disputes in Northeast Asia: Issues and Nature, Int'l J. Marine & Coastal L., pp. 213-247

4. Geographical definitions and island disputes (Sankeku-Diaoyu)
- McCormack G. (2013), Much Ado over Small Islands: The Sino-Japanese Confrontation over Senkaku/Diaoyu, The Asia-Pacific Journal, 11, 21, pp. 1-20
- Climate change and vanishing islands/reefs (Okininotori: a shima, or a reef'?)
- Yamamoto L., Esteban M. (2010), Vanishing Island States and sovereignty, Ocean & Coastal Management 53, pp. 1–9

5. A classical approach to the geopolitics of the sea: the myth of sea power (A.T. Mahan)
- Sumida J. (1999): Alfred Thayer Mahan, geopolitician, Journal of Strategic Studies, 22, 2-3, 39-62
- China as a maritime power and the South China Sea competition
- Nohara J.J. (2017) Sea power as a dominant paradigm: the rise of China's new strategic identity, Journal of Contemporary East Asia Studies, 6, 2, pp. 210-232

6. Sea power, sea nodes and islands as U.S. bases
- The Hawai'i and Pearl Harbor, Midway and Wake, Guam
- Vine D., (2015) Base Nation: How U.S. Military Bases Abroad Harm America and the World, Metropolitan Books, New York, Introduction, Capp. 1 and 2

7. Sea power, sea nodes and islands as overseas U.S. bases: bases of empire and lily pads
- Guantanamo, Micronesia and Marshall Islands, Okinawa, Diego Garcia
- Vine D., (2015) Base Nation: How U.S. Military Bases Abroad Harm America and the World, Metropolitan Books, New York, Cap 3.

8. LSMPAs (Large Scale Maritime Protected Areas): conservation or geopolitics?
- Sand P.H. (2012), 'Marine protected areas' off UK overseas territories: comparing the South Orkneys Shelf and the Chagos Archipelago, The Geographical Journal, 178, 3, pp. 201–207
- Leenhardt P., Cazalet B., Salvat B., Claudet J., Feral F. (2013). The rise of large-scale marine protected areas: Conservation or geopolitics? Ocean & Coastal Management, 85, pp. 112-118

9. Extra-territoriality 1: Pirates as enemies of all nations The golden age of piracy and the "pirate commonwealth" against the "world political map", pirates of today, popular geopolitics of "pirates"
- Featherstone D. (2005) Atlantic networks, antagonisms and the formation of subaltern political identities, Social & Cultural Geography, 6, 3, pp. 387-404
- Hastings J.V., (2008), Geographies of state failure and sophistication in maritime piracy hijackings, Political Geography 28, pp. 213–223

10. Extra-territoriality 2: Cruising ships: Cruise tourism as an example of globalization? (History and Development, Crews, Employment, exploitation)

- Hall C.M., (2001), Trends in ocean and coastal tourism: the end of the last frontier? Ocean & Coastal Management, 44, pp. 601-618

11. Extra-territoriality 3: Seasteading: "How Floating Nations Will Restore the Environment, Enrich the Poor, Cure the Sick, and Liberate Humanity from Politicians" (maybe)
- Steinberg P.E., (2009) Sovereignty, Territory, and the Mapping of Mobility: A View from the Outside, Annals of the Association of American Geographers, 99:3, 467-495,
- Steinberg P.E., Nyman E., Caraccioli M.J. (2012), Atlas Swam: Freedom, Capital, and Floating Sovereignties in the Seasteading Vision, Antipode, 44, 4, pp. 1532–1550

Part II – Geopolitics of deep oceans (Marco Grasso)

- Hannigan, J. (2016). The Geopolitics of Deep Oceans. Cambridge, UK: Polity Press
- Scientific articles and policy briefs pointed indicated below. They are all accessible from within the campus; for accessing them from outside the campus see here: https://www.biblio.unimib.it/it/risorse/accesso-alle-risorse-remoto

The tragedy of the commons
- Hardin, G. (1968). The tragedy of the commons. Science, 162(3859), 1243-1248.
- Breitburg, D., Levin, L. A., Oschlies, A., Grégoire, M., Chavez, F. P., Conley, D. J., ... & Jacinto, G. S. (2018). Declining oxygen in the global ocean and coastal waters. Science, 359(6371).
- See also, The Atlantic, 'A Foreboding Similarity in Today's Oceans and a 94-Million-Year-Old Catastrophe', https://www.theatlantic.com/science/archive/2018/01/suffocating-oceans/550415/]

Harvesting the Commons: the Oceanic frontier and the devolution of the seas
- Hanningan (2016): Introduction and Chapter 1
- Van Dover, C. L. (2011). Tighten regulations on deep-sea mining. Nature, 470(7332), 31-33.
- Sielen, A. B. (2013). The devolution of the seas: the consequences of oceanic destruction. Foreign Affairs, 92(6), 124-132.
- Diaz, R. J., and Rosenberg, R. (2008). Spreading dead zones and consequences for marine ecosystems. Science, 321(5891), 926-929.

Deep oceans: potential and problems
- Thurber, A. R., Sweetman, A. K., Narayanaswamy, B. E., Jones, D. O. B., Ingels, J., & Hansman, R. L. (2014). Ecosystem function and services provided by the deep sea. Biogeosciences, 11(14), 3941-3963.
-·Armstrong, C. W., Foley, N. S., Tinch, R., & van den Hove, S. (2012). Services from the deep: Steps towards valuation of deep sea goods and services. Ecosystem Services, 2, 2-13.
- Mengerink, K. J., Van Dover, C. L., Ardron, J., Baker, M., Escobar-Briones, E., Gjerde, K., ... & Sutton, T. (2014). A call for deep-ocean stewardship. Science, 344(6185), 696-698.

The deep seabed governance: the United Nations Convention on the Law of Sea (UNCLOS) and the International Seabed Authority (ISA)
-·Hanningan (2016): Chapter 2
-·Wolfrum, R. (2008). Legitimacy of international law and the exercise of administrative functions: the Example of the International Seabed Authority, the International Maritime Organization (IMO) and International Fisheries Organizations. German Law Journal, 8, 2039-2060. ONLY SECTION C, pp. 20145-2054.

The deep seabed governance

--Kim, B. M. (2014). Governance of the global commons: the deep seabed, the Antarctic, outer space. KIEP World Economy, 4(29).

--Guntrip, E. (2003). The Common Heritage of Mankind: an adequate regime for managing the deep seabed. Melb. J. Int'l L., 4, 376.

The deep seabed governance: the mining regime

--Jaeckel, A., Gjerde, K. M., and Ardron, J. A. (2017). Conserving the common heritage of humankind–Options for the deep-seabed mining regime. Marine Policy, 78, 150-157.

--Boetius, A., & Haeckel, M. (2018). Mind the seafloor. Science, 359(6371), 34-36.

Claiming the commons: Sovereignty and the deep seabed

--Hanningan (2016): Chapter 3

- Werner, W., & Aalberts, T. (2016). Mastering the globe: Law, sovereignty and the commons of mankind. In The Politics of Globality since 1945 (pp. 89-105). Routledge (Available at: http://www.academia.edu/download/38711813/Globality_-_Mastering_the_Globe_-_Aalberts_Werner_final.pdf)

Claiming the commons: the Arctic deep seabed

--Borgerson, S. (2013). The coming Arctic boom: as the ice melts, the region heats up. Foreign Affairs, 92, 76.

--Berkman, P. A., & Young, O. R. (2009). Governance and environmental change in the Arctic Ocean. Science, 324(5925), 339-340.

--Rothwell, D. R. (2013, April). The Law of the Sea and Arctic Governance. In ASIL Annual Meeting Proceedings, 107, pp. 272-275. American Society for International Law.

Protecting the commons

--Hanningan (2016): Chapter 4

--The Economists, 'The tragedy of the high seas', https://www.economist.com/news/leaders/21596942-new-management-needed-planets-most-important-common-resource-tragedy-high

Climate change and the future of the deep oceans

--Hanningan (2016): Chapter 5

--McGee, J., Brent, K., & Burns, W. (2018). Geoengineering the oceans: an emerging frontier in international climate change governance. Australian Journal of Maritime & Ocean Affairs, 10(1), 67-80.

Semester

Second semester.

Assessment method

Parte I - Political geography of the sea (Elena dell'Agnese)
2,000-2,500 word topical paper on an issue analyzed during the course and selected by the instructor.

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Office hours

Elena Dell'Agnese
Thursday 10,30-12,30
Room 358/U7 third floor

MARINE SCIENCES

MARINE SCIENCES

Course	Course Code	Course Credits	Course Year
HUMAN GEOGRAPHY OF SMALL ISLAND SYSTEMS	**F7502Q016**	**6**	**1**

Lecturer:
Dott. Stefano Malatesta

Aims

Mainly referring to the general framework of the Island Studies, the course aims to provide a set of tools useful to the analysis of socio-spatial dynamics within island systems. Furthermore the course aims to provide tools and interpretative models useful to understand how, at local scale, human communities (privately, socially and politically) cope with socio-environmental changes, crises, conflicts and transitions by producing a set of resilient practices, knowledge and adjustment

Contents

Geography of Archipelagos and Island States; Human Geography of Islands; Human Ecology of Island Systems; Environmental challenges in Small Island States; Trans-scalar Spatial Analysis of Island Systems; Environmental Policies of Small Island States, Islands as Ecotones, Archipelago and Aquapelagos

Detailed program

The course will be structured in two parts:

I. The first part of the course will be dedicated to the study of the human geography of islands and archipelagic states. Students will apply, even by adopting a critical perspective, a set of patterns and paradigms (such as isolation, vulnerability, distribution, concentration, center-periphery relationship and spatial dispersion), in order to understand the role of spatial features in shaping socio-environmental processes Furthermore reading these socio-environmental processes by adopting a trans-scalar perspective helps students and researchers to stress the complexity of the human ecology of islands, coastal areas and archipelagic systems.

II. The second part of the course will be dedicated to the reading, at local scale, of the set of social, political and spatial measures and adjustments that human communities adopt to deal with the environmental challenges affecting island systems.

Lessons:

- Island Studies: an introduction
- Some interpretative categories
- Human ecology: an introduction
- The geography of islands and island states
- The human ecology of islands
- Small Island States: some environmental issues
- Small islands: geography
- Small islands: human geography
- Small islands: sustainability
- Small islands: resilience and social response to change
- Human Geography of the Maldives
- Environmental changes and challenges of the Maldivian Islands

Prerequisites

None.

Teaching form

Classes will be provided by lessons, discussions of scientific papers, analysis of national and international reports, and reading of environmental assessments.
Students will be asked to work directly on a set of case studies, focusing on the geographical relevance of the environmental changes affecting small island systems in local, regional and supra-regional contexts.
The human geography of the Maldives will represent a reference for the understating of the interactions among human and environmental systems in small island states and archipelagos.

Textbook and teaching resource

References:

- A selection of essays from: Baldacchino G., Niles D. (eds), 2018, Geography of Small Islands, Outposts of Globalization, Springer, London
- Baldacchino, G. (2008). Studying Islands: On Whose Terms? Some Epistemological and Methodological Challenges to the Pursuit of Island Studies. Island Studies Journal, 3(1), 37-56.
- Depraetere C., 2008, The Challenge of Nissiology (part 1), Island Studies Journal, Vol.3, No. 1, pp. 3-16
- Depraetere C., 2008, The Challenge of Nissiology (part 2), Island Studies Journal, Vol.3, No. 1, pp. 17-36
- Hay P., 2006, A Phenomenology of Islands, Island Studies Journal, Vol. 1, No. 1, 2006, pp. 19-42
- Jędrusik M., 2014, The elusive sustainable development of small tropical islands, Miscellanea Geographica. Regional Studies on Development, 18, 3, 26-30
- Kelman, I. (2014). No change from climate change: vulnerability and small island developing states. The Geographical Journal, 180(2), 120-129.
- Malatesta S., Schmidt di Friedberg M., (2017), Environmental policy and climate change vulnerability in the Maldives: From the 'lexicon of risk' to social response to change, Island Studies Journal, 12, 1, 2017, pp. 53-70
- Malatesta S., (2018), International actors as policymakers? Discussing the influence of international actors on the environmental policies of small island states, Small States & Territories Journal, 1, 1, pp. 95-110
- Royle, 1989, A Human Geography of Islands, Geography, 74, 2, 106-116
- Stratford et al., 2011, Envisioning the Archipelago, Island Studies Journal, Vol.6, No. 2, pp. 113-130

Additional essays and case studies could be provided during the lessons.

Semester

Second semester.

Assessment method

Oral exam.

Office hours

Monday 11,00-13,00, u6-4147, IV Floor(or webex https://unimib.webex.com/meet/stefano.malatesta)

MARINE SCIENCES

Course	Course Code	Course Credits	Course Year
APPLIED GEOMORPHOLOGY AND HABITAT	**F7502Q021**	**6**	**1**

Lecturers:
Prof.ssa Daniela Basso, Prof. ssa Alessandra Savini

Aims

To provide knowledge on traditional and new advanced techniques used to characterise, map and model the distribution and extent of marine benthic habitats. To provide students with the necessary knowledge and practical experience to develop marine habitat maps; to identify and classify, when relevant, the main types of bioconstruction; to recognize the dominant habitat engineers and their relationship with the abiotic components, within an ecosystem approach.

Contents

This course deals with the geomorphological and geobiological characterization of benthic habitats, with an emphasis on marine benthic bioconstructions of the temperate Mediterranean Sea and the shallow water tropical reef environments. It focuses on field and remote observations of characteristic habitats and their multi-scale relationships with the associated abiotic components. Environmental issues, related to the role of habitat mapping and monitoring in marine ecosystem management, are explained and discussed using case histories.

Laboratory activities will offer the students the opportunity to use traditional and new advanced methods and techniques for mapping and modelling the distribution of marine benthic habitats.

Detailed program

Introduction to biogeomorphology: interplay between organisms and geomorphology in submerged environments. Mediterranean marine bioconstructions: from the shallow shelf to the bathyal zone. Examples of bioconstructions from tropical reef environments.

Applied submarine geomorphology for ecosystem based management: the role of habitat mapping.

Habitat mapping, characterization and classification. The use of surrogates in habitat mapping practice. Habitat suitability models. Habitat mapping and ecosystem-based management.

Tutorials: Habitat mapping and habitat characterization techniques.

Prerequisites

Introduction to Marine Physical Geography, Geobiology, Invertebrate zoology (base level) or systematic and general Palaeontology.

Teaching form

- Lessons: 2 + 2 credits
- Tutorials: 2 credits

During the COVID-19 restrictions the lessons and the tutorials will be recorded and available online, with some live events that will be planned and communicated on e-learning

Textbook and teaching resource

- Seafloor Geomorphology as benthic habitat. 2011. Ed. by P.T.Harris and E.K. Baker. Elsevier.
- A selection of scientific journal articles will be provided by the teachers.

Semester

Second semester.

Assessment method

Online practical tests and Oral examination
Practical test about habitat mapping on data and documents provided by the teachers.
Oral: short discussion about the lessons content and the practical tests.
Marks are given as n/30. Minimum positive value is 18/30

Office hours

To make an appointment, please contact the teachers by e-mail:
daniela.basso@unimib.it
alessandra.savini@unimib.it

Course	Course Code	Course Credits	Course Year
MARINE ENVIRONMENTAL MICROBIOLOGY	**F7502Q035**	**6**	**1**

Lecturer:
Prof. Andrea Franzetti

Aims

Expertise in applied microbiology of marine environments.
Skills in molecular and traditional analyses for characterization of microbial communities.
Skills in analysis of data from microbial community characterization by bioinformatic tools.

Contents

1. Microbial metabolisms and diversity in marine environments: diversity of bacteria and archea in marine environments, metabolic diversity of microbes in marine environments.
2. Roles of microbes in ocean processes.
3. Techniques for the characterization of microbial communities in marine environments.
4. Microbial marine habitats.
5. Microbial aspects of environmental issues in marine environments.

Detailed program

1. Microbial metabolisms and diversity in marine environments: diversity of bacteria and archea in marine environments, metabolic diversity of microbes in marine environments
- Microbial molecular phylogeny
- Phototrophy
- Microbial respiration
- Main microorganisms in marine environmet

2. Roles of microbes in ocean processes:
- Carbon cycle
- Sulfur cycle
- Iron cycle

3. Techniques for the characterization of microbial communities in marine environments
- Phylogenetic markers
- Libraries of gene 16S rRNA
- Metagenomics
- Microscope analyses

4. Microbial marne habitats
- Coastal environmets
- Open ocean
- Cold seeps
- Hydrothermal vents

5. Microbial aspects of environmental issues in marine environments:
- Aerobic and anaerobic biodegradation of aliphatic and aromatic hydrocarbons

- Biological treatments of contaminated sediments

Prerequisites

Basic knowledge of microbiology

Teaching form

Lessons, Seminars: 5 credits (35 hours) - During the COVID-19 restrictions the lessons will be recorded and available online, with some live events that will be planned and communicated on e-learning.
Bioinformatic laboratory: 1 credit (12 hours) - During the COVID-19 restrictions, the laboratory will be carried out with live events. Each student will be connected to a computer virtual machine provided by the university.

Textbook and teaching resource

1. “Marine Microbiology: ecology and applications” (2011), 2nd edition di Colin Munn. GS, New York

2. “Bioremediation and Natural Attenuation” (2006) di P. J. J. Alvarez, W. A. Illman. Ed Wiley $ Sons, New Jersey

3. “Brock - Biology of Microorganisms” (2007) di M. T. Madigan, J. M. Martinko Brock. Ed. CEA Milano.

4. “Molecular Microbial Ecology”. Ed. A.M. Osborn, C. J. Smith (2005) Taylor & Francis Group – New York NY

Scientific articles provided by the teacher

Semester

First semester.

Assessment method

The acquired knowledge about environmental microbiology concepts applied to marine environments will be tested by an oral exam. A report about laboratory activities will allow testing the bioinformatic competencies applied to environmental microbiology.
During the Covid-19 restrictions the oral exams will be exclusively through the WebEx platform. A public link will be posted on the e-learning page for the access of virtual public.

Office hours

Monday 9.00 - 10.00.

Course	Course Code	Course Credits	Course Year
OCEAN RESOURCES LAW AND POLICY	**F7502Q041**	**6**	**1**

Lecturer:
Prof. Tullio Scovazzi

Aims

The aim is to provide students who have a scientific background and have attended the course in "International Law of the Sea" with a basic knowledge of the international legal regime that presently applies to the exploration and exploitation of marine natural resources.

Contents

The legal regime concerning the exploration and exploitation of marine natural resources, both living and non-living, at the world basis, as provided for by the the 1982 United Nations Convention on the Law of the Sea.

Detailed program

1. The conservation of marine living resources.
a) the zonal approach:
- the conservation of marine living resources in the exclusive economic zone;
- the conservation of marine living resources in the high seas.
b) the species-specific approach:
- shared and straddling fish stocks;
- highly migratory species;
- marine mammals;
- anadromous species;
- catadromous species.
2. The current negotiations under the 1982 United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity beyond national jurisdiction.
3. The exploration and exploitation of non-living resources.
a) the resources of the continental shelf and the outer continental shelf;
b) the resources of the Area.
4. A regional case: the General Fisheries Commission for the Mediterranean..

Prerequisites

To have attended the course in "International Law of the Sea".

Teaching form

Oral classes with active involvement of students, who will be working directly on the relevant legal instruments and maps. During the COVID-19 emergency, the classes will be partially in presence and partially (mainly) from remote (recorded and uploaded on the e-learning web page).

Textbook and teaching resource

A number of papers and the relevant legal texts are collected in a syllabus that, at the beginning of the course, will be distributed to all students and uploaded on the e-learning web page.

Semester

Second semester.

Assessment method

The exam consists of one question cast by ballot among a list of questions previously circulated. The list of questions covers the entire programme of the course and, therefore, students are expected to be able to expound all topics addressed in class.
The exam takes into account the following elements:
- knowledge of the subject matter;
- consistency and completeness in the exposition;
- correct use of legal terminology;
- capacity of expression in a clear and concise manner.

The student may decide to withdraw from the exam before or immediately after the grade has been stated.

Office hours

Syllabi

2nd YEAR

Course	Course Code	Course Credits	Course Year
COASTAL AND MARINE HAZARD AND RESILIENCE	**F7502Q007**	**6**	**2**

Lecturer:
Prof.ssa Marcella Schmidt Muller Di Friedberg

Aims

The course explores the complexity of the relationship between culture, risk and disaster. The aim is to increase understanding of how best to deal with the risks associated with coastal and marine environments, and to examine human resilience to risk, exploring the cultural dimension of disaster.

Contents

Definitions and uses of the terms hazard, risk and disaster, vulnerability and resilience.
Hazards, risks and disasters in marine and coastal areas.
Culture, knowledge and world views related to hazards.
The cultural dimension of disaster risk reduction (DRR).
Cultural and political aspects of disasters, catastrophes and natural hazards (tsunamis, floods, climate change): adaptation, mitigation and resilience.
Governance, stakeholders, communication and participation.

Detailed program

The course examines the development of the meaning, uses and applications of the terms hazard, risk and resilience in marine and coastal areas, and explores the cultural dimension of disaster.

The significance of "culture" must be understood and incorporated into any attempt to deal with natural hazards (tsunami, storm surges, inundations, sea level rise) and disasters. The cultural dimension of disaster provides an understanding of human and social vulnerability to hazards, local knowledge and resilience and social response at the local level.

In the course, case studies will be presented, focusing on the resilience-based responses to hazards and risk of multiple sets of actors (women, children, older people, local communities, international agencies, political institutions) and human activities in different contexts.

Prerequisites

None.

Teaching form

In the Covid-19 emergency period, lectures will be done remotely asynchronously with synchronous videoconferencing events. Students will be engaged in case studies, discussions of scientific papers, analysis of national and international reports, oral presentations and reading of environmental assessments.

Textbook and teaching resource

Krüger F., Bankoff G., Cannon T., Orlowski B., and Schipper E.L.F. (Eds.) (2015), Cultures and Disasters: Understanding Cultural Framings in Disaster Risk Reduction, Abingdon and New York, Routledge.

And the four articles:

1) Alexander D.E. (2013)"Resilience and disaster risk reduction: an etymological journey", Nat. Hazards Earth Syst. Sci., 13, 2707–2716,

2) Weichselgartner J., Kelman I. (2015), "Geographies of resilience: Challenges and opportunities of a descriptive concept", Progress in Human Geography, Vol. 39(3) 249–267

3) Kelman I., Gaillard J.C., Mercer J. (2015), "Climate Change's Role in Disaster Risk Reduction's Future: Beyond Vulnerability and Resilience", Int. J. Disaster Risk Sci, 6:21–27

4) Adger W.N., Hughes T. P., Folke C., Carpenter S.R., Rockström J. (2005), "Social-Ecological Resilience to Coastal Disasters", Science 309, 1036–1039.

Semester

First semester.

Assessment method

In the Covid-19 emergency period, oral exams will take place only in telematic mode. They will be conducted using the WebEx platform and the e-learning page of the teaching will contain a public link to access the exam for eventual virtual viewers.

Oral final examination.

For attending students the final evaluation will be based on:
1) attendance and participation in the course,
2) articles presentations,
3) group presentation and ppt,
4) oral presentation of one's contribution to teamwork
5) writing assignment

For not attending students:
Oral discussion with open questions about the textbook and articles listed in the program.

Office hours

Appointment by e-mail
marcella.schmidt@unimib.it

MARINE SCIENCES

Course	Course Code	Course Credits	Course Year
COASTAL AND MARINE BOTANY	**F7502Q017**	**6**	**2**

Lecturer:
Dott.Rodolfo Filippo Gentili

Aims

Knowledge and understanding:

Knowledge of the diversity of species and structures of costal vegetation and marine algae and plants.

Understanding the role of costal vegetation and marine algae and plants in their own ecosystems.

Applying Knowledge and understanding:

Acquiring skills in identifying costal plants and marine algae and seagrasses

Providing basic concepts about the applications of marine algae and plants

Making judgements:

Favouring group sessions, debate and discussions (for instance after watching videos or reading scientific articles)

Communication and learning skills:

Conducting interactive lessons with a learner-centred approach: students will present thematic seminars.

Contents

This subject will focus on algae and plants of both marine submerged and emerged environments and particularly on marine microalgae, macroalgae and seagrasses and on terrestrial plants belonging to costal vegetation, with a special emphasis on those typical of Mediterranean and tropical regions. In the introductory part of the course attention will be paid in analysing the main evolutionary stages which have led to the actual biodiversity of marine algae and plants and in deeping in the knowledge on the major taxonomic groups of algae and plants that can be found in Mediterranean and tropical marine and costal environments. The following lessons will focus on the systematics of marine algae and seagrasses; a taxonomic classification will be conducted in an evolutionary key, based on the different kinds of photosynthetic pigments. Furthermore, the main morphological, biological and ecological features will also be described for the most important groups, as well as their environmental importance.
The second part of the course, instead, will focus on costal vegetation of Mediterranean and tropical regions. Initially, a general characterization will be conducted, considering the main taxonomic groups of coastal plants, prior to describe in detail the vegetation of the most particular habitats (cliffs, estuaries, mangrove forests, etc.
The third part of the course will be dedicated to analyse the main environmental and human problems related to marine algae, such as biological invasions and harmful algal blooms.
Finally, the last lessons will be organized as workshops, during which small groups of students will be asked to deep in their knowledge on the main uses of marine algae and plants and to share them with their mates.

Detailed program

INTRODUCTION TO COASTAL AND MARINE BOTANY
- Plant evolution and biodiversity (from Cyanobacteria to Angiosperms)
- Main taxonomic groups of algae and plants living in coastal and marine environments

SYSTEMATICS OF MARINE ALGAE AND PLANTS IN TERMS OF EVOLUTION
- Microalgae: Chrysophyceae, Dinoflagellata, Bacillariophyceae, Chlorophiceae, Pelagophiceae
- Macroalgae: Rhodophyta, Ulvophyceae, Phaeophyceae
- Tracheophyta

COASTAL VEGATATION AND FLORA
- Salt and brackish marshes
- Sand dunes
- Mangrove swamps and forests
- Coastal cliffs

PROBLEMS RELATED TO MARINE ALGAE AND PLANTS (Main topics)
- Alien species and biological invasions
- Harmful algal blooms
- Toxic algae

USES OF MARINE PLANTS (Students' workshops)
- Bio-indicators
- Phytoremediation
- Biofuel
- Fertilizers
- Food/pharmacy

Teaching form

- Lessons: 5 credits
- Tutorials: 1 credits

Textbook and teaching resource

Slides; Textbooks and References:
"Marine Botany", by Dawes C.J., John Wiley & Sons, Inc.
"Diatoms: Biology and Morphology of the Genera", by Round et al., Cambridge
"Marine Benthic Dinoflagellates: Unveiling Their Worldwide Biodiversity", by Horiguchi et al., Schweizerbart
"Chrysophyte algae: ecology, phylogeny and development", by Sandgren et al., Cambridge
"An Introduction to Phytoplanktons: Diversity and Ecology", by Pal & Choudhury, Springer
"Seaweed Ecology and Physiology", by Hurd et al., Cambridge
"Global Seagrass Research Methods", by Short & Coles, Elsevier
"Alghe e Fanerogame del Mediterráneo", by Rodríguez-Prieto et al., Il Castello (edizione italiana);
"Algaebase", Guiry & Guiry, www.algaebase.org
"Mangrove Ecosystems: A Global Biogeographic Perspective. Structure, Function and Ecosystem

Services.", by Rivera-Monroy V.H., Springer

"Coastal dunes, ecology and conservation" by.Martínez M.L and Psuty N.P., Springer

Semester

First semester.

Assessment method

Oral examination consisting of questions related to all the contents of the lessons and of the practical activities.

During the exam the candidate must demonstrate his ability to address and critically discuss the topics.

Mark range: 18-30/30.

Office hours

On request via email

Course	Course Code	Course Credits	Course Year
MANAGEMENT OF AQUATIC RESOURCES: FISHERIES	**F7502Q018**	**6**	**2**

Lecturer:
Dott.ssa Maria Cristina Mangano

Aims

The course examines key aspects and critical issues of aquatic resources management. Specifically, the course examines fishery and aquaculture productive systems focusing on ecosystem-based management approaches and innovative solutions to make both sectors more sustainable in a context of anthropogenic driven changes.

Contents

The course will facilitate the understanding of the broad biological, social and economic aspects of fisheries science and the interplay between them with an overall ecological emphasis, by applying lessons learned and incorporation of emerging methods and data sources

Detailed program

The course will specifically provide specific knowledge on:

Marine fisheries ecology: production processes – An introduction on how physical and biological processes drive the production of fishes; how species abundance changes in space and time.

Fishing gears and farming techniques - The scale, social and economic significance of global fishery and aquaculture; the species that are caught and farmed; fishing and farming strategies.

Stock assessment, ecosystem modelling, spatial planning - How to make basic quantitative assessment of single and multispecies fisheries; estimate of needed parameters for assessment; key strengths and gaps of different assessment and planning methods; the effects of uncertainty on the outputs.

Fish life histories and distribution - Functional and life-history traits of both fished and farmed species that make them vulnerable to fishing mortality and anthropogenic driven changes (e.g. climate change).

Fishing and farming effects on ecosystems - The impacts of fishing and farming on ecosystems; non-target species and habitats; mitigation measures and innovative solutions.

Evidence-based management and conservation options - The objectives of fishery and aquaculture management; factors that motivate and limit the fishing and farming activities, fishers/farmers behaviours; economic, social and biological reasons of overexploitation and extensive farming; how scientific advices can support the decision-making process and policy.

Prerequisites

None.

Teaching form

In the COVID-19 emergency period, lectures will be done remotely asynchronously with some synchronous live events (video conferencing events) that will be planned and communicated on e-learning. Students will be engaged in case studies design and discussion, reading and discussions of scientific papers, analysis of national and international reports.

Textbook and teaching resource

- Lesson slides (power point presentations)
- Textbooks:

  Jennings, S., Kaiser, M., & Reynolds, J. D. (2009). Marine fisheries ecology. John Wiley & Sons.

  Andersen, K. H. (2019). Fish ecology, evolution, and exploitation: a new theoretical synthesis. Princeton University Press.
- Suggested readings from:

  Levin, Simon A., et al., eds. The Princeton guide to ecology. Princeton University Press, 2012.

  Kaiser, Michel J., et al. "Marine ecology: processes, systems, and impacts". Oxford University Press, 2020 (3th Edition).

  Hilborn, Ray, and Ulrike Hilborn. Ocean Recovery: A sustainable future for global fisheries?. Oxford University Press, 2019..

Semester

First semester.

Assessment method

Online Oral examination (18-30/30). During the COVID-19 emergency period, oral exams will take place through the WebEx platform. A public link will be posted on the e-learning page for the access of virtual public. For attending students, the final evaluation will be based on: 1) attendance and participation in the course, 2) articles presentations, 3) group presentation and ppt. For not attending students: Oral discussion with open questions about the textbook and articles listed in the program.

Office hours

On appointment, by e-mail request.

Course	Course Code	Course Credits	Course Year
MARINE MOLECULAR BIOLOGY	**F7502Q019**	**6**	**2**

Lecturer:
Prof. Ivan Orlandi, Prof. Pereira Boeger Walter Antonio

Aims

This course introduces the basic aspects of the molecular and cellular biology of marine organisms. Topics include the methodology and applications of molecular biology as a means of examining ecosystem-wide biological processes. At completion of the course, the students should be able to define specific biological problems with corresponding molecular markers, to design compatible experimental procedures and to define the necessary analytical protocols.

Contents

Principles and applications of molecular biology tools (genomics, transcriptomics and proteomics) for the study of marine ecology.

Detailed program

Introduction

- Organization and structure of genomes.
- Principles of molecular evolution of genes.
- Relationship between gene regulation and biological functions.
- Phylogenetic relationships among marine organisms

Section 1: Molecular tools for marine biology and ecology

- Marine ecological genomics:
  - Genome sequencing methods: dideoxy procedure, primer walking, pyrosequencing, use of reversible chain terminators, sequencing by ligation, large-scale DNA sequencing methods: shot-gunning strategy for sequencing genomes, cyclic array
  - sequencing whole genome of key organisms, genome comparison for phylogeny, genomic analysis of natural communities, genomic analysis of communities (genome ecology),
  - Polymerase Chain Reaction (PCR): principles and application in marine ecology
  - Species identification by barcoding.
- Transcriptomic:
  - Quantitative real-time polymerase chain reaction (QPCR): principles and probes;
  - Absolute and quantitative analyses
    - RNase protection-based assays
    - CDNA subtractive hybridization(SSH)
    - DNA arrays: cDNA and oligonucleotide arrays
    - Comparative approaches to cellular functions based on molecular analyses.
- Proteomic:
  - Preparation of protein samples from bacteria, plants and animal tissues.
  - SDS PAGE and protein detection by Western analysis.
  - 2D gel electrophoresis: 2D protein patterns, mass spectrometry and comparative analyses.

Section 2: Application of molecular markers in marine biology and ecology

- Introduction:
  - Types of molecular markers and their applicability – a matter of scale
  - Basic concepts in evolution – why molecular data markers?
  - Specific concepts on genetics
- Markers and the individual
  - Barcode of life revisited- a tool to understand biology
  - Parentage, relatedness
- Markers and population
  - Basic principles of population genetics
  - Phylogeography
- Markers and species
  - Speciation
  - Phylogeny
  - Biogeography
- Markers and communities
  - Metagenomics
  - Invasive species
- Conservation genetics in the marine environment

Prerequisites

Undergraduate genetics and ecology.

Teaching form

Lessons and seminar activities. During the COVID-19 restrictions the lessons will be recorded and available online, with some live events that will be planned and communicated on the e-learning page of the course..

Textbook and teaching resource

The students can use "Gene Cloning and DNA Analysis: An Introduction" T.A. Brown 7th Edition as general textbook. The teaching material used for the lessons is available on the e-learning platform.

Semester

The course will take place in the first semester according to a timetable that will be published.

Assessment method

Examination type: Oral examination.
Students will perform a presentation focused on a research paper based on Molecular Biology approach and they will discuss about the principles and applications of technologies introduced in this course.
Mark range: 18-30/30.

Office hours

The teacher will receive by appointment.
Monday - Friday 9.00-17.00

Course	Course Code	Course Credits	Course Year
PALEOCEANOGRAPHY AND PALEOCLIMATOLOGY	**F7502Q020**	**6**	**2**

Lecturer:
Prof.ssa Elisa Malinverno

Aims

Understanding the natural variability in the climate system; knowledge of climatic variations and their causes at different time scales; study of proxies in different archives; knowledge of the main oceanographic processes in the present and in the past.

Contents

Bases of Paleoclimatology and Paleoceanography: climate system, chronology, proxies. Climatic variability and climate variations: timescales of changes. Paleoceanographic variations, as reconstructed through proxy data.

Detailed program

Lessons:
The climate system: components, inter-relations, annual and inter-annual variability.
Climatic variations: time scales and control mechanisms at the global scale; the anthropogenic impact.
Chronology: main dating methods in paleoclimatology and paleoceanography. 14C as a dating method and paleoclimatic paleoceanographic proxy.
Climatic evolution in the geologic past: greenhouse and icehouse states at geological scale; climate variations and Milankovitch cycles; millennial, centennial and decadal-scale variability in the recent past.
Paleoclimatic proxies: examples and applications in the marine, ice and terrestrial record.
Paleoceanographic applications; climate and sea level; paleocirculation and paleoproductivity; global and Mediterranean (sapropel) anoxic events; salinity crisis; ocean acidification in the present-day and in the paleo-record.

Tutorials:
Case studies: processing and interpretation of paleoclimatic and paleoceanographic data. Analysis and discussion on paleoclimatic and paleoceanographic reconstructions from the recent scientific literature.

Prerequisites

None.

Teaching form

- Lessons.
- Tutorials.

During the COVID-19 restrictions the lessons will be recorded and available online, with some live events that will be planned and communicated on the e-learning page of the course.

Textbook and teaching resource

Bradley – Quaternary Paleoclimatology
Slides provided by the Lecturer and scientific papers.

Semester

Second semester.

Assessment method

Oral examination: 3 questions related to the themes addressed in class, of which: 2 questions to assess the knowledge on proxies and the mechanisms and time scales of changes; 1 question related to the changes occurred within one specific time frame, among those shown in class and in the slides, drawing a graph.
Written report on the laboratory activities
Grades in /30.
During the Covid-19 restrictions the oral exams will be exclusively through the WebEx platform. A public link will be posted on the e-learning page of the course for the access of virtual public.

Office hours

Monday and Thursday: 9:00 AM - 12:00 AM

Course	Course Code	Course Credits	Course Year
COASTAL RISKS AND DYNAMICS	**F7502Q023**	**6**	**2**

Lecturer:
Prof. Felice D'Alessandro

Aims

The aim of the course is to provide the knowledge concerning coastal processes and risks interacting on coastal dynamics and evolution under changing climate. The student at the end of the course will be able to understand and evaluate the physical coastal system, identify coastal vulnerability and risk and the possible defence policies according to the Integrated Coastal Zone Management (ICZM).

Contents

The course is intended to provide basic knowledge of hydrodynamic (wave genesis and transformation) and morphodynamic (sediment transport, beach-profile evolution and coastline dynamics) processes induced by natural and anthropogenic pressures, and to assess design tools to prevent and reduce coastal risks related to beach erosion, flooding and extreme events.

Detailed program

The coastal zone. Wind waves. Wave theories. Random waves. Wave statistics. Wave transformation from off-shore to on-shore. Sea level. Astronomical tide. Wave set-down and wave set-up. Wave run-up. Longshore, rip and undertow currents. The beach. Sediment characteristics. Cross-shore beach profile. Equilibrium beach profile. Closure depth. The concept of physiographic region. Sediments balance. Coastal dynamics and processes. Sediment transport. Long-shore and cross-shore sediment transport. Historical shoreline evolution. Shoreline evolution modelling. Elements of beach-dune system morphodynamics. Coastal risk. Coastal erosion: natural and anthropogenic pressures. Resilience and resistance of coastal systems. Coastal vulnerability. Climate change and extreme events: storm surges, flooding, typhoon and tsunami hazards. Sea level rise projections. Risk assessment. Uni-variate and multi-variate analysis. Coastal protection systems. Design wave height related to structure lifetime. Breakwaters. Groynes. Wave-structure interactions. Nourishments. Coastal sand dune restoration with eco-friendly techniques. Elements of coastal management policies. Elements of marine renewable wind and wave energy..

Prerequisites

None.

Teaching form

Lessons: 6 credits (42 hours). Some seminars with experts will be organized.

Textbook and teaching resource

During the COVID-19 restrictions the lessons will be recorded and available on-line. Furthermore, the following textbooks are strongly suggested:

Dean, R.G., Dalrymple, R.A. (1991). Water wave mechanics for engineers and scientists. Adv. Series on Ocean Engineering – vol. 2, World Scientific.

Dean, R.G., Dalrymple, R.A. (2004). Coastal Processes with engineering applications. Cambridge University Press.

Davidson-Arnott R., Bauer B., Houser, C. (2019) Introduction to coastal process and geomorphology. Cambridge University Press.

Masselink, G., Hughes, M.G., Knight, J. (2011). Introduction to coastal process and geomorphology. Routledge.

Ciavola, P., Coco, G. (2017). Coastal storms: processes and impacts. Wiley-Blackwell.

Semester

First semester.

Assessment method

Oral exam. Mark range: 18-30/30.

Office hours

Friday from 12.30 pm – 1.30 pm.

MARINE SCIENCES

Course	Course Code	Course Credits	Course Year
FOOD LAW AND POLICY	**F7502Q024**	**6**	**2**

From 2020-2021 this course is no longer available.

Students enrolled in previous years who still have Food Law and Policy in their study plan will have to attend the lessons of Ocean Resources Law and Policy in order to take the exam (see page 47)

Course	Course Code	Course Credits	Course Year
COASTAL AND MARITIME TOURISM	**F7502Q025**	**6**	**2**

Lecturers:
Dott. Stefano Malatesta, Dott. Pietro Piana

Aims

This course aims at critically examining tourism activities and industry in coastal regions and marine spaces, focusing on social, economic and cultural impacts of tourism development in these specific contexts. Various types of tourism -such as ecotourism- in coastal and marine locations will be presented and discussed based on a number of selected case studies (e.g: Venice, the Black Sea; the Caribbean islands; The Red Sea; The Maldives). Moreover, the course will provide critical insights to explore the relationship between tourism economies and performances, socio-spatial practices and environmental issues, and finally it will explore coastal and marine tourism policies, strategies and guidelines as promoted by EU and other institutional agencies.

Contents

- Geographies of Coastal and Marine Tourism (definitions, facts and figures)
- Marine Tourist Destinations and main Trends
- Cultural Geographies of Marine Tourist Destinations
- European Strategies for Coastal and Maritime Tourism, EU and UNWTO reports analysis
- Sustainable Tourism and Blue Economy
- Environmental Impacts and Policies of Marine Tourism
- Political Ecologies of Marine Tourism
- Pesca tourism
- Tourisms and Small Islands' Geographies

Detailed program

The course will be organized in 3 modules, 21 lessons:

- The first module will initially provide general key concepts, facts and figures on tourism debates and issues. Attention will be focused on cultural, social and political meaning tourism activities produce in coastal and marine areas. By examining a range of case studies drawn from across the world, this module aims to provide conceptual tools, frameworks and categories to understand how coastal and marine tourist destinations are strongly affected by several factors, such as cultural struggles, social transformations and environmental changes.

- The second module will explore discourses presented in selected reports by Eu and UNWTO in order to discuss strategies for coastal and maritime tourism from an institutional perspective. Moreover, attention will be paid to the relation between sustainable tourism and blue economy through scientific articles and case studies that will be discussed among the participants.

- The third module will explore the environmental area of CMT from a political ecology perspective. Scientific papers and selected case studies will be discussed among the participants.

Prerequisites

None.

Teaching form

During this emergency period the didactics will be provided online by both synchronic and recorded lectures and seminars.
Readings, paper discussions and question time sessions will be included.

Textbook and teaching resource

- Orams, M. (1999). Marine Tourism: Development, impacts and management. London and New York: Routledge.
- Carlsen J., Butler, R. (2011), Island Tourism, Willingford, CABI
- Hall, C. M. (2001). Trends in ocean and coastal tourism: the end of the last frontier? Ocean & Coastal Management, 44(9–10), 601–618.
- Sheller, M., & Urry, J. (2004). Tourism Mobilities: Places to Play, Places in Play. London and New York: Routledge.
- Garrod, B., & Gossling, S. (Eds.). (2008). New Frontiers in Marine Tourism. New Frontiers in Marine Tourism. Oxford: Elsevier.
- Orams, M., & Lück, M. (2012). Marine systems and tourism. In A. Holden & D. Fennell (A C. Di), The Routledge Handbook of Tourism and the Environment (pagg. 170–182). London and New York: Routledge.

Please note that additional essays and reports may be provided during lectures.

Semester

First semester.

Assessment method

Oral exam. Students are asked to work on paper, case studies and other documents according to the guidelines provided.

Office hours

Monday 11.00 to 13.00, U6 Building, Room 4147.

Course	Course Code	Course Credits	Course Year
COMMUNICATION SKILLS AND INTERPERSONAL RELATION MANAGEMENT	**F7502Q027**	**6**	**2**

Lecturer:
Prof.ssa Maria Grazia Strepparava

Aims

Students will acquire the basic knowledge to develop expertise in teamwork and group dynamic, leadership, negotiation, communication in difficult situation; by several practical experiences they will increase self awareness of their own behaviours, attitudes and reactions, increasing their efficacy in teamwork, leadership, negotiation, conflict management, difficult or emergency situation.

Contents

The course will provide the basic knowledge of communication skills (dyadic and group) and a general overview of the most important psychological mechanisms involved in interpersonal relationship; students will learn these basic principles also by practical experiences and exercises (group activities, role-play, case simulation) and will learn some emotions and behaviors regulation strategies.

Detailed program

Group and teamwork: group definition, structure, type, roles and group structure, moreno sociogram; principles of group dynamics, social control mechanisms, sensemaking, cohesiveness, group interaction; stages of team growth and group development; team work principles. leadership, Blanchard model.
Communication: models of communication, principles and strategy, pragmatics of communication, conversational analysis, variables in communication, setting, communication techniques for collecting information (active listening, open and close questions, probing questions, cues and concerns) and for giving information (communication guidelines); non verbal communication.
Interaction: basic principles of negotiation and conflict resolution; the interpersonal motivational system model; personality and individual differences.
Emotion: model of emotions, emotion regulation principles, DBT skills in emotion regulation strategies, mindfulness.
Disaster psychology, psychological first aid, resilience, burnout.

Prerequisites

None.

Teaching form

Teaching form: Frontal lessons, supervised group activities, role-play, case simulation, book reading, selected movies discussion, individual work
During the COVID-19 restrictions the lessons will be recorded and available online, with some live events that will be planned and communicated on e-learning..

Textbook and teaching resource

A selection of scientific journal articles will be provided by the teachers; slides provided by the teacher.

Semester

First semester.

Assessment method

Written: students will prepare a report on group dynamics applying to real life situations the conceptual frameworks learned during the course. Open question possible as integrative section to assess specific knowledge;
Oral: discussion of the written report and answers to the open questions
Marks are given as n/30, averaging the two parts.
Minimum positive value is 18/30
During the Covid-19 restrictions the oral exams will be exclusively through the WebEx platform. A public link will be posted on the Communication skills e-learning page for the access of virtual public.

Office hours

To make an appointment, please contact the teachers by e-mail: mariagrazia.strepparava@unimib.it
Office: U38, villa Serena (Monza), room number 5-24, V floor.

Course	Course Code	Course Credits	Course Year
APPLIED MARINE GEOLOGY	**F7502Q040**	**6**	**2**

Lecturers:
Prof.ssa Paraskevi Nomikou, Dott. Luca Fallati

Aims

To provide knowledge on the major geological hazards in marine ad coastal environment, which are caused by geological processes that change dramatically the environmental conditions and present severe threats to coastal populations, offshore and onshore properties and offshore built infrastructures.

Contents

The course will provide basic knowledge about the use of innovative marine technologies to identify the marine geohazards and inherent risks and our ability to deal with them.

Detailed program

- Advanced Geophysical Marine Survey Methods with a focus on seismic acquisition offshore
- Underwater geomorphological features
- Introduction to marine geohazards, focused mainly on the coastal zone
- Geohazard maps: use and protection of marine and coastal areas
- Tutorials: 3D model reconstruction techniques using multibeam echosounder data and aerial structure from motion.

Prerequisites

Physics of the Sea; Fundamentals of Marine Physical Geography; International Law of the Sea.

Teaching form

2 credits (CFU) of frontal lessons.
4 credits (CFU) of laboratory and practicals.
During the COVID-19 restrictions the lessons, labs and practicals will be recorded and available online

Textbook and teaching resource

References:
- E. Seibold, W.H. Berger -The Sea Floor: An Introduction to Marine Geology. Springer (e-book);
- APAT – Atlante delle opere di sistemazione costiera. Manuali e Linee Guida;
- Journal of Coastal Research, v.20;
- Erosion littorale en Mediterranée occidentale: dynamique, diagnostic et remèdes. CIESM Workshop Series 18.

A selection of scientific journal articles will be provided by the teacher.

Semester

First semester.

Assessment method

- Oral and Computer-based examination
Computer: practical test about multibeam or structure from motion processing provided by the

teachers (on distance). Marks are given as n/30. Minimum positive value is 18/30.

During the Covid-19 restrictions the oral exams will be exclusively through the WebEx platform. A public link will be posted on the Geobiology e-learning page for the access of virtual public

Office hours

To make an appointment, please contact the teachers by e-mail:
evinom@geol.uoa.gr

Course	Course Code	Course Credits	Course Year
OCEAN MONITORING AND DATA ANALYSIS	**F7502Q042**	**6**	**2**

Lecturers:
Prof.ssa Claudia Pasquero, Prof. Roberto Colombo

Aims

Provide information on available oceanographic databases and how their data are gathered and stored. Provide background information on the contribution of remote sensing to ocean and coastal water monitoring. Show how data can be visualised and analysed to answer to specific questions, using statistical methods and models, with Matlab and/or Python software.

Contents

Ocean observing systems, including remote sensing, Eulerian stations, drifters and ship measurements. Ocean databases. Spatio-temporal data analysis. Modeling tools. Visualisation tools.

Detailed program

- Data retrieved from satellites: sea surface temperature, sea surface salinity, sea surface height, surface wind speed, significant wave height, ocean color.
- ARGO floats: subsurface measurements. Moorings and buoys. High Frequency coastal radar network. Reanalysis.
- Seasonal variations, removal of seasonal cycle, data detrending and filtering.
- Correlation and covariance. Composites.
- Statistical significance.
- Netcdf data format. TEOS-10 software for seawater properties.
- Examples of practical data analysis:
  Geostrophic currents from hydrographic measurements and from sea surface height.
  Tropical cyclone tracks and cold wakes.
  Coral bleaching heat stress monitoring: Degree Heating Weeks and coral hotspots.

Prerequisites

Physics of the Sea.

Teaching form

Lectures and practicum in computer lab.

During the Covid-19 emergency, lectures and practicum will be live from remote, with the use of Virtual Machines

Textbook and teaching resource

Mathworks tutorials: MATLAB Fundamentals, MATLAB Programming Techniques, MATLAB for Data processing and visualisation (available online).

Slides from the instructors.

Semester

First semester.

Assessment method

- Written examination: short report on an individual ocean data analysis project (10 pages upper limit)

- Oral examination: discussion of topics covered during class and of the individual data analysis project

During the COVID-19 emergency oral exams will be online, through the Webex platform. A public link will be provided on the elearning webpage..

Office hours

Contact the instructors

Useful information

Periods of teaching activities

First semester classes will be held during the period **5 October 2020 – 29 January 2021**.

Second semester classes will be held during the period from **1 March to 25 June 2021.**

Programme website

General information of the programme in E-learning: elearning Marine Sciences.

Documents:
- Programme Description
- Courses Delivered
- Student Guides

Course and programme information:
- Open Days
- Admission to the Master Programme
- Courses
- Timetable
- Exams
- Language Courses
- Study Plans
- Practical Training (Stage)
- Final Examination

International:
- Erasmus and International Mobility

Faculty Committees

Online Student Registry

Online Registry (Segreterie OnLine): the digital platform of the University of Milan-Bicocca provides services for students, lecturers and companies. It can be accessed at this link: https://s3w.si.unimib.it/Home.do

Students
Services are available for registered users. Registration can be carried out at any time and is free of charge. Users already registered (with username and password) can access services following login.

Lecturers
It is not necessary to register. You may log in with your university credentials (*@unimib.it*).
Services for teachers (online verbalization) are available following login.

Offices' e-mail

- Informations about practical training (stage): stage@unimib.it or contact the Faculty Committee for practical training at stefano.malatesta@unimib.it
- Information about delivery of the graduation degree (hardcopy): ufficio.diplomi@unimib.it
- information about tuition fees, scholarships, fee wavers, ISEEU declarations: segr.studenti.tasse@unimib.it
- information about study plan, examinations, registration, graduation: segr.studenti.scienze@unimib.it

University Libraries

Website: https://www.unimib.it/servizi/service-desk/biblioteca
E-mail: biblioteca@unimib.it

The University libraries are located at the following locations within opening hours:

Central Library
Address: piazza dell'Ateneo Nuovo, 1 - 20126 Milano; edificio U6, 2nd floor
Opening hours: 9.00-21.45 Monday to Friday; Saturday 9.00-13.45

Sciences Library
Address: piazza della Scienza, 3 - 20126 Milano; edificio U2, 1st floor
Opening hours: 9.00-18.30 Monday to Friday

Medicine Library
Address: via Cadore, 48 - 20900 Monza; edificio U8, ground floor
Opening hours: 9.00-19.30 Monday to Thursday; Friday 9.00-18.30

Pole of Digital Library
Address: via Martinelli, 23 - 20092 Cinisello Balsamo; edificio U46 - Villa di Breme Forno, 2nd floor
Opening hours: 9.00-17.00 Monday to Friday
Calendar of Villa Forno: https://www.biblio.unimib.it/it/node/331