COURSES TAUGHT IN ENGLISH

SCIENCE

DISCIPLINARY AREAS:

- Economics
- Medicine
- Science
- Education
- Psychology
- Sociology
- Law
WHY BICOCCA

Bicocca is a young university that will connect you with students from all over the world. You will not just be a student here. You will be a member of the global community.

Since its foundation, the University of Milano-Bicocca has reached beyond its borders entering into various agreements with European and non-European universities.

Research is always global. Our teachers are members of international research groups that share numerous projects and initiatives, with a common commitment to increase the quality of teaching. Our focus on innovation offers students competitive and practical training.
The field of Science at the University of Milano-Bicocca comprises of 6 leading departments that offer a diverse portfolio of teaching and research in physics, mathematics, biosciences, computer science, material science and environmental science.

* Dipartimento Di Biotecnologie E Bioscienze
* Dipartimento Di Fisica "Giuseppe Occhialini"
* Dipartimento Di Informatica, Sistemistica E Comunicazione
* Dipartimento Di Matematica E Applicazioni
* Dipartimento Di Scienza Dei Materiali
* Dipartimento Di Scienze Dell'ambiente E Della Terra

The departments bring together the following degree programs:

- **B** 10 Bachelor degrees
- **M** 13 Master degrees of which 2 completely taught in English

**OUR INTERNATIONAL OFFER**

In the field of Science, our University offers the following degree programs in English:

**MARINE SCIENCES**

**MATERIALS SCIENCE**

There are a total of 99 individual courses taught entirely in English across different Degree Programs.

**OUR LOCATION**

All courses in the field of Science are held at our Milan campus.
### TABLE OF CONTENTS:

**ASTROPHYSICS AND SPACE PHYSICS**
- COSMIC RAYS
- COSMOLOGY
- EXTRAGALACTIC ASTRONOMY
- GRAVITATIONAL WAVE ASTROPHYSICS
- QUANTUM FIELD THEORY I
- STELLAR ASTROPHYSICS

**BIOLOGY**
- ANALYSIS AND MANAGEMENT OF BIOCOENOSIS

**CHEMICAL SCIENCES AND TECHNOLOGIES**
- CHEMISTRY OF INORGANIC MATERIALS
- CHEMISTRY OF MOLECULAR MATERIALS
- LOW ENVIRONMENTAL PROCESSES
- MEDICINAL CHEMISTRY
- SOLID STATE AND SURFACE PHYSICAL CHEMISTRY
- SYNTHESIS AND SPECIAL ORGANIC TECHNIQUES IN MATERIAL CHEMISTRY
- THERMODYNAMICS AND KINETICS OF MATERIALS
- THERMODYNAMICS AND KINETICS OF MATERIALS

**COMPUTER SCIENCE**
- ADVANCED MACHINE LEARNING
- ARTIFICIAL INTELLIGENCE
- CLOUD COMPUTING
- DATA AND COMPUTATIONAL BIOLOGY
- DATA AND TEXT MINING
- EVOLUTION OF SOFTWARE SYSTEMS AND REVERSE ENGINEERING
- UBQUITOUS, PERVASIVE & CONTEXT-AWARE COMPUTING

**DATA SCIENCE**
- DATA MANAGEMENT AND VISUALIZATION
- DATA SEMANTICS
- DECISION MODELS (module)
- MACHINE LEARNING (module)
- MACHINE LEARNING AND DECISION MODELS
- TEXT MINING AND SEARCH

**GEOLOGICAL SCIENCES AND TECHNOLOGIES**
- 3D GEOMODELLING
- ACTIVE TECTONICS AND VOLCANOTO TECTONICS
- ADVANCED METHODS IN STRUCTURAL GEOLOGY
- ASSESSMENT OF GEOLOGICAL RISKS
- BIOFACIES
- FUNDAMENTALS OF MARINE PHYSICAL GEOGRAPHY
- GEOLICALY
- GEOCHRONOLOGY AND ARCHAEOLOGY
- GEOENERGY
- PALEOCEANOGRAPHY AND PALEOCLINOMATOLoGY
- PHYSICS OF THE SEA
- SEDIMENTARY PETROLOGY

**INDUSTRIAL BIOTECHNOLOGIES**
- MEDICINAL CHEMISTRY

**MARINE SCIENCES**
- APPLIED GEOMORPHOLOGY AND HABITAT
- APPLIED MARINE GEOLOGY
- BIODIVERSITY AND MARINE ECOLOGY
- BIODIVERSITY (module)
- BIOFACIES
- CHEMISTRY OF INORGANIC MATERIALS
- CHEMISTRY OF MARINE ENVIRONMENT
- COASTAL AND MARINE BOTANY
- COASTAL AND MARINE HAZARD AND RESILIENCE
- COASTAL AND MARITIME TOURISM
- COASTAL RISK AND DYNAMICS
- COMMUNICATION SKILLS AND INTERPERSONAL RELATION MANAGEMENT
- ENVIRONMENTAL JUSTICE AND GEOPOLITICS OF THE SEA
- FUNDAMENTALS OF MARINE BIOLOGY
- FUNDAMENTALS OF MARINE PHYSICAL GEOGRAPHY
- GEOBIOLOGY
- HUMAN GEOGRAPHY OF SMALL ISLAND SYSTEMS
- INTERNATIONAL LAW OF THE SEA AND MARINE ENVIRONMENT PROTECTION
- MANAGEMENT OF AQUATIC RESOURCES: FISHERIES
- MARINE ECOLOGY (module)
- MARINE ENVIRONMENTAL MICROBIOLOGY
- MARINE INVERTEBRATE ZOOLOGY
- MARINE MOLECULAR BIOLOGY
- MARINE VERTEBRATE ZOOLOGY
- PALEOCEANOGRAPHY AND PALEOCLIMATOLOGY
PHYSICS OF THE SEA
WAVES AND TURBULENCE

MATERIALS SCIENCE
APPLIED PHYSICAL CHEMISTRY WITH LABORATORY
CHEMISTRY AND TECHNOLOGY OF POLYMERS AND INDUSTRIAL APPLICATIONS
CHEMISTRY OF MOLECULAR MATERIALS
FUNCTIONAL ANALYSIS
LOW ENVIRONMENTAL IMPACT MATERIALS AND PROCESSES
MATERIALS AND DEVICES FOR ENERGY ENGINEERING
METALS SCIENCE AND SUSTAINABILITY
MOLECULAR ELECTRONICS AND PHOTONICS
NANOTECNOLOGY AND INNOVATION
PHYSICAL CHARACTERIZATION OF MATERIALS WITH LABORATORY
PHYSICAL CHEMISTRY OF SOLID STATE AND SURFACES
PHYSICS AND TECHNOLOGY OF ELECTRONIC DEVICES WITH LABORATORY
PHYSICS OF HOMOGENEOUS AND NANOSTRUCTURED DIELECTRICS
PHYSICS OF SEMICONDUCTORS
RADIATION MATTER INTERACTION
SOLID STATE PHYSICS
STATISTICAL THERMODYNAMICS OF MATERIALS
SURFACE AND INTERFACES
SYNTHESIS AND SPECIAL ORGANIC TECHNIQUES IN MATERIAL CHEMISTRY

MATHEMATICS
GEOMETRIC GROUP THEORY
MATHEMATICAL METHODS IN MODERN PHYSICS

PHYSICS
BIOPHOTONICS
COMPUTATIONAL STATISTICAL THERMODYNAMICS IN SOLIDS
MATHEMATICAL METHODS FOR PHYSICS
MC SIMULATION OF RADIATION DETECTORS
NUCLEAR AND SUBNUCLEAR MEASUREMENTS LABORATORY
NUCLEAR AND SUBNUCLEAR MEASUREMENTS LABORATORY II
OPTICAL MICROSCOPY
PLASMA PHYSICS II
QUANTUM FIELD THEORY I
QUANTUM FIELD THEORY II
SEMICONDUCTORS PHYSICS
SOLID STATE AND ELECTRONICS LABORATORY II
STATISTICAL MECHANICS
SURFACE AND INTERFACES
THEORETICAL PHYSICS I

THEORETICAL PHYSICS II
THEORY AND PHENOMENOLOGY OF FUNDAMENTAL INTERACTIONS
THEORY OF CONDENSED MATTER I
THEORY OF CONDENSED MATTER II

SCIENCE AND TECHNOLOGIES FOR ENVIRONMENT AND LANDSCAPE
ENVIRONMENTAL MICROBIOLOGY
LOW ENVIRONMENTAL IMPACT PROCESSES

THEORY AND TECHNOLOGY OF COMMUNICATION
APPLIED SOCIAL COGNITION TO PUBLIC POLICIES
APPLIED SOCIAL COGNITION TO PUBLIC POLICIES
CONSUMER PSYCHOLOGY
DATA SEMANTICS
DIGITAL MARKETING
INFORMATION RETRIEVAL
MULTIMEDIA DATA PROCESSING
UBIQUITOUS, PERVERSIVE & CONTEXT-AWARE COMPUTING
TURBULENCE

LEGEND
M didactic module
tbd: to be defined
N/A: information not available
3D GEOMODELLING*
LECTURER: BISTACCHI ANDREA  LUIGI PAOLO

CONTENTS
The course regards 3D geomodelling techniques, which are discussed in theory and implemented in exercises with industry-standard software.

PREREQUISITES
Tectonics and structural geology.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25753

YEAR:  2
SEM:  1
ECTS:  4
DEGREE in  Geological Sciences and Technologies
CONTACT:  andrea.bistacchi@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
ACTIVE TECTONICS AND VOLCANOTECTONICS*
LECTURER: TIBALDI ALESSANDRO

CONTENTS
The general objectives comprehend the preparation of students in order to carry out geological-structural analyses applied to the recognition of recent and active tectonic deformations. In the second part of the course, students will analyse the structures in volcanic areas in order to distinguish those produced by tectonic forces from those caused by magmatic forces.

PREREQUISITES
Base knowledge of geology, structural geology and geomorphology.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25771

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<td>SEM:</td>
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<tr>
<td>DEGREE in</td>
<td>Geological Sciences and Technologies</td>
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<tr>
<td>CONTACT:</td>
<td><a href="mailto:alessandro.tibaldi@unimib.it">alessandro.tibaldi@unimib.it</a></td>
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</table>

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.*
CONTENTS

This machine learning advanced course is aimed especially for students who are already familiar with the basics of machine learning and wish to strengthen their knowledge and explore important advanced topics in order to possess in-depth and wide range capabilities at this so important field.

The course will cover some of the most important advanced topics in machine learning such deep learning and reinforcement learning, with their underlying theory but also a focus on modeling and practical implementation.

These advanced techniques will be applied to a number of applications, including: image recognition, natural language processing, recommendation systems.

PREREQUISITES

Basic Machine Learning techniques.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25376

YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Computer Science
CONTACT: enza.messina@unimib.it
ADVANCED METHODS IN STRUCTURAL GEOLOGY*
LECTURER: BISTACCHI ANDREA LUIGI PAOLO

CONTENTS
The course covers advanced techniques for the collection, analysis and modelling of quantitative structural geology data at different scales in the field and in the lab.

PREREQUISITES
Tectonics and Structural Geology.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25752

YEAR: 2
SEM: 1
ECTS: 4
DEGREE in Geological Sciences and Technologies
CONTACT: andrea.bistacchi@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
ANALYSIS AND MANAGEMENT OF BIOCOENOSIS*
LECTURER: ABDULLA NASEER

CONTENTS
The present course examines key aspects and critical issues of marine aquaculture, as part of the primary production activity (aquaculture) with the largest growth rate among other food production techniques worldwide. Aquaculture nowadays supply fifty percent of fish products consumed in the world. The big challenge that aquaculture is facing concerns with sustaining and ever increasing demand circumscribed by environmental sustainability Therefore, the course aims to provides and overall knowledge of marine aquaculture, its potential in food security and the negative aspects/mitigations measures of the subject.


PREREQUISITES
None.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26288

YEAR: 1
SEM: 1
ECTS: 6
DEGREE in  Biology
CONTACT: tbd

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
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.

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

WEBSITE  [https://elearning.unimib.it/course/info.php?id=25832](https://elearning.unimib.it/course/info.php?id=25832)
APPLIED MARINE GEOLOGY
LECTURER: MARCHESE FABIO, NOMIKOU PARASKEVI

CONTENTS
To provide knowledge on the major geological hazards in marine and 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.

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.

PREREQUISITES
Physics of the Sea; Introduction to Marine Physical Geography; Law of the Sea.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25820

M
YEAR: 2
SEM: 1
ECTS: 6
DEGREE in  Marine Sciences
CONTACT: fabio.marchese1@unimib.it
CONTENTS

Aims of the lectures (5 CFU) are to supply the student with base knowledge about the physical chemistry of ionic conductors and the electrochemistry and its application in the energy conversion by electrochemical devices and in corrosion and protection of metals. The lab part (3 CFU) is devoted to the characterization of materials and electrodes for secondary batteries and electrochromic applications. In the lab FT-IR, XRPD, electrochemical and spectroelectrochemical techniques will be used.


PREREQUISITES

Standard physical and mathematic knowledge, thermodynamic and kinetic of chemical system.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25603

M

YEAR: 1
SEM: 1+2
ECTS: 8
DEGREE in Materials Science
CONTACT: riccardo.ruffo@unimib.it
CONTENTS

The course will provide an overview of domains in which socio-cognitive theories and research have been applied outside the laboratory to influence public policies. The course will be devoted to examining a sample of behavioral domains and contexts in which applied research has made contributions. These include political issues (e.g., promoting participation, reducing inequalities and improving intergroup relations), psychological and physical health (e.g., promotion and prevention behaviors), environmental concerns (e.g., climate change), mass media effects (e.g., scientific misinformation and conspiracy theories). Practical problems and ethical issues unique to the applied research will be considered.

PREREQUISITES

No previous knowledge is required. Good knowledge of the basis of Social Psychology enables more aware fruition of the course contents. Students lacking such basic knowledge are encouraged to ask for a list of basic references.
ARTIFICIAL INTELLIGENCE
LECTURER: BIANCHI F., MESSINA V., PALMONARI M. L., VIZZARI GIUSEPPE

CONTENTS
The aim of the course is to enable the student to master the knowledge and basic tools necessary to comprehend, use and create Artificial Intelligence systems, together with the ability to analyze classes of problems particularly suitable to be solved with methods and techniques that characterize the discipline. The practical and at the same time explorative nature of Artificial Intelligence will invite the student to learn how to discriminate among problems for which current solutions can be used and innovative directions of research in this field. The students will be given conceptual, computational and basic methodological tools to understand and develop innovative solutions to automation problems through advanced Artificial Intelligence techniques. The course is aimed at students who aspire to enter into work and research environments where innovative choices prevail for the solution of complex problems and areas with a strong multidisciplinary component.

PREREQUISITES
Basic knowledge of logics and mathematics.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25378

YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Computer Science
CONTACT: enza.messina@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
ASSESSMENT OF GEOLOGICAL RISKS*
LECTURER: FRATTINI PAOLO

CONTENTS
The course aim at providing concepts and methodologies for the analysis, the evaluation and the mitigation of geological risks.

Definition of hazard, vulnerability and risk. Description and assessment of flood risk, seismic risk, landslide risk and snow avalanche risk. Introduction on coastal risks and volcanic risk.

PREREQUISITES
None.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25778

YEAR:  1
SEM:  2
ECTS:  6
DEGREE in Geological Sciences and Technologies
CONTACT:  paolo.frattini@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
BIODIVERSITY AND MARINE ECOLOGY

MODULES: Biodiversity (ref. F7502Q004M)
         Marine Ecology (ref. F7502Q005M)

LECTURER: GALLI PAOLO

CONTENTS

Biodiversity: 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.

Marine Ecology: N/A

PREREQUISITES

See course modules.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25833

M
YEAR: 1
SEM: 1
ECTS: 12
DEGREE in Marine Sciences
CONTACT: paolo.galli@unimib.it
BIODIVERSITY (module of Biodiversity and Marine Ecology - F7502Q004)
LECTURER: SHAZLA MOHAMED, MONTANO SIMONE

CONTENTS
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.

PREREQUISITES
None

WEBSITE  https://elearning.unimib.it/course/info.php?id=25834

YEAR: 1
SEM: 1
ECTS: Only if the entire course is frequented
DEGREE in Marine Sciences
CONTACT: simone.montano@unimib.it
BIOFACIES
LECTURER: BASSO DANIELA MARIA, MALINVERNO ELISA

CONTENTS

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.

PREREQUISITES
Paleontology, Geobiology.

https://elearning.unimib.it/course/info.php?id=25836
https://elearning.unimib.it/course/info.php?id=25779

WEBSITE

YEAR: 1
SEM: 2
ECTS: 6/8
DEGREE in Marine Sciences
Geological Sciences and Technologies
CONTACT: daniela.basso@unimib.it
BIOPHOTONICS*
LECTURER: CHIRICO GIUSEPPE

CONTENTS
Introduction to the main spectroscopic techniques for studying biosystems and development of devices for biotechnology and Medicine


PREREQUISITES
Knowledge of the basic concepts of quantum mechanics atomic physics achieved during the bachelor degree.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26349

M
YEAR:  1
SEM:  1
ECTS:  6
DEGREE in  Physics
CONTACT:  giuseppe.chirico@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
CHEMISTRY AND TECHNOLOGY OF POLYMERS AND INDUSTRIAL APPLICATIONS
LECTURER: COMOTTI ANGIOLINA

CONTENTS
The aim of the course is to highlight the applications of a few classes of polymers, and both up-to-date scientific methods and technological processes to improve their properties.

The course encompasses advanced technological processes in the synthesis and transformation of polymers, including new methods of polymer synthesis, introduction to hybrid materials and nanochemistry with particular emphasis to preparation and characterization of polymer materials endowed with heterogeneous interfaces and new functional properties.

PREREQUISITES
Basic knowledge of macromolecular chemistry.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25604

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<td>DEGREE in</td>
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<td>CONTACT:</td>
<td><a href="mailto:angiolina.comotti@unimib.it">angiolina.comotti@unimib.it</a></td>
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CONTENTS

Describe and discuss relevant methods for the synthesis of functional inorganic and hybrid organic-inorganic materials, focusing on the choice of precursors and development of suitable process conditions in order to synthesize materials with the required composition, structure and physico-chemical properties.

Introduce the student to fundamentals of mechanisms of nucleation and crystal growth.

PREREQUISITES

General and inorganic chemistry, physical chemistry, basic crystallography.
CHEMISTRY OF MARINE ENVIRONMENT
LECTURER: FERRERO LUCA

CONTENTS
The course aims to provide students with knowledge about the processes and mechanisms that regulate the chemical composition of the sea and oceans. A special attention is given to climate change impact on the chemistry of the Oceans.

The course CHEMISTRY OF MARINE ENVIRONMENT provides an understanding of the chemical composition of seawater and related chemical reactions. Equilibrium and steady state conditions in aqueous solution are discussed. A particular attention is also given to priority and emerging pollutants.

PREREQUISITES
Basics of inorganic and organic chemistry.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25837

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Marine Sciences
CONTACT: luca.ferrero@unimib.it
CONTENTS
Molecular materials are rapidly gaining momentum, both in terms of scientific research and technological applications. Aim of the course is to provide a detailed knowledge of the structure properties relationships ruling the behaviour of such materials, with particular emphasis on electronic, optical and optoelectronic properties.

PREREQUISITES
Molecular based materials require an interdisciplinary approach. Elements of Materials science, Organic chemistry, Physical chemistry, Medicinal chemistry, environmental chemistry, physics…. (depending on the application) are required.

WEBSITE  
https://elearning.unimib.it/course/info.php?id=25606  
https://elearning.unimib.it/course/info.php?id=25622

YEAR: 1/2  
SEM: 2  
ECTS: 6  
DEGREE in  
Materials Science  
Chemical Sciences and Technologies  
CONTACT: luca.beverina@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
CLOUD COMPUTING
LECTURER: CIAVOTTA MICHELE, DE PAOLI FLAVIO MARIA, TUNDO ALESSANDRO

CONTENTS
The goal of the course is to provide students with fundamental elements to understand and design distributed service-oriented applications. After the course, students will master the most important models for distributed systems based on Cloud technology, and the basic characteristics of languages and tools for their development. They will be able to analyze and design applications based on microservices and container-based technology..

PREREQUISITES
Thorough comprehension of networking and distributed system principles to design and develop distributed applications.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25379

YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Computer Sciences
CONTACT: flavio.depaoli@unimib.it
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 coastal vegetation, with a special emphasis on those typical of Mediterranean and tropical regions.

PREREQUISITES

None.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25821

M
YEAR:  2
SEM:  1
ECTS:  6
DEGREE in  Marine Sciences
CONTACT:  rodolfo.gentili@unimib.it
COASTAL AND MARINE HAZARD AND RESILIENCE
LECTURER: SCHMIDT MULLER DI FRIEDBERG MARCELLA

CONTENTS
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.

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.

PREREQUISITES
None.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25822

CONTACT:  marcella.schmidt@unimib.it
CONTENTS
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: the Mediterranean Sea, 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.

PREREQUISITES
N/A.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25823

**M**
YEAR:  2  
SEM:  1  
ECTS:  6  
DEGREE in  Marine Sciences  
CONTACT:  stefano.malatesta@unimib.it
PROGRAM CODE: F7502Q023

COASTAL RISKS AND DYNAMICS
LECTURER: VICINANZA DIEGO

CONTENTS
The course is intended to provide basic knowledge of coastal processes for the proper management of the coastline from a physical point of view. The knowledge on maritime hydraulics (wave genesis, wave transformations, coastal currents), sediment transport and beaches morphodynamic will be deepened. Coastal risk elements will be presented, with particular regard to coastal erosion and possible defense approaches. The main techniques for studying and monitoring the coastal system will be examined. The part of the Coastal Risk Course aims to provide the student with advanced knowledge in the study and forecast of the impact of catastrophic events on the coastline. The training obtained can be applied for Civil Protection purposes and to minimize impacts on coastline.

PREREQUISITES
None.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25824

M
YEAR:  2
SEM:  1
ECTS:  6
DEGREE in  Marine Sciences
CONTACT:  diego.vicinanza@unimib.it
COMMUNICATION SKILLS AND INTERPERSONAL RELATION MANAGEMENT
LECTURER: STREPPARAVA MARIAGRAZIA

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.

PREREQUISITES
None.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25825

YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Marine Sciences
CONTACT: mariagrazia.strepparava@unimib.it
CONTENTS

The main goal of the Course is to provide to the students some key theoretical/computational tools for approaching at the atomic scale thermodynamics and kinetics of solids.

Summary of basic concepts in classical statistical mechanics, adiabatic approximation, classical approximation for the motion of nuclei, ab initio and classical molecular dynamics, scientific coding with Matlab, implementation in Matlab of a molecular dynamics code, application of the molecular dynamics code, configurational Monte Carlo, implementation of a configurational Monte Carlo code, kinetic Monte Carlo, transition state theory.

PREREQUISITES

Basic classical and quantum mechanics. Knowledge of the Boltzmann distribution.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26379

YEAR: 1
SEM: 1
ECTS: 6
DEGREE in Physics
CONTACT: roberto.bergamaschini@unimib.it
francesco.montalenti@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
CONSUMER PSYCHOLOGY
LECTURER: OLIVERO NADIA

CONTENTS
The course provides a complete overview of the main topics of Consumer Psychology and integrates theoretical contributions with case histories from main brands and companies.

The course is divided in three parts.

* The first one is about theoretical and scientific models for the understanding of the consumer as an individual, and focuses on decision making, perception, and learning.

* The second part is concerned with motivation, attitudes, identity construction in relation with products consumption and brands, the role of the socio-cultural context, the social group and advertising.

* The third part explores fields of application such as ‘information communication technologies for consumer research and strategy, food consumption, marketing of experience and non-conventional marketing.

PREREQUISITES
None.
COSMIC RAYS*
LECTURER: GERVASI MASSIMO

CONTENTS
Cosmic rays (CR) will be described in relation to the experimental data, their composition and properties. Main topics will be: origin and astrophysical sources of CR; acceleration processes; interaction with interstellar medium; propagation in the Milky Way; interaction with solar wind; propagation in the solar cavity; interaction with the Earth magnetic field; radiation belts and geomagnetic cut-off; interaction with Earth atmosphere; atmospheric showers; CR in fundamental physics and cosmology.

PREREQUISITES
Knowledge of the previous courses of physics.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26389

M
YEAR:  1
SEM:   1
ECTS:  6
DEGREE in  Astrophysics and Space Physics
CONTACT:  massimo.gervasi@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
COSMOLOGY*
LECTURER: DOTTI MASSIMO

CONTENTS
Knowledge of the structure of the Universe and of the main stages of the cosmic history, from the big bang to the cosmic microwave background.


PREREQUISITES
Mathematics and Physics for undergraduates.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26386

M
YEAR: 1
SEM: 2
ECTS: 6
DEGREE in  Astrophysics and Space Physics
CONTACT: massimo.dotti@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
DATA AND COMPUTATIONAL BIOLOGY
LECTURER: ANTONIOTTI MARCO

CONTENTS
N/A.

PREREQUISITES
N/A.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25382

YEAR:  2
SEM:   1
ECTS:  6
DEGREE in  Computer Science
CONTACT: marco.antoniotti@unimib.it
DATA AND TEXT MINING
LECTURER: CHIESA PAOLA, STELLA FABIO ANTONIO

CONTENTS
To train the expert of knowledge extraction from structured, un-structured and semi-structured data according to the data and text mining methodology.
The goal is achieved by:
* teaching how to design, develop and present data mining and text mining projects,
* introducing the main learning algorithms and models for structured, un-structured and semi-structured data,
* exploiting open source platforms, languages and software,
* stimulating the team working methodology.

The student will be able to design, develop, document, and present data and text mining projects solving real world problems.

PREREQUISITES
Basic knowledge on; informatics, probability calculus and statistics.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25383

M
YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Computer Science
CONTACT: paola.chiesa@unimib.it
         fabio.stella@unimib.it
CONTENTS
At the end of the module students will be able to select, design and query a database (relational or not) according to their application needs. Students will be able to use a NoSql database management system to acquire, memorize and query semi structured data.

* Introduction to data management in big data context
* data lifecycle
* Variety: nosql models and architecture
* Volume: data distribution and replication, hadoop architecture
* Velocity: data architecture for capturing and elaborating near real time data.

PREREQUISITES
Knowledge of relational model.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26202

M
YEAR:  1
SEM:  1
ECTS:  12
DEGREE in Data Science
CONTACT: andrea.maurino@unimib.it
CONTENTS
The course presents computational methods to represent, harmonize and reconstruct the semantics of data used in data science applications, with a particular focus on:

* models and languages developed within the semantic web to support the integration of heterogeneous data (knowledge graph, data linking, ontologies, RDF, RDFS, OWL);
* techniques for the integration of data and vocabularies;
* techniques for extracting information from texts (outline);
* artificial intelligence models for data and knowledge exploration.

PREREQUISITES
Mathematics and computer science as taught in the compulsory courses of the first semester.

WEBSITE
https://elearning.unimib.it/course/info.php?id=26204
https://elearning.unimib.it/course/info.php?id=26217

YEAR: 1/2
SEM: 2
ECTS: 6
DEGREE in Data Science
Theory and Technology of Communication
CONTACT: matteo.palmonari@unimib.it
DECISION MODELS (module of Machine Learning and Decision Models - F9101Q005)
LECTURER: CIAVOTTA MICHELE, MESSINA VINCENZINA

CONTENTS
This module will emphasizes the relevance of data in decision making. The general aim is to develop skills in mathematical modeling and in algorithms and computational methods to solve and analyze decision problems. The course will illustrates how to formulate real world problems using case studies and examples; how to use efficient algorithms – both old and new – for solving these models; and how to evaluate, draw useful conclusions and derive useful planning information from the output of these algorithms.

PREREQUISITES
None.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26210

YEAR: 1
SEM: 2
ECTS: Only if the entire course is frequented

DEGREE in Data Science
CONTACT: michele.ciavotta@unimib.it
        enza.messina@unimib.it
DIGITAL MARKETING
LECTOR: fbd

CONTENTS
This course has the aim to show in detail the understanding of digital marketing by focusing on its pillars and future paths, data have a strong impact on this processes. The students will design, plan and build an end-to-end marketing campaign using the most used tools in the market. At the end of the course the attendants will have the basics to develop on their own a digital marketing campaign.

PREREQUISITES

WEBSITE  [https://elearning.unimib.it/course/info.php?id=26219](https://elearning.unimib.it/course/info.php?id=26219)

YEAR: 2
SEM: 2
ECTS: 8
DEGREE in Theory and Technology of Communication
CONTACT: fbd
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 territorialisiation, 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.

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.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25838

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Marine Sciences
CONTACT: elena.dellagnese@unimib.it
CONTENTS
The course aims to provide in-depth knowledge on the microbial communities in marine environments. 1. Knowledge and understanding. At the end of the course the student must know: the main microbial populations inhabiting the marine habitats; the impact of microbial metabolism on geochemistry of marine environments; the interaction between marine microorganisms and other organisms; the characterization and monitoring methods of microbial communities. 2. Applying knowledge and understanding. At the end of the course the student must be able to apply the knowledge acquired during the course to real cases to evaluate the impact a certain disturbance (human impact, climate change,...) on marine microbial metabolisms and its possible consequences. 3. Making judgments. The student must be able to critically read scientific papers about marine microbiology. 4. Communication skills. At the end of the course the student will be able to describe appropriately the topics studied using the correct specific vocabulary. 5. Learning skills. At the end of the course the student will be able to consult the literature on the topics covered and autonomously integrate the knowledge acquired with others related to marine sciences, with a multidisciplinary approach.

PREREQUISITES
Basic knowledge of microbiology.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25797

YEAR: 2
SEM: 1
ECTS: 6
DEGREE in  Science and Technologies for Environment and Landscape
CONTACT: andrea.franzetti@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
EVOLUTION OF SOFTWARE SYSTEMS AND REVERSE ENGINEERING

LECTURER: ARCELLI FONTANA FRANCESCA, PIGAZZINI ILARIA

CONTENTS

The student will learn all the principal techniques used to support software evolution and reverse engineering. The student will be able to use different tools useful for reverse engineering, program comprehension and software maintainability.

Introduction to the principal problematics of reverse engineering, software evolution and program comprehension. Deep study of some topics with different tools experimentations.

PREREQUISITES

Knowledge of Java Language.
Knowledge of design patterns.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25384

YEAR: 2
SEM: 1
ECTS: 6
DEGREE in  Computer Science
CONTACT: francesca.arcelli@unimib.it
          ilaria.pigazzini@unimib.it
EXTRAGALACTIC ASTRONOMY*
LECTURER: DOTTI MASSIMO

CONTENTS
Knowledge of the structure of galaxies. Comprehension of the fundaments of the dynamics of complex stellar systems. Analytical and numerical derivation of gravitational potentials generated by mass distributions. Distribution function analysis for highly symmetric systems. Understanding of the dynamical secular processes driving the evolution of galaxies and other stellar structures. Knowledge and usage of numerical simulation techniques.

Galactic dynamics. Introduction to N-body numerical simulations. Introduction to the physics of galaxy clusters.

PREREQUISITES
Undergraduate degree in physics

WEBSITE  https://elearning.unimib.it/course/info.php?id=26385

YEAR:  1
SEM:  1
ECTS:  8
DEGREE in  Astrophysics And Space Physics
CONTACT:  massimo.dotti@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
FUNCTIONAL ANALYSIS
LECTURER: RAIMONDO ANDREA, VERONELLI GIONA

CONTENTS
The aim of the course is to provide the basic tools of Mathematical Analysis useful in the study of the differential equations of Classical Physics and Quantum Mechanics.


PREREQUISITES
Basic mathematical analysis: differential calculus for functions of one or several variables, ordinary and partial differential equations, integral calculus.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25607

YEAR:  1
SEM:  1
ECTS:  6
DEGREE in: Materials Science
CONTACT:  andrea.raimondo@unimib.it
davide.veronelli@unimib.it
FUNDAMENTALS OF MARINE BIOLOGY*
LECTURER: MAGGIONI DAVIDE

CONTENTS
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.

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

PREREQUISITES
None.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25839

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
CONTENTS

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

* 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.

PREREQUISITES

Fundamentals of Mathematics, Physics and Chemistry.

WEBSITE

https://elearning.unimib.it/course/info.php?id=25781
https://elearning.unimib.it/course/info.php?id=25840

M

YEAR: 1
SEM: 1
ECTS: 8/6
DEGREE in Geological Sciences and Technologies
               Marine Sciences
CONTACT: alessandra.savini@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
CONTENTS

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.

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.

PREREQUISITES

Fundamentals of Marine Biology, Ecology and Physical geography. General Palaeontology is also suggested.
GEOCHRONOLOGY AND ARCHEOMETRY*
LECTURER: VILLA IGOR MARIA

CONTENTS
N/A.

PREREQUISITES
N/A.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25749

M
YEAR: 2
SEM: 2
ECTS: 6
DEGREE in Geological Sciences and Technologies
CONTACT: igor.villa@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
CONTENTS

Provide a broad framework of knowledge to geologists to address the emerging issues in the field of geo-energy and sustainability.

Energy resources are one of the most important factors for human activity and consumption of these sources has an immediate impact on the living conditions but also on the equilibrium and evolution of our planet. The course will cover the basic aspects regarding the problems of research and exploitation of energy resources with hints about the associated risks.

PREREQUISITES

None.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25750

YEAR: 2
SEM: 2
ECTS: 4
DEGREE in Geological Sciences and Technologies
CONTACT: giovannibattista.crosta@unimib.it
CONTENTS
The main scope of the course is to provide the students with the necessary mathematical knowledge, i.e., definitions, notions, and the statement of the theorems of Bass-Serre theory on groups acting on trees. Apart from the necessary theoretical competences allowing the student to follow the proof of the main results of the theory, we also aim to provide the student with the ability to apply the theory in exercises and open problems (problem solving). The course will finish with a general discussion on important applications of the theory in group theory, like the discussion of the trefoil knot group, Ihara's theorem, the boundary of a tree, etc..

PREREQUISITES
Algebra I, Geometria I.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25446

M
YEAR:  1
SEM:  1
ECTS:  8
DEGREE in  Mathematics
CONTACT:  thomas.weigel@unimib.it
CONTENTS

Acquire basic knowledge in the field of gravitational waves, which have recently been confirmed as an extraordinary tool for understanding the universe and the objects that populate it.

At the end of the course the student:

* will know now learn to derive the general formula for the amplitude of a gravitational wave
* will know the main sources of gravitational waves and the type of signals they emit
* will know the main techniques of gravitational waves observations, and the type of signals they observe.

PREREQUISITES

None, besides the basic classes of the bachelor.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26382

YEAR:  1
SEM:  1
ECTS:  6
DEGREE in  Astrophysics And Space Physics
CONTACT:  alberto.sesana@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
HUMAN GEOGRAPHY OF SMALL ISLAND SYSTEMS
LECTURER: MALATESTA STEFANO

CONTENTS
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 adjustments.

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.

PREREQUISITES
N/A.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25842

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Marine Sciences
CONTACT: stefano.malatesta@unimib.it
CONTENTS

This course aims at introducing the basic concepts, the formal models and the main techniques to define and design Information Retrieval Systems (also called Search Engines, and in particular Web Search Engines when working on the Web to the aim of retrieving Web pages) and Information Filtering (IF) systems. In particular, various techniques for the analysis and the indexing of texts will be presented, also including a basic introduction to multimedia documents indexing. Moreover, the issue of estimating the relevance of documents to a query will be addressed: several models finalised at the assessment of a numeric estimate of relevance (degree or probability) of a document to a query will be explained. The main approaches to personalized search will be presented. The course will also introduce additional applications related to text analysis and mining, such as the crawling and analysis of user generated content on Social Media (e.g. Twitter, Facebook, etc.). The important issue of the evaluation of the credibility of the content generated by users in social media will be also presented.

PREREQUISITES

Basic knowledge of statistics and of linear algebra.

WEBSITE

https://elearning.unimib.it/course/info.php?id=25386
https://elearning.unimib.it/course/info.php?id=26220

| YEAR: | 2 |
| SEM: | 1 |
| ECTS: | 6 |
| DEGREE in | Computer Science |
| Theory and Technology of Communication |
| CONTACT: | gabriella.pasi@unimib.it |
| | marco.viviani@unimib.it |
INTERNATIONAL LAW OF THE SEA AND MARINE ENVIRONMENT PROTECTION

LECTURER: TANI ILARIA

CONTENTS
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.

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.

PREREQUISITES
None.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25843

YEAR: 1
SEM: 1
ECTS: 6
DEGREE in Marine Sciences
CONTACT: ilaria.tani@unimib.it
LOW ENVIRONMENTAL IMPACT MATERIALS AND PROCESSES
LECTURER: ORLANDI MARCO EMILIO

CONTENTS
The course focuses on the design manufacture and use of chemicals processes that have little or no pollution potential or evionmental risk and are both economically and technologically feasible.


PREREQUISITES
Basic knowledge of Chemistry and Biology.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25608

M
YEAR: 1
SEM: 2
ECTS: 6
DEGREE in  Materials Science
CONTACT: marco.orlandi@unimib.it
CONTENTS
The course aims to provide the knowledge and methodological basis to define a process with low environmental impact. The course will then focus on some chemical processes that can currently be defined as having a low environmental impact.


PREREQUISITES
Basic knowledge of Chemistry and Biology.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25799

YEAR: 2
SEM: 2
ECTS: 6
DEGREE in Science and Technologies for Environment and Landscape
CONTACT: marco.orlandi@unimib.it
CONTENTS
The course aims to provide the knowledge and methodological basis to define a process with low environmental impact. The course will then focus on some chemical processes that can currently be defined as having a low environmental impact.


PREREQUISITES
Basic knowledge of Chemistry and Biology.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25629

M
YEAR: 2
SEM: 2
ECTS: 6
DEGREE in Chemical Sciences and Technologies
CONTACT: marco.orlandi@unimib.it
MACHINE LEARNING (module of Machine Learning and Decision Models - F9101Q005)
LECTURER: STELLA FABIO ANTONIO

CONTENTS
The course contents are the following:
* **Data Exploration** to inspect and summarize the available data and to design and develop a pre-processing workflow,
* **Supervised Classification**, to learn a mapping from input attributes to output or target attributes to be classified or predicted,
* **Unsupervised Classification**, to form homogeneous groups of observations and/or attributes using a given proximity measure,
* **Association Rules**, to automatically extract rules hidden in the data with specific reference to transaction data.

PREREQUISITES
Basic knowledge on; informatics, probability calculus and statistics.

WEBSITE  [https://elearning.unimib.it/course/info.php?id=26211](https://elearning.unimib.it/course/info.php?id=26211)

M
YEAR:  1
SEM:  1
ECTS: Only if the entire course is frequen-
DEGREE in Data Science
cONTACT: fabio.stella@unimib.it
CONTENTS

Decision Models: This module will emphasize the relevance of data in decision making. The general aim is to develop skills in mathematical modeling and in algorithms and computational methods to solve and analyze decision problems. The course will illustrate how to formulate real-world problems using case studies and examples; how to use efficient algorithms – both old and new – for solving these models; and how to evaluate, draw useful conclusions and derive useful planning information from the output of these algorithms.

Machine Learning: The course contents are the following:

* **Data Exploration** to inspect and summarize the available data and to design and develop a pre-processing workflow,
* **Supervised Classification**, to learn a mapping from input attributes to output or target attributes to be classified or predicted,
* **Unsupervised Classification**, to form homogeneous groups of observations and/or attributes using a given proximity measure,
* **Association Rules**, to automatically extract rules hidden in the data with specific reference to transaction data.

PREREQUISITES

See each module.

**WEBSITE**  [https://elearning.unimib.it/course/info.php?id=26209](https://elearning.unimib.it/course/info.php?id=26209)

**YEAR:** 1

**SEM:** 1+2

**ECTS:** 12

**DEGREE in** Data Science

**CONTACT:** enza.messina@unimib.it
CONTENTS

The present course examines key aspects and critical issues of marine aquaculture, as part of the primary production activity (aquaculture) with the largest growth rate among other food production techniques worldwide. Aquaculture nowadays supply fifty percent of fish products consumed in the world. The big challenge that aquaculture is facing concerns with sustaining and ever increasing demand circumscribed by environmental sustainability. Therefore, the course aims to provides and overall knowledge of marine aquaculture, its potential in food security and the negative aspects/mitigations measures of the subject.


PREREQUISITES

None.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25827
MARINE ECOLOGY (module of Biodiversity and Marine Ecology - F7502Q004)
LECTURER: GALLI PAOLO, SEVESO DAVIDE

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

PREREQUISITES
None.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25835

YEAR: 1
SEM: 1
ECTS: Only if the entire course is frequented
DEGREE in Marine Sciences
CONTACT: paolo.galli@unimib.it
MARINE ENVIRONMENTAL MICROBIOLOGY
LECTURER: FRANZETTI ANDREA

CONTENTS
The course aims to provide in-depth knowledge on the microbial communities in marine environments.

* Microbial metabolisms and diversity in marine environments: diversity of bacteria and archea in marine environments, metabolic diversity of microbes in marine environments
* Roles of microbes in ocean processes
* Techniques for the characterization of microbial communities in marine environments
* Microbial marine habitats
* Microbial aspects of environmental issues in marine environments

PREREQUISITES
Basic knowledge of microbiology.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25844

M
YEAR: 1
SEM: 1
ECTS: 6
DEGREE in Marine Sciences
CONTACT: andrea.franzetti@unimib.it
MARINE INVERTEBRATE ZOOLOGY
LECTURER: BENZONI FRANCESCA, GALIMBERTI ANDREA

CONTENTS

Zoology deals with the study of animals (in this specific course, 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.

PREREQUISITES

None.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25845

M
YEAR:  1
SEM:  2
ECTS:  6
DEGREE in  Marine Sciences
CONTACT:  francesca.benzoni@unimib.it
          andrea.galimberti@unimib.it
MARINE MOLECULAR BIOLOGY
LECTURER: ORLANDI IVAN, PEREIRA BOEGER WALTER ANTONIO

CONTENTS
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.

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

PREREQUISITES
Undergraduate genetics and ecology.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25828

YEAR:     2
SEM:      1
ECTS:     6
DEGREE in Marine Sciences
CONTACT:  ivan.orlandi@unimib.it
MARINE VERTEBRATE ZOOLOGY
LECTURER: DE MADDALENA ALESSANDRO, VALSECCHI ELENA AGNESE

CONTENTS
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.

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

PREREQUISITES
Basic biology notions.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25846

M
YEAR: 1
SEM: 2
ECTS: 6
DEGREE in  Marine Sciences
CONTACT: alessandro.demaddalena@unimib.it
elena.valsecchi@unimib.it
CONTENTS

The aim of the course is the description of the structure, properties, functions and characterization of materials for solar applications. The course will also include the description of the corresponding devices.

Description of the operating principles of a photovoltaic cell and the properties of the main photovoltaic absorbers and photovoltaic devices currently on the market and in an advanced research and development phase.

Description of the main photocatalytic and photoelectrochemical processes for the production of fuels and chemical compounds from solar energy.

PREREQUISITES

Basic knowledge of chemistry (general chemistry, inorganic, organic, physical) and solid state physics.
MATHEMATICAL METHODS FOR PHYSICS*
LECTURER: DESTRI CLAUDIO, ZAFFARONI ALBERTO

CONTENTS
Group theory, distributions, and their applications to theoretical physics.
Lie groups, Lie algebras; their representations. Distributions; Green's functions.

PREREQUISITES
Undergraduate degree in math or physics.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26371

YEAR:  1
SEM:  1
ECTS:  6
DEGREE in  Physics
CONTACT:  claudio.destri@unimib.it
          alberto.zaffaroni@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
MATHEMATICAL METHODS IN MODERN PHYSICS*
LECTURER: RICCA RENZO

CONTENTS
The taught material aims to provide students with the basic notions regarding the definitions and the fundamental results for a geometric and topological approach to the study of classical field theory, with particular emphasis on classical vortex dynamics, ideal magnetohydrodynamics and quantum hydrodynamics.

Part I. Fluid flows and diffeomorphisms, Green's identities, conservation theorems, Euler's equations, Helmholtz's conservation laws, Navier-Stokes equations, ideal magnetohydrodynamics, magnetic helicity.
Part II. Elements of knot theory, torus knot solutions to LIA, Gross-Pitaevskii equation, topological defects, helicity and linking numbers, measures of topological complexity.

PREREQUISITES
Elements of differential geometry of curves and surfaces in three-dimensional space, elements of mechanics of continuum systems, balance laws in physics.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25434

YEAR: 1
SEM: 2
ECTS: 8
DEGREE in Mathematics
CONTACT: renzo.ricca@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
MC SIMULATION OF RADIATION DETECTORS*
LECTURER: CROCI GABRIELE, REBAI MARICA

CONTENTS
The objective of the course is to learn the up-to-date numeric simulation instruments presently available about the radiation matter interaction and in particular about the operation of gaseous radiation detectors.

* MC Simulation of radiation detectors
* Learning GEANT4
* Learning ROOT
* Learning Garfield.

PREREQUISITES
Physics I and Physics II.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26375

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Physics
CONTACT: gabriele.croci@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.*
CONTENTS

Rational drug design (structure and ligand-based), drug development (from hit to lead), pharmacokinetic, metabolism of drugs, prodrugs, strategies in drug release, exemples of drug development, personal work.

PREREQUISITES

The course is intended for students who have a solid background in chemistry, with an advanced knowledge of organic chemistry. A good knowledge of the analytical methods in organic chemistry is also needed, in particular NMR spectroscopy.

WEBSITE

https://elearning.unimib.it/course/info.php?id=26327
https://elearning.unimib.it/course/info.php?id=25626

M

YEAR: 1/2
SEM: 1
ECTS: 6
DEGREE in Industrial Biotechnologies
Chemical Sciences and Technolo-
gies

CONTACT: francesco.peri@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
CONTENTS
The teaching aims to provide a broad foundational knowledge of metallurgy and metallic materials. The learning objective is acquiring a general understanding of how chemophysical, microstructural and technological factors can impact on the final properties of metals and alloys.

The course topics can be divided into three major blocks. The first block includes basic chemophysical and metallurgical phenomena that are involved in the development of phases and microstructures in metals and alloys, and characterisation methods. The second block comprises examples of technological processes used for the synthesis and transformation of metallic materials, and for the setting of their final properties. The third block provides an overview of the main metallic material classes by composition, including classification, applications and life cycle.

PREREQUISITES
Basic knowledge of: Calculus, Thermodynamics, General Chemistry, Solid Mechanics, Crystal Structures, Elements of X-ray Diffraction, Calorimetry.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25609

M
YEAR:  1
SEM:  1
ECTS:  6
DEGREE in  Materials Science
CONTACT:  simone.pittaccio@unimib.it
MOLECULAR ELECTRONICS AND PHOTONICS

LECTURER: tbd

CONTENTS
The course deals with the physical principles of the properties of molecular semiconductors. Molecular crystals and quantum mechanic origins of the intermolecular forces. Carbon-based policonjugated systems: anisotropy, low-dimensional properties. Polymeric semiconductors.

* Electronic states of policonjugated molecules and polymers.
* Excited states in molecular crystals.
* Electroluminescence and led devices.
* Organic photovoltaic cells.
* Molecular electronics and photonics.

PREREQUISITES
This course requires a good knowledge of quantum physics (time-independent and time-dependent Schroedinger Equations, perturbation theory, Fermi golden rule), structure of matter (atoms, molecules and solids) and some basic knowledge of organic chemistry.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25610

M
YEAR: 1  
SEM: 2  
ECTS: 6  
DEGREE in  Materials Science  
CONTACT:  tbd
MULTIMEDIA DATA PROCESSING
LECTURER: CORCHS SILVIA ELENA, GASPARINI FRANCESCA

CONTENTS
The course offers an introduction to multimedia signals: images, video and audio, presenting the main methods of processing, digitizing and encoding. At the beginning the course analyzes the analog to digital conversion in particular by introducing the concepts of sampling and quantization. The main processing algorithms especially for the case of digital images are shown: histogram modification, filtering and white balancing. During the practical activities the student will apply the acquired theory to audio, image and video signals.

The course provides the basis for digitizing and encoding analogic signals: images, audio and videos. It also provides the competences to develop algorithms to process, code and compress digital signals.

PREREQUISITES
None.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26237

<table>
<thead>
<tr>
<th>M</th>
<th>YEAR: 1</th>
<th>SEM: 2</th>
<th>ECTS: 6</th>
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<tr>
<td>DEGREE in</td>
<td>Theory and technology of communication</td>
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<tr>
<td>CONTACT:</td>
<td><a href="mailto:francesca.gasparini@unimib.it">francesca.gasparini@unimib.it</a></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
NANOTECHNOLOGY AND INNOVATION
LECTURER: BROVELLI SERGIO

CONTENTS
The aim of the course is to provide in depth knowledge on various classes of nanomaterials that will constitute the main ingredient of future nanotechnologies. For each materials class, the synthesis approaches and the physical mechanisms underpinning their functionality will be studied in detail with particular focus on size-related processes, such as quantum and dielectric confinement. Applications of nanomaterials in various technological fields will be considered and their functioning principles will be studied, highlighting promising strategies for their design and optimization. Regulation aspects regarding health, safety and environmental aspects of nanotechnology will be discussed.

PREREQUISITES
Basic chemistry and chemical physics. Quantum mechanics, solid state physics.

WEBSITE https://elearning.unimib.it/course/info.php?id=25599

YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Materials Science
CONTACT: sergio.brovelli@unimib.it
NUCLEAR AND SUBNUCLEAR MEASUREMENTS LABORATORY I*
LECTURER: BROFFERIO CHIARA, TERRANOVA FRANCESCO

CONTENTS
The laboratory course provides an introduction at graduate level of the experimental techniques employed in particle and nuclear physics, including applications to medical and environmental physics.
The students carry on a full experiment in nuclear and particle physics, including the characterization of the source, detector, front end electronics, data acquisition and analysis.

PREREQUISITES
Experimental and analysis techniques from the Bachelor level lab courses.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26343

YEAR: 1
SEM: 1
ECTS: 10
DEGREE in Physics
CONTACT: chiara.brofferio@unimib.it
francesco.terranova@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
NUCLEAR AND SUBNUCLEAR MEASUREMENTS LABORATORY II*
LECTURER: PREVITALI EZIO, TERRANOVA FRANCESCO

CONTENTS
In this II part, the students deepen the experimental techniques developed in the I part of this Laboratory. The experimental apparatus assembled in the previous course is now employed to perform more sophisticated measurements; here the assessment of systematic bias plays a leading role in data taking and analysis.

PREREQUISITES
Laboratory of nuclear and particle physics, I part.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26355

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Physics
CONTACT: ezio.previtali@unimib.it
         francesco.terranova@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.*
OPTICAL MICROSCOPY*
LECTURER: tbd

CONTENTS
To offer an introduction to optics applied to the development of optical devices for the research and development in Biophysics, Biotechnology, Medicine and Biophotonics.

* Geometrical Optics for lenses and mirrors and compositions of lenses and stops.
* Physical Optics, Fresnel Theorem and its applications.
* Aberrations of optical devices
* Scanning Optical Microscopies.

PREREQUISITES
Knowledge of electromagnetic waves and of the mathematical treatment of the wave equation. Knowledge of the fundamentals of the light-matter interactions modes. Ability to solve partial differential equations; trigonometry.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26357

YEAR:  1
SEM:  2
ECTS:  6
DEGREE in  Physics
CONTACT:  tbd

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
CONTENTS

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.

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

PREREQUISITES

N/A.

WEBSITE

https://elearning.unimib.it/course/info.php?id=25830
https://elearning.unimib.it/course/info.php?id=25760

M

YEAR: 2
SEM: 1
ECTS: 6

DEGREE in Marine Sciences
Geological Sciences and Technologies

CONTACT: elisa.malinverno@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
PHYSICAL CHARACTERIZATION OF MATERIALS WITH LABORATORY

LECTURER: VEDDA ANNA GRAZIELLA

CONTENTS

The course includes two parts with one final examination. The first part consists in lessons aimed at the presentation of the fundamental concepts of optical and vibrational spectroscopy of solids, together with the description of selected experimental techniques; the second part consists in an experimental activity.

Optical and vibrational spectroscopy of solids. Introduction to selected experimental techniques.

PREREQUISITES

Fundamentals of the structure of matter.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25611

YEAR: 1
SEM: 1+2
ECTS: 8
DEGREE in Materials Science
CONTACT: anna.vedda@unimib.it
CONTENTS

Importance of defects on material properties, mainly in semiconductors. Elements of physical chemistry of surfaces. Adsorption phenomena: physisorption and chemisorption. Principal methods and techniques of Surface Characterization. Growth techniques of massive materials and thin film deposition procedures. Correlation of properties, defects and growth techniques.

PREREQUISITES

Main Physical Chemistry I and Materials Science topics in 1st cycle bachelor degree programs.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25612

M

YEAR:  1
SEM:  2
ECTS:  6
DEGREE in  Materials Science
CONTACT:  carlo.antonini@unimib.it
          simona.binetti@unimib.it
CONTENTS

The course is devoted to provide the student with the fundamentals of the physics and technology of semiconductors devices. In addition to lectures the course offers two laboratory activities dedicated to state of the art electrical characterization and simulation of the devices.

Physics of conventional electronic devices (junctions, transistors), of ultrascaled nanoelectronic devices (single electron and single atom transistors), and of emerging and novel nanoelectronic and spintronic devices for logic and memory applications, and for quantum information processing. Nanoelectronic devices (EOS, EOSFETs, Memristors) for neuroelectronic applications will be also discussed.

PREREQUISITES

Solid State Physics and Physics and Semiconductors.

WEBSITE  https://elearning.unimib.it/course/info.php?id=19936

M
YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Materials Science
CONTACT: marco.fanciulli@unimib.it
CONTENTS

The course starts from the description of polarization effects in materials to achieve the consciousness of the physical mechanisms responsible for the refractive index dispersion, optical absorption, light emission yield and nonlinear response in homogeneous, composite, and nanostructured systems as a function of materials features, structural order and disorder, and working parameters as temperature, stress, and light intensity. The lectures highlight the main properties making silica-based oxides key dielectric materials in photosensitive systems for the fabrication of fibre filters and fibre sensors, in optical amplifiers as doped active glasses, and in even more complex systems via nonlinear response.

PREREQUISITES

Basic knowledge of electromagnetism.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25613

M
YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Materials Science
CONTACT: alberto.paleari@unimib.it
CONTENTS
The main objective of the course is to provide an overview of the subject and a solid background for further specialization in the area of electronics and optoelectronics, sensors, energy harvesting and production, and supervised laboratory research. After a summary of technologically relevant materials and their properties and a reminder of solid-state physics concepts, such as crystal structure, lattice vibrations and band structure, semiconductor specific topics such as effective mass and its experimental determination, k dot p perturbation method, point defects and their structural, thermodynamic and electronic properties, charge statistic in intrinsic and extrinsic semiconductors, optical properties, charge transport, semiconductors in equilibrium and non-equilibrium conditions will be presented as the core of the course.

Semiconductor physics: electronic, optical, and transport properties.

PREREQUISITES

WEBSITE  https://elearning.unimib.it/course/info.php?id=25614

YEAR:  1
SEM:  2
ECTS:  6
DEGREE in  Materials Science
CONTACT:  marco.fanciulli@unimib.it
CONTENTS
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.

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.

PREREQUISITES
None.

https://elearning.unimib.it/course/info.php?id=25847
https://elearning.unimib.it/course/info.php?id=25780

YEAR: 1
SEM: 1
ECTS: 6
DEGREE in Marine Sciences
Geological Sciences and Technologies
CONTACT: claudia.pasquero@unimib.it
PLASMA PHYSICS II*
LECTURER: NOCENTE MASSIMO

CONTENTS
The course aims at providing the students an introduction to plasma physics and thermonuclear fusion.

Introduction to plasma physics, charge particle motion in a magnetic field, introduction to collisional processes in plasmas, introduction to the collisional kinetic theory, basics of nuclear fusion in tokamak devices, physics principles of selected diagnostic techniques for tokamak plasmas.

PREREQUISITES
Mathematics and physics courses of the Bachelor Degree in Physics.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26361

| YEAR:  | 1 |
| SEM:   | 1 |
| ECTS:  | 6 |
| DEGREE in | Physics |
| CONTACT: | massimo.nocente@unimib.it |

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
CONTENTS
To give the conceptual and technical tools of relativistic quantum field theories for studying fundamental interactions.

Path integral formulation of relativistic quantum field theories.

PREREQUISITES
Quantum mechanics and Theoretical physics I and II.

WEBSITE
https://elearning.unimib.it/course/info.php?id=26346
https://elearning.unimib.it/course/info.php?id=26393

M
YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Physics
Astrophysics And Space Physics
CONTACT: leonardo.giusti@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
**QUANTUM FIELD THEORY II***
LECTURER: GIUSTI LEONARDO

**CONTENTS**

To give the conceptual and technical tools of relativistic quantum field theories for studying fundamental interactions.

Path integral formulation of relativistic quantum field theories.

**PREREQUISITES**

Quantum mechanics, Theoretical Physics I and II, Quantum field theory I.

**WEBSITE**  [https://elearning.unimib.it/course/info.php?id=26347](https://elearning.unimib.it/course/info.php?id=26347)

**YEAR:**  1  
**SEM:**  2  
**ECTS:**  6  
**DEGREE in**  Physics  
**CONTACT:**  leonardo.giusti@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.*
RADIATION MATTER INTERACTION
LECTURER: MARTINI MARCO

CONTENTS
Aim of the course is to give the basis of the mechanisms of energy transfer from ionizing radiation to materials and to introduce some applications based on the interaction of ionizing radiation with materials.


PREREQUISITES
Basic knowledge of physics of matter
SEDIMENTARY PETROLOGY*
LECTURER: ANDO' SERGIO, GARZANTI EDUARDO ALDO FRANCO

CONTENTS
This course in Sedimentary Petrography is dedicated to our MSc and PhD Students, worldwide interested in heavy mineral identification and provenance studies of sediments and sedimentary rocks carried out with classical optical methods and supported by innovative methods as Raman spectroscopy.

* Introduction to Sedimentary Petrography
* Sampling in the field
* Laboratory for heavy mineral separation
* Petrography of siliciclastic detritus
* Heavy-mineral studies
* Physical processes
* Chemical processes
* How to count in provenance studies and data processing
* Geochronology of detritus
* Applications to Petroleum Geology.

PREREQUISITES
A good knowledge of mineralogy and petrography is necessary. A complementary course in Basin analysis for a better understanding of plate tectonic and regional geology is also important. A real interest in learning techniques for the study of the mineralogy of sediments in the laboratory of sedimentology and sedimentary petrography is strongly recommended. Students interested in petroleum geology are strongly encouraged to follow this course.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25770

M
YEAR: 1
SEM: 1
ECTS: 6
DEGREE in Geological Sciences and Technologies
CONTACT: sergio.ando@unimib.it
          eduardo.garzanti@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
CONTENTS

The main objective of the course is to provide an overview of the subject and a solid background for further specialization in the area of electronics and optoelectronics, sensors, energy harvesting and production, and supervised laboratory research. After a summary of technologically relevant materials and their properties and a reminder of solid-state physics concepts, such as crystal structure, lattice vibrations and band structure, semiconductor specific topics such as effective mass and its experimental determination, k dot p perturbation method, point defects and their structural, thermodynamic and electronic properties, charge statistic in intrinsic and extrinsic semiconductors, optical properties, charge transport, semiconductors in equilibrium and non-equilibrium conditions will be presented as the core of the course.

Semiconductor physics: electronic, optical, and transport properties.

PREREQUISITES


WEBSITE  https://elearning.unimib.it/course/info.php?id=26362

*MIF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.*
SOLID STATE AND SURFACE PHYSICAL CHEMISTRY*
LECTURER: BINETTI SIMONA OLGA

CONTENTS
Importance of defects on material properties, mainly in semiconductors. Elements of physical chemistry of surfaces. Adsorption phenomena: physisorption and chemisorption. Principal methods and techniques of Surface Characterization. Growth techniques of massive materials and thin film deposition procedures. Correlation of properties, defects and growth techniques.

PREREQUISITES
Main Physical Chemistry I and Materials Science topics in 1st cycle bachelor degree programs.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25624

YEAR: 2  
SEM: 2  
ECTS: 6  
DEGREE in Chemical Sciences and Technologies  
CONTACT: simona.binetti@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
SOLID STATE PHYSICS
LECTURER: BERGAMASCHINI ROBERTO, MIGLIO LEONIDA

CONTENTS
A first part of the course is devoted to the treatment of simpler phenomena, as described in terms of non-interacting particles (Electrons or phonons), with particular attention in teaching the skill of developing analytical models, which allow to solve complicated problems by ingenious simplifications. The second part analyzes more complex phenomena, generated by the interaction among particles, which give rise to significant macroscopic properties of the perfect and infinite solid. In this part, the focus is placed on the understanding of non-intuitive concepts and the ideal line of reasoning, preferring - also here - the methodological approach rather than the taxonomic one. The complementation of a main text with several others, depending on the topic, is an important aspect of the teaching method, that is, to acquire the habit of consulting different sources and comparing them critically.

PREREQUISITES
Atomic and molecular quantum physics; Elementary introduction to Solid State Physics; A short course in advanced calculus.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25616

M
YEAR:  1
SEM:  1+2
ECTS:  8
DEGREE in  Materials Science
CONTACT:  roberto.bergamaschini@unimib.it
          leo.miglio@unimib.it
CONTENTS

For the students of solid-state-oriented, the course consist in a laboratory experience performed by a study group of two or three students.

For the student electronics-oriented, the course consists in the full design of an analog CMOS circuit by means of the simulation software Cadence.

PREREQUISITES

Graduate in physics or equivalent.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26364

M
YEAR:  1
SEM:  2
ECTS:  6
DEGREE in  Physics
CONTACT:  andrea.baschirotto@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
CONTENTS
At the end of the course students should be familiar with the basic ideas of Statistical Mechanics such as the statistical approach to the derivation of the equation of states for classical and quantum gases, the theory phases transitions and of critical phenomena.

Statistical ensembles, derivation of the equation of state for classical and quantum gases, theory phases transitions, critical phenomena and renormalization group.

PREREQUISITES
N/A.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26356

YEAR: 1
SEM: 1
ECTS: 6
DEGREE in Physics
CONTACT: Sara.pasquetti@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.*
STATISTICAL THERMODYNAMICS OF MATERIALS
LECTURER: BERGAMASCHINI ROBERTO, MONTALENTI FRANCESCO CIBRO M.

CONTENTS
The main goal of the Course is to provide to the students some key theoretical/computational tools for approaching at the atomic scale thermodynamics and kinetics of solids.

Summary of basic concepts in classical statistical mechanics, adiabatic approximation, classical approximation for the motion of nuclei, ab initio and classical molecular dynamics, scientific coding with Matlab, implementation in Matlab of a molecular dynamics code, application of the molecular dynamics code, configurational Monte Carlo, implementation of a configurational Monte Carlo code, kinetic Monte Carlo, transition state theory.

PREREQUISITES
Basic classical and quantum mechanics. Knowledge of the Boltzmann distribution.

WEBSITE  https://elearning.unimib.it/course/info.php?id=25601

YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Materials Science
CONTACT: roberto.bergamaschini@unimib.it
          francesco.montalent@unimib.it
CONTENTS
The aim is at providing the tools for understanding the physics of stars, from their formation in the interstellar medium to their death as collapsed objects. These studies find their application within the nascent field of gravitational wave astrophysics and in the context of galaxy formation and evolution.

Introduction to stellar astrophysics: formation, structure and evolution.

PREREQUISITES
Calculus, Classical Mechanics, Electromagnetism, Condensed Matter, Quantum Mechanics.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26384

YEAR: 1
SEM: 1
ECTS: 8
DEGREE in  Astrophysics And Space Physics
CONTACT: monica.colpi@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
CONTENTS
The course has two targets: on the one hand, to complete the knowledge acquired during the courses of Solid State Physics, answering the fundamental question: what happens to the properties of a perfect and infinite solid when the lattice periodicity ends at a surface? On the other hand, it is intended to provide the basis for all applications of Semiconductor Physics, Physics of Electronic Devices and Nanotechnologies, inevitably involving surfaces, interfaces and epitaxial depositions. The approach is both theoretical and experimental.

PREREQUISITES
Advanced Course in Solid State Physics.

https://elearning.unimib.it/course/info.php?id=26376
https://elearning.unimib.it/course/info.php?id=25617

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Physics
Materials Science
CONTACT: leo.miglio@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
SYNTHESIS AND SPECIAL ORGANIC TECHNIQUES IN MATERIALS CHEMISTRY*
LECTURER: PAPAGNI ANTONIO

CONTENTS
Overview on the strategies for the preparation of organic materials with specific optical and electronic properties exploitable in the field of photonics, organic semiconductors and on the synthesis of principal polymers with application as organic conductors or electroluminescent devices. An overview on basic concepts organic photochemistry and its application to organic synthesis.

PREREQUISITES
For an optimum understanding of the topic treated, a consolidated organic chemistry background is required together with basic knowledge on the optical and electronic properties of polyconjugated organic molecules and polymers.

WEBSITE
https://elearning.unimib.it/course/info.php?id=25602
https://elearning.unimib.it/course/info.php?id=25631

CONTACT: antonio.papagni@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
TEXT MINING AND SEARCH
LECTURER: PASI GABRIELLA, VIVIANI MARCO

CONTENTS
At first this course will provide the definition of Text Mining and will point out the basic differences between Data Mining and Text Mining.
The course will introduce then some main tasks involved by Text Mining, which include Information Retrieval (IR), Information Filtering (IF), Text Summarization, and Text Classification. The issues of text pre-processing and analysis, and of text indexing and representation will be addressed. Then the course will introduce the previously mentioned tasks. Some open source software for Text Mining and Search will be introduced and practiced.

PREREQUISITES
Basic knowledge of statistics and of programming languages.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26201

YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Data Science
CONTACT: gabiella.pasi@unimib.it
          marco.viviani@unimib.it
THEORETICAL PHYSICS I*
LECTURER: PENATI SILVIA

CONTENTS
Introduction to the main concepts of relativistic quantum field theory applied to the study of fundamental interactions.

Formulation of a relativistic quantum field theory in terms of particles and fields. Perturbation theory, Feynman diagrams and the main processes of quantum electrodynamics.

PREREQUISITES
Deep knowledge of Classical Physics and Quantum Mechanics at the level of a Bachelor in Physics is required. A basic familiarity with Special Relativity, Lorentz transformations and relativistic kinematics is given for granted. The structure of the Lorentz group and the covariant formalism will be subjects of the course.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26338

YEAR:  1
SEM:  1
ECTS:  6
DEGREE in  Physics
CONTACT:  silvia.penati@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
THEORETICAL PHYSICS II*
LECTURER: PENATI SILVIA

CONTENTS
Introduction to the Standard Model of Fundamental Interactions.

Applications of Quantum Field Theory to the study of electroweak interactions. Brief introduction to renormalization theory.

PREREQUISITES
Deep knowledge of Classical Physics and Quantum Mechanics at the level of a Bachelor in Physics is required. The course of Theoretical Physics I is required.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26339

YEAR: 1
SEM: 1
ECTS: 6
DEGREE in Physics
CONTACT: silvia.penati@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
**THEORY AND PHENOMENOLOGY OF FUNDAMENTAL INTERACTION**

**LECTURER:** OLEARI CARLO

**CONTENTS**

Provide the fundamental bases of the Standard Model, in the electroweak and strong sector, the tools for cross-section and decay-rate calculations. Deepen the knowledge of the phenomenology of the fundamental particles.

Introduction to the Standard Model of the electroweak and strong interactions: the SU(2) xU(1)xSU(3) model. The spontaneous symmetry breaking, the Higgs boson, and the phenomenology of the strong and electroweak interactions.

**PREREQUISITES**

Basics knowledge of Quantum Field Theory.

**WEBSITE**  [https://elearning.unimib.it/course/info.php?id=26378](https://elearning.unimib.it/course/info.php?id=26378)

**YEAR:** 1  
**SEM:** 2  
**ECTS:** 6  
**DEGREE in** Physics  
**CONTACT:** carlo.oleari@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.*
THEORY OF CONDENSED MATTER I*
LECTURER: BERNASCONI MARCO

CONTENTS
To provide an introduction to the study of the electronic structure of solids beyond the independent electrons approximation. To provide an introduction to the magnetic properties of solids.


PREREQUISITES
The courses of Quantum Mechanics and Structure of Matter of the first level degree in Physics.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26359

YEAR:  1
SEM:  1
ECTS:  6
DEGREE in  Physics
CONTACT:  marco.bernasconi@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
THEORY OF CONDENSED MATTER II*
LECTURER: SANGUINETTI STEFANO

CONTENTS
Introduction to Advances Condensed Matter Physics: topological effects on the electronic structure of solids and superconductivity.

Topological Effects, Bose Einstein Condensates (BEC), Superfluidity, Superconductivity.

PREREQUISITES
Electromagnetism, quantum mechanics, solid state physics.

WEBSITE  https://elearning.unimib.it/course/info.php?id=26377

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Physics
CONTACT: stefano.sanguinetti@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.
CONTENTS

The aim of the course is to provide students with the knowledge and skills necessary to master the complex mechanisms and processes that underlie the phase transformations of materials, both concerning the thermodynamic aspects and the kinetic ones. The knowledge and skills acquired will be applied to some case studies of technological relevance in the field of functional materials.

* Thermodynamics and kinetics of solids.
* Phase transformation processes and the kinetic mechanisms (diffusion, transport) that are at their base.
* Fundamentals of some spectroscopic techniques able to investigate the correlations between structure, dynamics and functional properties of some classes of solids.

PREREQUISITES

Basic thermodynamics. Basic crystallography.

https://elearning.unimib.it/course/info.php?id=25618

WEBSITE  https://elearning.unimib.it/course/info.php?id=25633

**YEAR:** 1/2  
**SEM:** 1  
**ECTS:** 6  
**DEGREE in** Materials Science  
Chemical Sciences and Technologies  
**CONTACT:** piercarlo.mustarelli@unimib.it

*IF THE TITLE APPEARS IN ITALIAN, PLEASE CHECK THE ENGLISH VERSION.*
CONTENTS
The course introduces students to the main principles of the Ubiquitous Computing re-
search area and, successively, focusses on those themes related to the definition, model-
ing, and use of contextual information in designing and developing ubiquitous/pervasive
and context-aware technologies.
An overview of the various accepted meaning of Context and Context-Awareness will be
presented; then the course focusses on the definition and use of those contextual infor-
mation asking for complex representations (e.g., those information related to the user's
activity and his/her preferences).

PREREQUISITES
A good knowledge of the basis of ICT, web technology & app.

https://elearning.unimib.it/course/info.php?id=25394
WEBSITE https://elearning.unimib.it/course/info.php?id=26228

YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Computer Science
Theory and Technology of Commu-
nication
CONTACT: alessandra.agostini@unimib.it
CONTENTS

Provide information on available oceanographic databases and how their data are gathered and stored. Show how data can be visualised and analysed to answer to specific questions, using statistical methods and models, with Matlab software.


PREREQUISITES

Physics of the Sea

WEBSITE  https://elearning.unimib.it/course/info.php?id=25831

YEAR:  2  
SEM:  1  
ECTS:  6  
DEGREE in  Marine Sciences  
CONTACT:  roberto.colombo@unimib.it  
claudia.pasquero@unimib.it
FOR FURTHER INFORMATION, PLEASE CONSULT OUR WEBSITE:  WWW.UNIMIB.IT

IT’S IMPORTANT TO FOLLOW ALL UPDATE ON THE WEBSITE: HTTPS://ELEARNING.UNIMIB.IT

COURTESY OF THE INTERNATIONAL PROMOTION OFFICE OF THE MILANO-BICOCCA UNIVERSITY.