COURSES TAUGHT IN ENGLISH

SCIENCE

DISCIPLINARY AREAS:

- ECONOMICS
- EDUCATION
- LAW
- MEDICINE
- PSYCHOLOGY
- SCIENCE
- SOCIOLOGY
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** 11 Bachelor degrees of which **1 completely taught in English** in cooperation with University of Pavia and Universitu of Milano-Statale
- **M** 12 Master degrees of which **3 completely taught in English**

### OUR INTERNATIONAL OFFER

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

- **ARTIFICIAL INTELLIGENCE**
- **ASTROPHYSICS AND SPACE PHYSICS**
- **MARINE SCIENCES**
- **MATERIALS SCIENCE**

There are a total of 132 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:

## ARTIFICIAL INTELLIGENCE
- Cognitive Psychology
- Experimental Physics for AI
- Knowledge Representation and Reasoning
- Theoretical and Computational Linear Algebra

## Astrophysics and Space Physics
- Cosmic Rays
- Gravitational Wave Astrophysics
- Quantum Field Theory I
- Relativistic Astrophysics
- Stellar Astrophysics

## Biology
- Analysis and Management of Biocenosis
- Genetic Mechanisms of Human Disease

## Chemical Sciences and Technologies
- Chemistry of Inorganic Materials
- Chemistry of Molecular Materials
- Low Environmental Processes
- 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

## Data Science
- Cloud Computing
- Data and Computational Biology
- Evolution of Software Systems and Reverse Engineering
- Information Retrieval
- Ubiquitous, Pervasive & Context-Aware Computing

## Geodetic Sciences and Technologies
- Cybersecurity for Data Science
- Data Semantics
- Machine Learning (module)
- Machine Learning and Decision Models
- Social Media Analytics
- Streaming Data Management and Time Series Analysis
- Technological Infrastructures for Data Science
- Text Mining and Search

## Geodetic Sciences and Technologies
- 3D Geomodelling
- Active Tectonics and Volcanotectonics
- Advanced Methods in Structural Geology
- Applied Seismology
- Assessment of Geodetic Risks
- Biofacies
- Climate Change Impact on Geohazards
- Coastal Risk and Dynamics
- Earth Observation for Geology
- Earth System Models in Climate Change Science
- Environmental Geochemistry

## Geodetic Sciences and Technologies
- Fundamentals of Marine Physical Geography
- Geobiology
- Geochronology and Archeometry
- Geoenvironmental Risk
- Laboratory of Advanced Numerical Modelling in Earth Sciences
- Laboratory of Microzonation
- Laboratory of Mitigation—Work Design
- Paleoceanography and Paleoclimatology
- Physics of the Sea
- Quantitative Georisk Analysis
- Sedimentary Petrology
- Slope Instability

## 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
* OCEAN MONITORING AND DATA ANALYSIS
* OCEAN RESOURCES LAW AND POLICY
* PALEOCEANOGRAPHY AND PALEOClimatology
* PHYSICS OF THE SEA

**MATERIALS SCIENCE**
* APPLIED PHYSICAL CHEMISTRY WITH LABORATORY
* BASIC CHEMISTRY FOR MATERIALS SCIENCE
* CHEMISTRY AND TECHNOLOGY OF POLYMERS AND INDUSTRIAL APPLICATIONS
* CHEMISTRY OF INORGANIC MATERIALS
* CHEMISTRY OF MOLECULAR MATERIALS
* ENGINEERED NANOMATERIALS
* FUNDAMENTAL ANALYSIS
* FUNDAMENTALS OF QUANTUM MECHANICS FOR MATERIALS SCIENTISTS
* LOW ENVIRONMENTAL IMPACT MATERIALS AND PROCESSES
* MATERIALS AND DEVICES FOR ENERGY ENGINEERING
* METALS SCIENCE AND SUSTAINABILITY
* MOLECULAR ELECTRONICS AND PHOTONICS
* NANOTECNOLOGÍA Y INNOVACIÓN
* 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
* THERMODYNAMICS AND KINETICS OF MATERIALS

**MATHEMATICS**
* MATHEMATICAL METHODS IN MODERN PHYSICS
* REPRESENTATION THEORY

**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
* PLASMA PHYSICS I
* QUANTUM FIELD THEORY I
* QUANTUM FIELD THEORY II
* SEMICONDUCTORS PHYSICS
* SOLID STATE AND ELECTRONICS LABORATORY II
* STATISTICAL MECHANICS
* SURFACE AND INTERFACES
* THEORY AND PHENOMENOLOGY OF FUNDAMENTAL INTERACTIONS
* THEORY OF CONDENSED MATTER I

**SCIENCE AND TECHNOLOGIES FOR ENVIRONMENT AND LANDSCAPE**
* 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
* INFORMATION RETRIEVAL
* MULTIMEDIA DATA PROCESSING
* UBQUITOUS, PERVERSIVE & CONTEXT-AWARE COMPUTING
3D GEOMODELLING
LECTURER: BISTACCHI ANDREA  LUIGI PAOLO

CONTENTS
3D geomodelling techniques, discussed in a synthesis on theory, and implemented in exercises and case studies with industry-standard software. the course includes a review of theory tightly integrated with practical exercises. Principal topics are:
1. Fundamentals of geomodelling, topology, discrete models, grids, geostatistics and interpolation;
2. 3D data sources: surface geology, borehole, and geophysical data (e.g. 2D and 3D seis-
   smics);
3. Software: problems and functionalities;
4. Modelling a simple layer-cake stratigraphy;
5. Fault networks;
6. Cylindrical folds;
7. Complex geo-bodies;
8. Representation, modelling and simulation of properties of geological objects;
9. Fracture network modelling;
10. Retrodeformation;
11. Using 3D geomodels as input data for further modelling steps: mechanical models,
    flow simulators in hydrocarbon geology, hydrogeological models, etc.

PREREQUISITES
Tectonics and structural geology.

WEBSITE  https://elearning.unimib.it/course/info.php?id=38100

YEAR:  2
SEM:  1
ECTS:  4
DEGREE in  Geological Sciences and Technologies
CONTACT:  andrea.bistacchi@unimib.it
ACTIVE TECTONICS AND VOLCANOTECTONICS
LECTURER: TIBALDI ALESSANDRO

CONTENTS
The general objectives comprehend the preparation of students in order to carry out geo-
logical-structural analyses applied to the recognition of recent and active tectonic defor-
mations. 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=38123

YEAR: 1
SEM: 1
ECTS: 6
DEGREE in Geological Sciences and Technologies
CONTACT: alessandro.tibaldi@unimib.it
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=37951

M
YEAR:  2
SEM:  1
ECTS:  6
DEGREE in  Computer Science
CONTACT:  enza.messina@unimib.it
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=38099

YEAR: 2
SEM: 1
ECTS: 4
DEGREE in Geological Sciences and Technologies
CONTACT: andrea.bistacchi@unimib.it
ANALYSIS AND MANAGEMENT OF BIOCOENOSIS
LECTURER: MANGANO MARIA CRISTINA

CONTENTS
N/A

PREREQUISITES
N/A

WEBSITE  https://elearning.unimib.it/course/info.php?id=38876

YEAR:  1
SEM:  1
ECTS:  6
DEGREE in  Biology
CONTACT:  maria.mangano@unimib.it
APPLIED GEOMORPHOLOGY AND HABITAT
LECTURER: BASSO DANIELA MARIA, SAVINI ALESSANDRA, BRACCHI VALENTINA ALICE

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=38156

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Marine Sciences
CONTACT: daniela.basso@unimib.it
          alessandra.savini@unimib.it
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=38164

YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Marine Sciences
CONTACT: luca.fallati@unimib.it
paraskevi.nomikou@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 physic and mathematic knowledge, thermodynamic and kinetic of chemical system.

WEBSITE  https://elearning.unimib.it/course/info.php?id=37948

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

* qubits practical implementations
* operate with qubits
* qubits as sensors
* superconducting qubits
* design, fabrication and characterization
* usage and related technologies
* application examples
* other type of qubits and examples of their application

PREREQUISITES

A course in Quantum Mechanics at the bachelor's degree level in physics (the basic concepts required will be recalled)

WEBSITE  https://elearning.unimib.it/course/info.php?id=39133

M
YEAR: 1
SEM: 1
ECTS: 6
DEGREE in Physics
CONTACT: angelo.nucciotti@unimib.it
APPLIED SEISMOLOGY
LECTURER: PACOR FRANCESCA, AUGLIERA PAOLO

CONTENTS
a) fundamentals of seismology;
b) introduction to the seismic source;
c) principles of attenuation of elastic waves and ground motion;
d) shaking parameters, response spectrum, ground motion prediction equations;
e) site effects;
f) fundamentals of seismic hazard;
g) seismic microzonation;
h) introduction to the Italian seismic code (sections of interest to geologists).
i)

PREREQUISITES
None

WEBSITE  https://elearning.unimib.it/course/info.php?id=38128

M
YEAR: 1
SEM: 1
ECTS: 6
DEGREE in Geological Sciences and Technologies
CONTACT: paolo.augliera@unimib.it
        francesca.pacor@unimib.it
APPLIED SOCIAL COGNITION TO PUBLIC POLICIES

LECTURER: MARI SILVIA

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.

WEBSITE

https://elearning.unimib.it/course/info.php?id=37771
https://elearning.unimib.it/course/info.php?id=38264

CONTACT:  
silvia.mari@unimib.it
ARTIFICIAL INTELLIGENCE
LECTURER: BANDINI STEFANIA, BIANCHI FEDERICO, PALMONARI MATTEO LUIGI

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=37949

YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Computer Science
CONTACT: stefania.bandini@unimib.it
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=38124

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

CONTENTS
Introduction to the physical principles of operation of telescopes and detectors of electromagnetic, gravitational and particle radiation (cosmic rays).

PREREQUISITES
Physics 1, Physics 2, Physics 3, Structure of Matters

WEBSITE
https://elearning.unimib.it/course/info.php?id=35307

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Astrophysics and Space Physics

CONTACT: mario.zannoni@unimib.it
ASTROPHYSICS OF GRAVITATIONAL WAVES
LECTURER: SESANA ALBERTO

CONTENTS
1- theory of gravitational wave emission
2- detection methods: interferometers and pulsar timing
3- astrophysical sources of gravitational waves and their signals
4- the bands of the gravitational wave spectrum and the observers that cover them: LI-GO / Virgo, LISA, PTAs
5- basics of gravitational wave data analysis

PREREQUISITES
None, besides the basic classes of the bachelor. It is advised to take this class after Relativistic Astrophysics. Some of the concepts developed during the course will be easier to understand if the students have attended the General Relativity course. I stress, however, that this is not a needed prerequisite, as the course will be largely self-contained.

WEBSITE  https://elearning.unimib.it/course/info.php?id=35306

M
YEAR:  1
SEM:  2
ECTS:  6
DEGREE in  Astrophysics and Space Physics
CONTACT:  alberto.sesana@unimib.it
ASTROSTATISTICS
LECTURER: GEROSA DAVIDE

CONTENTS
The use of statistics is ubiquitous in astronomy and astrophysics. Modern advances are made possible by the application of increasingly sophisticated tools, often dubbed as "data mining", "machine learning", and "artificial intelligence". This class provides an introduction to (some of) these statistical techniques in a very practical fashion, pairing formal derivations to hands-on computational applications. Although examples will be taken almost exclusively from the realm of astronomy, this class is appropriate to all Physics students interested in machine learning.

PREREQUISITES
No formal prerequisites. Some previous knowledge of the python programming language is highly recommended (see below for some catch-up resources).

WEBSITE  https://elearning.unimib.it/course/info.php?id=35298

M
YEAR:  1
SEM:  2
ECTS:  6
DEGREE in  Astrophysics and Space Physics

CONTACT:  davide.gerosa@unimib.it
CONTENTS

Basic course of general, inorganic and organic chemistry. The general and inorganic chemistry deals with the fundamental aspects of chemistry, with the aim to relate the physical properties of the materials with their chemical composition. The main chemical phenomena (reactions, equilibria, ph), as well as some basis of stoichiometry, will be also addressed. In organic chemistry the structural aspects, the weak bonds responsible for molecular interactions and the covalent bonds that give rise to polymeric structures of interest for materials sciences will be addressed.

PREREQUISITES

None.

WEBSITE  https://elearning.unimib.it/course/info.php?id=37939

M
YEAR:  1
SEM:  1
ECTS:  6
DEGREE in  Materials Science
CONTACT:  luca.beverina@unimib.it
          sergio.tosoni@unimib.it
Biodiversity and Marine Ecology

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

LECTURER: SHAZLA MOHAMED, MONTANO SIMONE, GALLI PAOLO, SEVESO DAVIDE

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=38157

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=38158

YEAR: 1
SEM: 1
ECTS: 6 (Only if the entire course is frequented)
DEGREE in Marine Sciences
CONTACT: simone.montano@unimib.it
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=38137
https://elearning.unimib.it/course/info.php?id=38160

WEBSITE

CONTACT: daniela.basso@unimib.it
CAUSAL NETWORKS
LECTURER: BREGOLI ALESSANDRO

CONTENTS
Main contents are as follows; the potential outcome framework, main definitions and properties of probabilistic graphical models with specific reference to Bayesian networks, causal networks and structural causal models, randomized experiments, nonparametric identification of causal effect, estimation of causal effect, unobserved confounding, instrumental variables, structural learning from observational data and from observational and intervention data, basic concepts of transfer learning and transportability, and finally a basic introduction to counterfactuals.

PREREQUISITES
Basic knowledge of graph theory, optimization, probability and statistics, programming; mainly R and Python.

WEBSITE  
https://elearning.unimib.it/course/info.php?id=37965

YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Computer Science
CONTACT: alessandro.bregoli@unimib.it
CHEMISTRY AND TECHNOLOGY OF POLYMERS AND INDUSTRIAL APPLICATIONS

LECTURER: COMOTTI ANGIOLINA, SOZZANI PIERO ERNESTO

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=37931

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Materials Science
CONTACT: angiolina.comotti@unimib.it
         piero.sozzani@unimib.it
CONTENTS


PREREQUISITES

Chemistry of inorganic materials requires an interdisciplinary approach exploiting general and inorganic chemistry, organic chemistry, physical chemistry (thermodynamics and chemical equilibria) and basic knowledge of crystallography.

https://elearning.unimib.it/course/info.php?id=38015
https://elearning.unimib.it/course/info.php?id=37934

M
YEAR: 1/2
SEM: 1
ECTS: 6
DEGREE in Materials Science
       Chemical Sciences and Technologies
CONTACT: massimo.moret@unimib.it
CHEMISTRY OF MARINE ENVIRONMENT
LECTURER: FERRERO LUCA

CONTENTS
The course 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. The course aims at providing fundamental knowledges concerning 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.

PREREQUISITES
Basics of inorganic and organic chemistry.

WEBSITE  https://elearning.unimib.it/course/info.php?id=38149

M
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

https://elearning.unimib.it/course/info.php?id=37938
https://elearning.unimib.it/course/info.php?id=38016

M YEAR: 1/2
SEM: 2
ECTS: 6
DEGREE in Materials Science
            Chemical Sciences and Technologies
CONTACT: luca.beverina@unimib.it
CLIMATE CHANGE IMPACTS ON GEOHAZARDS
LECTURER: FRATTINI PAOLO

CONTENTS
N/A

PREREQUISITES
N/A

WEBSITE  https://elearning.unimib.it/course/info.php?id=38131

| YEAR:  | 2 |
| SEM:   | 1 |
| ECTS:  | 6 |
| DEGREE in | Geological Sciences and Technologies |
| CONTACT: | luca.ferrero@unimib.it |
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=37956

YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Computer Sciences
CONTACT: flavio.depaoli@unimib.it
COASTAL AND MARINE BOTANY
LECTURER: GENTILI RODOLFO FILIPPO

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. 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 coastal environments. The second part of the course, instead, will focus on coastal 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.

PREREQUISITES
None.

WEBSITE  https://elearning.unimib.it/course/info.php?id=38145

M
YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Marine Sciences
CONTACT: rodolfo.gentili@unimib.it
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=38142

M
YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Marine Sciences
CONTACT: marcella.schmidt@unimib.it
COASTAL AND MARITIME TOURISM
LECTURER: MALATESTA STEFANO, PIANA PIETRO

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=38143

M
YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Marine Sciences
CONTACT: stefano.malatesta@unimib.it
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=30860
https://elearning.unimib.it/course/info.php?id=38141

YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Marine Sciences
Geological Sciences and Technologies
CONTACT: felice.dalessandro@unimib.it
COGNITIVE PSYCHOLOGY
LECTURER: BRICOLO EMANUELA

CONTENTS

PREREQUISITES

WEBSITE  https://elearning.unimib.it/course/info.php?id=38143

YEAR:  1
SEM:  2
ECTS:  6
DEGREE in  Artificial Intelligence
CONTACT:  emanuela.bricolo@unimib.it
COMMUNICATION SKILLS AND INTERPERSONAL RELATION MANAGEMENT

LECTURER: STREPPARAVA MARIAGRAZIA, RUSSO SELENE

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=38144

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=39134

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

WEBSITE  https://elearning.unimib.it/course/info.php?id=37770

https://elearning.unimib.it/course/info.php?id=38242
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=35297

M
YEAR: 1
SEM: 1
ECTS: 6
DEGREE in  Astrophysics and Space Physics
CONTACT: massimo.gervasi@unimib.it
COSMIC STRUCTURE FORMATION
LECTURER: CANTALUPO SEBASTIANO

CONTENTS
Content goals/objectives include:
- The students will learn how to investigate and characterise the physical properties of the largest baryonic structures in the universe by studying in detail the mechanisms that produce and modify the electromagnetic radiation detectable with astronomical observing facilities.
- The students will learn that radiation processes are an active agent in shaping the formation and evolution of cosmic structures in the universe from the largest scales associated with intergalactic gas to galaxies.
- The students will learn how to use astronomical observations at different wavelengths to infer physical properties (mass, star formation rate, composition) of galaxies and their constituents (stars, interstellar medium, dark matter).
- The students will learn about the diversity of galaxies in the universe, in terms of, e.g., morphology, kinematics, stellar populations, properties of the interstellar medium. In this context, the students will learn how to identify possible trends and regularities, which may be then used as possible clues to their physical origin.

PREREQUISITES
The course is geared towards students in the physical sciences with no particular prerequisites on previous classes or study background. The only prerequisites necessary for this class are: i) motivation, ii) curiosity, iii) willingness to actively participate.

WEBSITE  https://elearning.unimib.it/course/info.php?id=35292

YEAR: 1
SEM: 1
ECTS: 6
DEGREE in Astrophysics and Space Physics
CONTACT: sebastiano.cantalupo@unimib.it
CYBERSECURITY FOR DATA SCIENCE

LECTURER: DENARO GIOVANNI, FERRETTI CLAUDIO

CONTENTS
The domain of cybersecurity: technologies where we apply the discipline, and goals: basic terminology in the area (e.g. vulnerability VS exploit, etc.); unifying principle: technologies introduce possibilities of the being used improperly. Protection of data: cryptography, filtering network traffic, detection of threats. Improving security without technology: awareness and best practices. Case studies: data management frameworks, and where they can be hardened against security threats.

PREREQUISITES
None.

WEBSITE  https://elearning.unimib.it/course/info.php?id=37905

YEAR: 2  
SEM: 1  
ECTS: 6  
DEGREE in Data Science  
CONTACT: giovanni.denaro@unimib.it claudio.ferretti@unimib.it
CONTENTS
The course is composed of three main parts/topics.

- Introduction to Biology and Biochemical Network Modeling
- Modeling and Simulation of Biological systems.
- Data Analysis of biomedical phenomena, with special attention to oncological progression phenomena.

PREREQUISITES
Introductory courses (undegraduate or master level) on Mathematics, Probability and Statistics, and/or Biology and Biochemistry. Some knowledge of R, Python (et al.) programming.

WEBSITE  https://elearning.unimib.it/course/info.php?id=37953

M
YEAR:  2
SEM:  1
ECTS:  6
DEGREE in  Computer Science
CONTACT:  marco.antoniotti@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=37920
https://elearning.unimib.it/course/info.php?id=37785
EARTH OBSERVATION FOR GEOLOGY
LECTURER: ROSSINI MICOL

CONTENTS
Theory and practice for remote sensing data analysis using open-source software for image processing for geological applications. The aim of the course is to provide expertise in the analysis and interpretation of remote sensing images for Earth Sciences applications.

PREREQUISITES
None.

WEBSITE  https://elearning.unimib.it/course/info.php?id=38105

YEAR:  2
SEM:  1
ECTS:  4
DEGREE in  Geological Sciences and Technologies
CONTACT:  micol.rossini@unimib.it
EARTH SYSTEM MODELS IN CLIMATE CHANGE SCIENCE

LECTURER: ALBANI SAMUEL

CONTENTS

The aim of the course is to enable students to gain a basic knowledge of the climate system and its representation in numerical Earth System Models (ESMs), as a fundamental tool in the framework of climate change studies.

For all students, this course will provide basic knowledge on climate change, and it will allow them to communicate with experts in climate modeling, and make sense of climate model data that may constitute the inputs / starting point of their future work, for instance on the impacts of climate changes.

For those who are interested in pursuing modelling climate or other aspects of the physical world, this course could be a good starting point, and should be complementary to more focused courses.

- The climate system and climate change
- Theoretical bases of numerical climate prediction
- Applications with the WRF regional climate model

PREREQUISITES

Physical Geography.

WEBSITE  https://elearning.unimib.it/course/info.php?id=38111

YEAR: 1
SEM: 1
ECTS: 6
DEGREE in Geological Sciences and Technologies
CONTACT: samuel.albani@unimib.it
CONTENTS

The course covers the basic principles associated with nanoscience and nanotechnology which is necessary to understand the nanomaterials properties, and how nanomaterials can be designed and engineered. The course will span from nanotools (characterizations and fabrication methods), to physics (size dependent properties and phenomena) and chemistry (synthesis and modification), as well as applications of materials at nanometer length scales with an emphasis on recent technological breakthroughs in the field.

PREREQUISITES

Suggested: Physical Chemistry of Solid State and Surfaces (1st year, MSc degree in Materials Science).

WEBSITE  https://elearning.unimib.it/course/info.php?id=37924
ENVIRONMENTAL GEOCHEMISTRY
LECTURER: ROTIROTI MARCO

CONTENTS

* Geochemical processes in the hydrosphere, atmosphere and lithosphere
* Biogeochemical cycles
* Pollution of different environmental matrices
* Stable isotope geochemistry

PREREQUISITES
Basic knowledge of chemistry and geochemistry.

WEBSITE  https://elearning.unimib.it/course/info.php?id=38110

YEAR:  1
SEM:  1
ECTS:  6
DEGREE in  Geological Sciences and Technologies
CONTACT:  marco.rotiroti@unimib.it
ENVIRONMENTAL JUSTICE AND GEOPOLITICS OF THE SEA
LECTURER: DELL’AGNESE ELENA, GRASSO MARCO

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 sea 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=38148

YEAR:  1
SEM:  2
ECTS:  6
DEGREE in  Marine Sciences
CONTACT:  elena.dellagnese@unimib.it
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=37957

YEAR:  2
SEM:  1
ECTS:  6
DEGREE in  Computer Science
CONTACT:  francesca.arcelli@unimib.it
          ilaria.pigazzini@unimib.it
EXPERIMENTAL COSMOLOGY
LECTURER: NATI FEDERICO

CONTENTS
Elements of cosmology. Cosmic Microwave Background: history and current status of measurements. The sky at millimeter and submillimeter wavelengths. Physical observables, cosmological parameters and experimental techniques.

PREREQUISITES
None.

WEBSITE  https://elearning.unimib.it/course/info.php?id=35294

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Astrophysics and Space Physics
CONTACT: federico.nati@unimib.it
EXPERIMENTAL PHYSICS FOR AI
LECTURER: CHIRICO GIUSEPPE

CONTENTS

PREREQUISITES

WEBSITE

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Artificial Intelligence
CONTACT: giuseppe.chirico@unimib.it
CONTENTS

The course focuses on two macro areas of topics. A first part focused on more advanced portfolio theory models, i.e. Strategic/Tactical Asset Allocation models. The focus in this first part will be more on the empirical applications of the models and the more technical data issues involved in the development of the models. In the second part the course focuses on Equity Portfolio Management issues, introducing Economic, Fundamental and Screening factor models, clarifying the relationship with the market efficiency hypothesis and the relevance of data and its quality for building investment strategies.

PREREQUISITES

There are no formal prerequisites for the course, but basic knowledge of financial theory will be useful. Students are also expected to know the basic concepts of statistics and in particular those related to multiple linear regression models. Basic concepts of matrix algebra will also be given for granted.

WEBSITE  https://elearning.unimib.it/course/info.php?id=37918

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Data Science
CONTACT: gianfranco.forte@unimib.it
CONTENTS
The course consists of a theoretical part and a part of exercises. The theoretical part aims at exploring applied math, machine learning basics and deep neural networks. The practical part consists in basic and advanced exercises using deep learning frameworks.

PREREQUISITES
None.

WEBSITE  https://elearning.unimib.it/course/info.php?id=37919
FUNCTIONAL ANALYSIS
LECTURER: 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=37937

M
YEAR: 1
SEM: 1
ECTS: 6
DEGREE in Materials Science
CONTACT: andrea.raimondo@unimib.it
giona.veronelli@unimib.it
FUNDAMENTALS OF MARINE BIOLOGY
LECTURER: MAGGIONI DAVIDE, SEVESO 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=38161

YEAR: 1
SEM: 1
ECTS: 6
DEGREE in Marine Sciences
CONTACT: davide.maggioni@unimib.it
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.
CONTENTS

* Introduction to the quantum mechanics formalism
* Observables, Operators and their properties
* Quantum Models in 1D and 3D.
* Hydrogen atom
* Spin
* Non-interacting Many-Particle Systems
* Emission and Absorption of Light

PREREQUISITES

Basic physics concepts and (likely) some quantum ideas in a modern physics course.

WEBSITE  https://elearning.unimib.it/course/info.php?id=37930
GENETIC MECHANISMS OF HUMAN DISEASE
LECTURER: MERCURO SARA, NICOLIS SILVIA KRISTEN, RONCHI ANTONELLA

CONTENTS
The course will consist of research seminars and discussion in class of research papers concerning subjects that are part of the courses of Genetics of Development and differentiation and Human Molecular genetics.

The papers will address subjects that are part of the courses of Genetics of Development and differentiation and Human Molecular genetics, in particular:

* The development and differentiation of the hematopoietic, muscular, and nervous systems;
* Genetic disease, with special regard to these systems, and their modelling in mice and cells (e.g. iPS cells);
* Genome editing approaches to the therapy of genetic disease

PREREQUISITES
A good understanding of basic genetics and molecular biology is required

WEBSITE  https://elearning.unimib.it/course/info.php?id=38888

M
YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Biology
CONTACT: sara.mercurio@unimib.it
CONTENTS

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=35291

YEAR: 1
SEM: 1
ECTS: 8
DEGREE in Astrophysics and Space Physics
CONTACT: massimo.dotti@unimib.it
GENERAL RELATIVITY
LECTURER: TOMASIELLO ALESSANDRO

CONTENTS
1) Principles and equations of general relativity.
2) Elements of differential geometry.
3) Black hole physics.
4) Elements of cosmology.

PREREQUISITES
A good understanding of basic genetics and molecular biology is required.

WEBSITE
https://elearning.unimib.it/course/info.php?id=39140

YEAR: 1
SEM: 1
ECTS: 6
DEGREE in Physics, Astrophysics and Space Physics
CONTACT: alessandro.tomasiello@unimib.it
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.

https://elearning.unimib.it/course/info.php?id=38139

https://elearning.unimib.it/course/info.php?id=38163

YEAR: 1
SEM: 1
ECTS: 8/6
DEGREE in Geological Sciences and Technologies
      Marine Sciences
CONTACT: daniela.basso@unimib.it
GEOCHRONOLOGY AND ARCHEOMETRY
LECTURER: VILLA IGOR MARIA

CONTENTS

PREREQUISITES
Chemistry, physics, geochemistry, geophysics (suggested)

WEBSITE  https://elearning.unimib.it/course/info.php?id=38108

M
YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Geological Sciences and Technologies
CONTACT: igor.villa@unimib.it
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=38093

YEAR: 2
SEM: 2
ECTS: 4
DEGREE in Geological Sciences and Technologies
CONTACT: giovannibattista.crota@unimib.it
GEO-HYDROLOGICAL RISK
LECTURER: DE BLASIO FLAVIO VITTORIO

CONTENTS
N/A

PREREQUISITES
N/A

WEBSITE  https://elearning.unimib.it/course/info.php?id=38112

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Geological Sciences and Technologies
CONTACT: fabio.deblasio@unimib.it
GRAVITATIONAL WAVE ASTROPHYSICS
LECTURER: SESANA ALBERTO

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 how 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=31980

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Astrophysics And Space Physics
CONTACT: alberto.sesana@unimib.it
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=38152

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=37981
https://elearning.unimib.it/course/info.php?id=37787

M
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
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=38150](https://elearning.unimib.it/course/info.php?id=38150)

YEAR:  1
SEM:  1
ECTS:  6
DEGREE in  Marine Sciences
CONTACT:  ilaria.tani@unimib.it
INTRODUCTION TO COSMOLOGY
LECTURER: DOTTI MASSIMO

CONTENTS

PREREQUISITES
Mathematics and Physics for undergraduates.

WEBSITE  https://elearning.unimib.it/course/info.php?id=35290

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

PREREQUISITES

WEBSITE

| YEAR: | 1 |
| SEM: | 1+2 |
| ECTS: | 12 |
| DEGREE in | Artificial Intelligence |
| CONTACT: | rafael.penalozanyssen@unimib.it |
LABORATORY OF ADVANCED NUMERICAL MODELLING IN EARTH SCIENCES
LECTURER: DE BLASIO FABIO VITTORIO

CONTENTS
N/A

PREREQUISITES
N/A.

WEBSITE  https://elearning.unimib.it/course/info.php?id=38097

YEAR: 2
SEM: 1
ECTS: 4
DEGREE in Geological Sciences and Technologies
CONTACT: fabio.deblasio@unimib.it
LABORATORY OF DATA ACQUISITION
LECTURER: FUMAGALLI MICHELE, LONGOBARDI ALESSIA, ZANNONI MARIO

CONTENTS
How to write a proposal, know-how on optical instrumentations, elements of data acquisition and data reduction, best practice for the analysis of data, how to present results in a scientific report.

- Proposal writing: the structure of a successful proposal, scientific and technical elements, planning of observations
- Know-how on optical instrumentations: imaging and spectroscopy, site conditions, estimates of integration times
- Data acquisition and data reduction: from raw to science-grade data, extracting measurements from data and associated errors
- Data analysis and scientific report: how to model observations and address the goal of the proposal, reporting results
- Practicals: mini research projects using data from the Bicocca Telescope

PREREQUISITES
Undergraduate degree in physics.

WEBSITE  https://elearning.unimib.it/course/info.php?id=35303

M
YEAR: 1
SEM: 1
ECTS: 6
DEGREE in Astrophysics And Space Physics
CONTACT: michele.fumagalli@unimib.it
LABORATORY OF DATA ANALYSIS
LECTURER: FUMAGALLI MICHELE, CANTALUPO SEBASTIANO

CONTENTS
Brief introduction on the basic principles of galaxy formation and evolution, learn how to formulate a scientific question, design and conduct a scientific experiment in astrophysics using archival observations, analysis and data mining of observations and theoretical models, how to present results in a science report.

PREREQUISITES
Undergraduate degree in physics.

Students particularly interested in a more in depth understanding of how astrophysical data are acquired are encouraged to follow the "Laboratory of data acquisition" offered in the first semester.

Students interested in deepening their understanding of galaxy formation and evolution should also consider the course "Cosmic Structure Formation".

WEBSITE  https://elearning.unimib.it/course/info.php?id=35304

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Astrophysics and Space Physics
CONTACT: michele.fumagalli@unimib.it
LABORATORY OF MICROZONATION
LECTURER: CAIELLI GRAZIA MARIA

CONTENTS
N/A

PREREQUISITES
N/A

WEBSITE  https://elearning.unimib.it/course/info.php?id=38095

M
YEAR:  2
SEM:  1
ECTS:  4
DEGREE in  Geological Sciences and Technologies
CONTACT:  grazia.caielli@unimib.it
LABORATORY OF MITIGATION WORK DESIGN
LECTURER: ORLANDI GIAN MARCO

CONTENTS
The objective of this course is to familiarize students with a work method for planning the hydrogeological risk mitigation works.
During the course real cases of hydrogeological risks will be analysed, to which the work method will be applied, so as to develop mitigation works projects, both independently or in a team.

PREREQUISITES
Applied Geology

WEBSITE  https://elearning.unimib.it/course/info.php?id=38096

YEAR: 2
SEM: 1
ECTS: 4
DEGREE in Geological Sciences and Technologies
CONTACT: marco.orlandi@unimib.it
LOW ENVIRONMENTAL IMPACT MATERIALS AND PROCESSES

LECTURER: ORLANDI MARCO EMILIO

CONTENTS

* Environmentally compatible processes for the production of materials.
* Environmentally compatible processes for the production of fine chemicals.
* Environmentally compatible processes for energy production.
* The concept of green chemistry.
* The concept of biorefinery.
* Biotechnology and energy aspects in the biorefinery context.
* Potentially sustainable concepts for performing chemical reactions.
* Sustainable nanomaterials.

PREREQUISITES

* Basic knowledge of organic and inorganic chemistry, and biology
* Basic concepts of thermodynamics.

WEBSITE  https://elearning.unimib.it/course/info.php?id=37933

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.
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=37914

YEAR: 1
SEM: 1
ECTS: 6 (Only if the entire course is frequented)

DEGREE in Data Science
CONTACT: fabio.stella@unimib.it
MACHINE LEARNING AND DECISION MODELS

MODULES: Decision Models (ref. F9101Q006M)
          Machine Learning (ref. F9101Q005M)

LECTURER: MESSINA VINCENZINA, STELLA FABIO ANTONIO

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/view.php?id=37912

M
YEAR: 1
SEM: 1+2
ECTS: 12
DEGREE in Data Science
CONTACT: enza.messina@unimib.it
                  fabio.stella@unimib.it
**MANAGEMENT OF ACQUATIC RESOURCES: FISHERIES**

**LECTURER:** MANGANO MARIA CRISTINA

**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. 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.

**PREREQUISITES**

None.

**WEBSITE**  [https://elearning.unimib.it/course/info.php?id=38146](https://elearning.unimib.it/course/info.php?id=38146)

| YEAR: | 2 |
| SEM:  | 1 |
| ECTS: | 6 |
| DEGREE in | Marine Sciences |
| CONTACT: | maria.mangano@unimib.it |
MARINE ENVIRONMENTAL MICROBIOLOGY
LECTURER: FRANZETTI ANDREA

CONTENTS
1. Microbial metabolisms and diversity in marine environments: diversity of bacteria and archaea 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

PREREQUISITES
Basic knowledge of microbiology

WEBSITE  https://elearning.unimib.it/course/info.php?id=38151

| YEAR:  | 1 |
|SEM:    | 1 |
|ECTS:   | Only if the entire course is frequented |
|DEGREE in| Marine Sciences |
|CONTACT:| andrea.franzetti@unimib.it |
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=38154

YEAR:  1
SEM:  2
ECTS:  6
DEGREE in  Marine Sciences
CONTACT:  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 Molecular Biology and Ecology

WEBSITE  https://elearning.unimib.it/course/info.php?id=38140

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

PREREQUISITES
Basic biology notions.

WEBSITE  https://elearning.unimib.it/course/info.php?id=38155

YEAR:  1
SEM:  2
ECTS:  6
DEGREE in  Marine Sciences
CONTACT:  alessandro.demaddalena@unimib.it
          elena.valsecchi@unimib.it
MATERIALS AND DEVICES FOR ENERGY ENGINEERING
LECTURER: MANFREDI NORBERTO, BINETTI SIMONA OLGA

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.

WEBSITE  https://elearning.unimib.it/course/info.php?id=37926

M
YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Materials Science
CONTACT: norberto.manfredi@unimib.it
simona.binetti@unimib.it
MATHEMATICAL METHODS FOR PHYSICS
LECTURER: DESTRI CLAUDIO, BRUNO MATTIA

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=39141

| YEAR: | 1 |
| SEM:  | 1 |
| ECTS: | 6 |
| DEGREE in | Physics |
| CONTACT: | claudio.destri@unimib.it |
| | mattia.bruno@unimib.it |
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=37751

M YEAR: 1  SEM: 2  ECTS: 8  DEGREE in Mathematics  CONTACT: renzo.ricca@unimib.it
MC SIMULATION OF RADIATION DETECTORS (BLENDDED)
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=39144

**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
The teaching aims to provide a broad foundational knowledge of metallurgy and metallic materials. The learning objective is acquiring a general understanding of how chemo-physical, 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 chemo-physical 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=37932
MOLECULAR ELECTRONICS AND PHOTONICS
LECTURER: MONGUZZI MARIA ANGELO

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=37935

M
YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Materials Science
CONTACT: angelo.monguzzi@unimib.it
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=37783

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<th>M</th>
<th>YEAR: 1</th>
<th>SEM: 2</th>
<th>ECTS: 6</th>
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<td></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>
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</tbody>
</table>
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 discussed 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=37925

M
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 tech-
niques 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 cha-
racterization of the source, detector, front end electronics, data acquisition and analysis.

PREREQUISITES
Experimental and analysis techniques from the Bachelor level lab courses. It is strongly
recommended to follow the course on Radiation Detectors, which is normally delivered
almost completely before the start of the laboratory.

WEBSITE  https://elearning.unimib.it/course/info.php?id=39116

YEAR:  1  SEM:  1  ECTS:  10  DEGREE in  Physics
CONTACT: chiara.brofferio@unimib.it
          francesco.terranova@unimib.it
NUCLEAR AND SUBNUCLEAR MEASUREMENTS LABORATORY II
LECTURER: NUCCIOTTI ANGELO, 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=39115

M
YEAR:  1
SEM:   2
ECTS:  6
DEGREE in  Physics
CONTACT:  angelo.nucciotti@unimib.it
francesco.terranova@unimib.it
NUMERICAL RELATIVITY
LECTURER: GIACOMAZZO BRUNO

CONTENTS
Neutron stars, binary neutron star systems and their observations, numerical relativity.

PREREQUISITES
This course requires a basic knowledge of special and general relativity. The latter can be obtained by following the Relativistic Astrophysics or General Relativity courses.

WEBSITE  https://elearning.unimib.it/course/info.php?id=35299

YEAR:  1
SEM:  2
ECTS:  6
DEGREE in  Astrophysics and Space Physics
CONTACT:  bruno.giacomazzo@unimib.it
CONTENTS

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.


PREREQUISITES

Physics of the Sea

WEBSITE  https://elearning.unimib.it/course/info.php?id=38165

M

YEAR:  2
SEM:  1
ECTS:  6
DEGREE in  Marine Sciences
CONTACT:  roberto.colombo@unimib.it
claudia.pasquero@unimib.it
OCEAN RESOURCES LAW AND POLICY
LECTURER: SCOVAZZI TULLIO, TANI ILARIA

CONTENTS
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.

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 1982 United Nations Convention on the Law of the Sea.

PREREQUISITES
To have attended the course in “International Law of the Sea”.

WEBSITE  https://elearning.unimib.it/course/info.php?id=31002

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Marine Sciences
CONTACT: tullio.scovazzi@unimib.it
          ilaria.tani@unimib.it
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.

https://elearning.unimib.it/course/info.php?id=38147
https://elearning.unimib.it/course/info.php?id=38103
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=37947

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=37936

M
YEAR:  1
SEM:  2
ECTS:  6
DEGREE in  Materials Science
CONTACT:  carlo.antonini@unimib.it
simona.binetti@unimib.it
PHYSICS AND TECHNOLOGY OF ELECTRIC DEVICES WITH LABORATORY

LECTURER: FANCIULLI MARCO, ZULLINO LUCIA

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=37929

YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Materials Science
CONTACT: marco.fanciulli@unimib.it
PHYSICS OF HOMOGENEOUS AND NANOSTRUCTURED DIELECTRICS
LECTURER: PALEARI ALBERTO MARIA FELICE

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=37943

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=37944

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.
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=39102

YEAR: 1
SEM: 1
ECTS: 6
DEGREE in Physics
CONTACT: massimo.nocente@unimib.it
QUANTITATIVE GEORISK ANALYSIS
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=38126

M
YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Geological Sciences and Technologies
CONTACT: paolo.frattini@unimib.it
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=31991
https://elearning.unimib.it/course/info.php?id=39132

YEAR: 1
SEM: 2
ECTS: 6

DEGREE in Physics
Astrophysics And Space Physics

CONTACT: leonardo.giusti@unimib.it
QUANTUM FIELD THEORY II
LECTURER: PENATI SILVIA

CONTENTS
Complete the study of QFTs by developing the functional approach to gauge theories, which describe fundamental interactions. Deepen the knowledge of the main properties of QED and QCD. Become familiar with advanced topics in QFT. Functional approach to gauge theories. Perturbative renormalization of QED and QCD. Renormalization group for gauge theories. Anomalies.

PREREQUISITES
General Relativity, Theoretical Physics I,II, Quantum Field Theory I

WEBSITE  https://elearning.unimib.it/course/info.php?id=39131

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Physics
CONTACT: silvia.penati@unimib.it
QUANTUM GRAVITY
LECTURER: NOCENTE MASSIMO

CONTENTS
The course aims at providing the students an introduction to plasma physics and thermo-nuclear 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=39138

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

The physical description of the materials is rooted in quantum mechanics, which describes how atoms bond between each other and how electrons interact. Although these quantum effects can in many cases be approximated by a classical description at the macroscopic level, there are material systems where quantum effects remain evident over a wider range of energy and length scales. Such quantum materials include superconductors, graphene, topological insulators, Weyl semimetals. Many of them derive their properties from reduced dimensionality, in particular from confinement of electrons to two-dimensional sheets. Moreover, they tend to be materials in which electrons cannot be considered as independent particles but interact strongly and give rise to collective excitations known as quasiparticles. This course will introduce the electronic properties of quantum materials and examines how its entanglement and topology give rise to a rich variety of quantum states and phases.

Topological Effects, Integer Quantum Hall Effect, Topological Insulators, Weyl semimetals, Superconductivity

PREREQUISITES

Electromagnetism, quantum mechanics, solid state physics

WEBSITE  https://elearning.unimib.it/course/info.php?id=37946

M

YEAR:  1
SEM:  2
ECTS:  6

DEGREE in  Physics
Materials Science

CONTACT:  stefano.sanguinetti@unimib.it
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.


Sources of ionizing radiation. Energy transfer from radiation to materials. Defects induced by radiation. Experimental techniques for the study of the effects of the interaction radiation-matter on the physical properties of the materials: nuclear techniques, as Accelerator Mass Spectrometry (AMS), luminescence techniques and X-ray Fluorescence (XRF), with particular focus on archaeometric applications, like dating and ancient materials identification and measurements.

PREREQUISITES
Basic knowledge of physics of matter.

WEBSITE  https://elearning.unimib.it/course/info.php?id=37942

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Materials Science
CONTACT: m.martini@unimib.it
RADIATIVE PROCESSES
LECTURER: COLPI MONICA

CONTENTS
◊ The electromagnetic spectrum
◊ The multi-wavelength Universe
◊ Thermal plasma - Black body - Bremsstrahlung
◊ Synchrotron emission and self-absorption
◊ Direct Compton and Inverse Compton
◊ Atomic structure and radiative transitions
◊ Relativistic beaming
◊ Theory of accretion onto black holes
◊ Active Galactic Nuclei: phenomenology and interpretation - Inference of their fundamental physical parameters

PREREQUISITES
Classical mechanics, classical electro-magnetism.

WEBSITE  https://elearning.unimib.it/course/info.php?id=35302

YEAR: 1
SEM: 1
ECTS: 6
DEGREE in Astrophysics and Space Physics
CONTACT: monica.colpi@unimib.it
RELATIVISTIC ASTROPHYSICS
LECTURER: SESANA ALBERTO

CONTENTS
N/A

PREREQUISITES
N/A

WEBSITE

M
YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Astrophysics and Space Physics
CONTACT: alberto.sesana@unimib.it
CONTENTS

The course is aimed to present the contents and the fundamental methods, as well as some noteworthy applications of the ‘classical’ theory of representations of finite groups. The expected learning outcomes include: the knowledge of the main results in the representation theory of finite groups, as well as the ability to apply them on concrete examples. Semisimple rings and modules. Modules and representations. Characters of finite groups. Tensor products of representations. Permutation representations and applications. Direct products. Induction and restriction of representations. Clifford Theory.

PREREQUISITES

It is recommended an a priori knowledge of the standard contents of first and second year Algebra courses, plus some extra knowledge of field theory.

WEBSITE  https://elearning.unimib.it/course/info.php?id=37761
SEDIMENTARY PETROLOGY
LECTURER: ANDO' SERGIO, GARZANTI EDUARDO ALDO FRANCO, RESENTINI ALBERTO

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=38133

M
YEAR:  1
SEM:  1
ECTS:  6
DEGREE in  Geological Sciences and Technologies
CONTACT:  sergio.ando@unimib.it
          eduardo.garzanti@unimib.it
PROGRAM CODE: F1701Q118

SEMICONDUCTORS PHYSICS
LECTURER: FANCIULLI MARCO

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=39103

M
YEAR:  1
SEM:  2
ECTS:  6
DEGREE in  Physics
CONTACT:  marco.fanciulli@unimib.it
SLOPE INSTABILITY
LECTURER: AGLIARDI FEDERICO

CONTENTS
Advanced knowledge of processes and mechanisms of natural and engineered slope instability; ability to recognize and characterize different types of slope instabilities; ability to use stability analysis methods and tools to solve practical problems. Theory and techniques for the recognition, characterisation and modelling of slope instability processes in soils and rocks.

PREREQUISITES
Geology, hydrogeology, engineering geology

WEBSITE  https://elearning.unimib.it/course/info.php?id=30885

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Geological Sciences and Technologies
CONTACT: federico.agliardi@unimib.it
SOCIAL MEDIA ANALYTICS
LECTURER: FERSINI ELISABETTA, VIVIANI MARCO, TOCCU MAURIZIO

CONTENTS

At the end of the course, the student will have learned the main concepts underlying the management of data originating in social media (access, pre-processing, modeling) and their subsequent analysis. The student will be able, in particular, to collect, process and analyze data from the main social media, using the most suitable technologies for the purpose. S/he will also be able to provide a representation of complex social structures in order to extract useful information.

The Social Web: introduction and related terminology;
* Retrieving data in social media.
* Representing complex social data structures (graph theory and networks);
* Description of some open issues (information diffusion and credibility);
* Social Network Analysis;
* Subjectivity and sentiment analysis, irony detection;
* Named Entity Recognition and Linking;
* Visualization of social media data: open issues and techniques.

PREREQUISITES

Basic knowledge of the principles of linear algebra, statistics, programming, relational databases, and NoSQL.

WEBSITE  https://elearning.unimib.it/course/info.php?id=37906

YEAR: 2
SEM: 1
ECTS: 6
DEGREE in  Data Science
CONTACT: elisabetta.fersini@unimib.it
marco.viviani@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
Physical Chemistry in 1st cycle bachelor’s degree programs and Physical chemistry of solid state

WEBSITE  https://elearning.unimib.it/course/info.php?id=38014

YEAR: 2
SEM: 2
ECTS: 6
DEGREE in Chemical Sciences and Technologies
CONTACT: simona.binetti@unimib.it
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=37945

M
YEAR:  1
SEM:  1+2
ECTS:  8
DEGREE in  Materials Science
CONTACT:  roberto.bergamaschini@unimib.it
           leo.miglio@unimib.it
SOLIDO STATE AND ELECTRONICS LABORATORY II
LECTURER: BASCHIROTTO A., DE MATTEIS M., PEZZOLI F., SANGUINETTI S.

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=32105

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Physics
CONTACT: andrea.baschirotto@unimib.it
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.
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=37927

YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Materials Science
CONTACT: roberto.bergamaschini@unimib.it
francesco.montalenti@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=35300

YEAR:  1
SEM:  1
ECTS:  8
DEGREE in  Astrophysics And Space Physics
CONTACT:  monica.colpi@unimib.it
STREAMING DATA MANAGEMENT AND TIME SERIES ANALYSIS
LECTURER: CANDELIERI ANTONIO, PELLEGATTI MATTEO

CONTENTS
The course illustrates methods and applications for managing, analysing and forecasting - possibly streaming - time series.
Beside data managing applications, our lessons cover both linear (ARIMA, VAR, state-space/Kalman filter) and nonlinear (neural networks, support vector machine) methods.
The student who successfully follows this course will be able to manage streaming data and select, identify and implement the time series model fit to the data and the problem under analysis.
Streaming data management, linear-filter based models (ARIMA, VAR), unobserved component models (state-space form/Kalman filter), non-linear methods (neural networks, support vector machines, nearest neighbors).

PREREQUISITES
Attending students should know statistical inference and R.

WEBSITE  https://elearning.unimib.it/course/info.php?id=37907

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<td>6</td>
<td>Data Science</td>
<td><a href="mailto:antonio.candelieri@unimib.it">antonio.candelieri@unimib.it</a></td>
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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.
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.
TECHNOLOGICAL INFRASTRUCTURES FOR DATA SCIENCE
LECTURER: CIAVOTTA MICHELE, MELAN RICCARDO

CONTENTS
The course aims at providing a solid understanding of the technological platforms (sensors and networks) which allow the collection of data in an IoT environment, as well as of the computing platforms (architectures, algorithms and infrastructures) which can be used to analyse those data. The exercises will provide the student with the basic capabilities necessary to interact with such platforms. Sources of sensor data, quality of sensor data, data collection networks, sensor management platforms. Data processing architectures, Infrastructure Management, Big Data Platforms for data Science, platform examples.

PREREQUISITES
None

WEBSITE  https://elearning.unimib.it/course/info.php?id=31238

YEAR: 2
SEM: 1
ECTS: 6
DEGREE in Data Science
CONTACT: michele.ciavotta@unimib.it
TEXT MINING AND SEARCH
LECTURER: LULLI GUGLIELMO, VIVIANI MARCO, UPADHYAY RISHABH GYANENDRA

CONTENTS
The aim of the course is to provide an introduction to the fundamental concepts related to Text Representation and Text Mining techniques; moreover, in the course some Text Mining applications will be presented: Text Classification and Clustering, Topic Modelling, and Text Summarization. An introduction to Search Engines and Recommender Systems will be provided.

This course will first provide the definition of Text Mining and will point out the basic differences between Data Mining and Text Mining.

The course will then introduce some tasks involved by Text Mining, which include 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 will be introduced and practiced.

PREREQUISITES
Basic knowledge of statistics and of programming languages.

WEBSITE  https://elearning.unimib.it/course/info.php?id=37923

YEAR:  2
SEM:  1
ECTS:  6
DEGREE in  Data Science
CONTACT: guglielmo.lulli@unimib.it
marco.viviani@unimib.it
CONTENTS

PREREQUISITES

WEBSITE

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Artificial Intelligence
CONTACT: lourenco.beirao@unimib.it
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=39127

YEAR: 1
SEM: 2
ECTS: 6
DEGREE in Physics
CONTACT: emanuele.re@unimib.it
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=39129

YEAR: 1
SEM: 1
ECTS: 6
DEGREE in Physics
CONTACT: marco.bernasconi@unimib.it
THEORY OF QUANTUM INFORMATION AND QUANTUM COMPUTING

LECTURER: RE EMANUELE

CONTENTS
Computing and Quantum Technologies: entanglements, Bell's inequalities, qubits and their physical realization, examples of quantum circuits and elementary algorithms.

* Basic elements of quantum mechanics
* Entanglement and Bell's inequalities
* Quantum information
* Qubits
* Quantum circuits
* Simple example of quantum algorithms
* Examples of quantum correcting codes
* Physical realization of qubits

PREREQUISITES
Knowledge of Quantum Mechanics at the level of the Bachelor degree (the basic notions necessary for this course will be reviewed).

WEBSITE  https://elearning.unimib.it/course/info.php?id=39146

M YEAR: 1
SEM: 1
ECTS: 6
DEGREE in Physics
CONTACT: emanuele.re@unimib.it
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=38023
https://elearning.unimib.it/course/info.php?id=37941

YEAR: 1/2
SEM: 1
ECTS: 6
DEGREE in Materials Science
Chemical Sciences and Technologies
CONTACT: piercarlo.mustarelli@unimib.it
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, mode-
ling, 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.
FOR FURTHER INFORMATION, PLEASE CONSULT OUR WEBSITE:  WWW.UNIMIB.IT

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

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