# Università degli Studi di Milano Bicocca
# Master's Degree
# in MATERIALS SCIENCE
## Min. Decree nr. 270 of 22/10/2004
## Course regulations – academic year 2017/2018

### ART. 1 Introduction

| | |
|---|---|
| Original course name | MATERIALS SCIENCE |
| Course name in English | MATERIALS SCIENCE |
| Program | LM-53 Master's Degree Program in Materials Science and Engineering |
| Primary faculty | |
| Associated faculties | |
| Primary department | DEPARTMENT OF MATERIALS SCIENCE |
| Associated departments | |
| Normal course duration | 2 years |
| Credits | 120 |
| Degree awarded | Master's Degree in MATERIALS SCIENCE |
| Joint degree | No |
| Partner universities | |
| Double degree | |
| Teaching formats | Conventional |
| The course is | new |
| Program start date | |
| Date of approval by Ministerial Decree | |
| Date of approval by Regional Decree | |
| Date of approval by Faculty Board | |
| Date of approval by Academic Board | 21/02/2017 |
| Date of Quality Evaluation Report | 23/01/2008 |
| Date of Reg. Coordination Committee Report | |

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|---|---|
| Date of consultations with local representatives of manufacturing, tertiary, professional services sectors | 22/01/2008 |
| Maximum number of transfer credits allowed | 12 |
| Courses in same class | |
| Affinity Group number | 1 |
| Location of administrative offices | MILAN (MI) |
| Campus locations | MILAN (MI) |
| Website | http://www.mater.unimib.it/it/didattica/scienza-dei-materiali |
| Further information | |

## ART. 2 Presentation

The Master's Degree in Materials Science is a degree program conducted by the Department of Materials Science and Engineering (LM-53). It normally takes two years to complete and includes a course of study with 12 examinations and 120 credit points. The course culminates in awarding a Master's Degree in Materials Science. Graduates of the Master's Degree program in Materials Science will be prepared to pursue a higher level degree, such as a doctorate, or a Level 2 Master's degree. The course of study, brought to completion through a thesis conducted in research laboratories, prepares a professional with a solid understanding of chemistry and physics, whose knowledge and skills afford the graduate the ability to design molecular atomic structures into organized solid structures that meet specific requirements and deliver specifically requested functionalities. This field of specialization offers numerous employment opportunities in Italy since there are multiple industries dedicated to developing both established materials as well as innovative new materials.
The academic year 2017/2018 will be the first year for this degree program.

## ART. 3 Specific aims and structure of the course

The Master's Degree program in Materials Science, conducted in English, follows the European framework for Master's degree courses in Materials Science.
The course provides the student with an understanding of the subject areas that expands and reinforces the knowledge acquired at the Bachelor's degree level and allows students to gain operational and essential transferrable skills to make full use of the information applying it in pratical settings. Specifically, students will expand their comprehension of the chemical and physical properties of materials as well as elements connected to the engineering aspects. Furthermore, students are given the opportunity to learn the methods for analyzing, designing and creating materials and processes. To achieve these aims, the course includes a wide variety of learning activities, including classroom lectures; seminars by experts in research and industry to expand the breadth of knowledge of specific issues; workshops and internship opportunities using the research skills and tools available at the university as well as the skills and research tools of industrial partners through the network of partnerships between manufacturers and research sections of the Department of Materials Science.

Specifically, the course aims to develop students' knowledge and skills according to a chronological and subject-based plan of learning activities which can be categorized into four main subunits.

1. FOUNDATIONS: the course work expands the comprehension and knowledge of the basic subject areas offered mainly in the first year regarding physical chemistry, experimental and solid state physics, materials science and technology, and mathematical tools.
2. MATERIALS: the course work in the first year focusses on the study of the classes of materials, including organic and polymer materials, dielectrics, semiconductors and nanomaterials.
3. APPLICATIONS: the course work is of an applied nature in the first and second year, concerning the aspects related to surface properties and interface, applications of polymers and composites, the computational simulation of materials properties, electronic devices, materials for energy, and sustainability of the production processes in the field of organic-based materials and in the field of metals.
4. SKILLS: the course work envisages an internship opportunity and thesis and preparation of the final exam for most of the second year, which includes laboratory work in both the first and second year. These courses aim to provide students with significant skills in the area of how materials science applies to the world of research and technology, including skills in methodologies, reprocessing, and relationships as well as an understanding of the main aspects related to innovation and manufacturing.

Through this varied array of course work, students are guided toward designing, engineering, conducting experiments, gathering data, critically analyzing the results of experiments and measurements, and finally, writing an original thesis to submit for public discussion. Students must gain not only a solid comprehension of the material but an understanding of the tools for independent continuous learning and skills such as an ability to concurrently balance their studies and their jobs, the ability to work in a group, and effectively communicate - to diverse audiences – their scientific and technological knowledge, including in English. The interdisciplinary nature of the course of study gives students the ability to communicate and interact with a variety of specialists in the field. The professional roles available to them in the employment market are in the areas of research, development and industrial innovation of materials, directly and in managing others, also as concerns areas of communication, finance and industrial consulting.

Expected learning outcomes as described in the European Qualifications Framework for the degree.

Knowledge and understanding, and applying the knowledge and understanding: Summary

Knowledge and ability to understand
Students in the Master's Degree program in Materials Science will have:
i. gained a sound degree of comprehension of the physical and chemical properties of a broad spectrum of materials and reinforced the mathematical skills to model them;
ii. gained knowledge in the field of the major classes of materials, learning the terminology, techniques, and potential in both research and in the applied setting;
iii. gained an expanded comprehension of a specific class of materials, related to the work of the thesis, and learned the rules, methods and potential of the work of a research group;
iv. gained knowledge in how to approach new research topics and how to manage the data gathered.

These aims are pursued by attending instructor-led lectures; learning outcomes are measured with written and oral exams, frequently combined with mid-term exams throughout the course. The knowledge related to the methods used in basic and industrial research is gained in a student's relationships built with professors and independent experts and are measured through presentations and written reports as part of preparation for the final exam, as well as in applied lab sessions.

Ability to apply knowledge and skills
Students in the Master's Degree program in Materials Science will be able to:
i. select and handle the instruments designed to analyze chemical and physical properties of the major classes of materials;
ii. apply advanced techniques in formulating and resolving complex problems in the major classes of materials;
iii. independently approach new problems in a range of contexts, understand their nature and conceive of solutions;
iv. actively participate in the work group to develop new materials that will be applied in a variety of contexts.

Students learn the skills and abilities to apply the knowledge, methods and models to approach complex problems and propose plans of action to investigate the properties and conceive of solutions in the field of materials through the master's thesis and rigorous internship activities with a scientific and/or industrial research firm. Students will acquire these skills and be tested on their learning chiefly through the internship and thesis. The practical laboratories will be learning opportunities as well as afford students the opportunity to interact and discuss issues with professors, independent experts and corporate tutors. Students will present their experiments and compose internal reports on their studies and the experimental and/or computational work conducted.

Knowledge and understanding, and applying the knowledge and understanding: Details

Foundations
Knowledge and understanding
Through these activities, students in the Master's Degree program in Materials Science will:
i. gain a broad knowledge of advanced concepts in the field of physics and the physical chemistry typical of Materials Science, which expand on and develop the knowledge gained in their Bachelor's degree;

ii. reinforce their mathematical skills;
iii. know how to characterize and model the basic properties, even of advanced materials.

Applying knowledge and understanding
Through the course work, students in the Master's Degree program in Materials Science are able to select and implement the scientific tools best suited to characterizing the physical, chemical and physical chemical properties of these types of materials.

Students will gain these skills and be tested in the following courses:

THERMODYNAMICS AND KINETICS OF MATERIALS APPLIED PHYSICAL CHEMISTRY WITH LABORATORY
SOLID STATE PHYSICS
PHYSICAL CHARACTERIZATION OF MATERIALS WITH LABORATORY FUNCTIONAL ANALYSIS

Materials
Knowledge and understanding
Through the activities included in this teaching unit, students in the Master's Degree program in Materials Science will gain an extensive comprehension of the four major classes of advanced materials: organics and polymers, dielectrics, semiconductors and nanomaterials.

Applying knowledge and understanding
Through the activities included in this teaching unit, students in the Master's Degree program will be able to apply advanced techniques and contents in formulating and resolving complex problems in the key classes of materials.

Students will gain these skills and be tested on their learning in the following courses:
CHEMISTRY OF MOLECULAR MATERIALS
MOLECULAR ELECTRONICS AND PHOTONICS
PHYSICS OF HOMOGENEOUS AND NANOSTRUCTURED DIELECTRICS CHEMISTRY OF INORGANIC MATERIALS PHYSICS OF SEMICONDUCTORS
PHYSICAL CHEMISTRY OF SOLID STATE AND SURFACES NANOTECHNOLOGY AND INNOVATION

Applications
Knowledge and understanding
Through the broad range of topics offered by these courses, students in the Master's Degree program in Materials Science will:
i. acquire a sound comprehension of the properties and characteristics of applied interest in a broad range of materials;
ii. learn the terminology and techniques employed in both research and practical applications.

Applying knowledge and understanding
As a result of the broad spectrum of activities offered by these courses, students in the Master's Degree program in Materials Science will be able to:
i. apply advanced techniques and content to conceive of and resolve complex problems in various classes of materials;
ii. approach new problems in multiple contexts, understand their nature and come up with possible solutions;
iii. develop and implement the scientific tools best suited to characterizing the physical, chemical and physical chemical properties typical of these types of materials.

Students will gain these skills and be tested on their learning in the following courses:

STATISTICAL THERMODYNAMICS OF MATERIALS RADIATION MATTER INTERACTION SURFACES AND INTERFACES
CHEMISTRY AND TECHNOLOGY OF POLYMERS AND INDUSTRIAL APPLICATIONS PHYSICS AND TECHNOLOGY OF ELECTRONIC DEVICES WITH LABORATORY SYNTHESIS AND SPECIAL ORGANIC TECHNIQUES IN MATERIALS CHEMISTRY MATERIALS AND DEVICES FOR ENERGY ENGINEERING METALS SCIENCE AND SUSTAINABILITY
LOW ENVIRONMENTAL IMPACT MATERIALS AND PROCESSES

Skills
Knowledge and understanding
Through the internship, preparation for the final exam and other laboratory activities, students in the Master's Degree program in Materials Science will:
i. deepen their knowledge of a specific type of material (the type chosen for their thesis);
ii. participate in the work of a research group and experiment with its rules, constraints and potential;
iii. participate in acquiring new knowledge (theoretical and/or instrumental) in an applied context, one of scientific research or industrial development;
iv. acquire independence in approaching research topics, including subject areas not previously encountered during the class;
v. learn to manage their study and data collected to write their thesis, and hone their skills in applying knowledge and understanding

Through the practical activities involved in the course, students in the Master's Degree program in Materials Science will gain the ability to participate fully in developing new materials for application in various fields with high value added.

The knowledge and skills
Students will acquire these skills and be tested on their learning in the following courses:
INTERNSHIP
LABORATORY OF SCIENTIFIC LANGUAGE
MASTER THESIS

Making judgements
Students in the Master's Degree program in Materials Science will be able to:
- identify the scientific and applied context to develop changes, applications or innovations of existing materials, to control quality and plan actions to improve their inherent properties;
- critically use the data found in scientific literature to evaluate which characteristics and qualities are the best suited to innovating and improving the diverse classes of materials;
- take a generally critical approach to selecting the method best suited to solving specific problems, choose and produce proposals and reference frameworks appropriate to correctly face complex problems and look for functional, sustainable solutions;
- independently take on roles of responsibility in research and development settings, namely, in the field of high level scientific teaching and communication.

Students in the Master's Degree program in Materials Science gain the skills to make independent judgements and take a critical approach and select the method best suited to solving specific problems. The skill is gained through course work characterized by complex and multidisciplinary theoretical and methodological approaches, in mandatory laboratory training, the internship, and in writing a highly developed thesis, as part of research groups and in conjunction with other research institutions or industries. All these learned skills are tested in a final exam, which may be either written (reports, problem solving, and tests) or oral. The course may also include mid-term examinations or interactive tests to assess the student's progress and formulate a personal assessment of their ability to build upon and apply what they have learned.

Communication Skills
Students in the Master's Degree program in Materials Science will be able to:
- communicate concepts and issues related to materials, their own and in the published literature, to diverse audiences, bothin writing and orally, in English;
- engage in discussions with experts in other related sectors, especially engineers, physicists, and chemists, recognizing the opportunities for complementary visions and interpretations.

Students are required to write and subsequently present concise reports on the aspects and properties of a wide array of materials upon conclusion of their laboratories and in the second year of the course, as a final exam on some of the core and/or related courses.
Students learn to express themselves directly with teachers from various backgrounds and converse with experts from other fields and in new languages.

Learning skills
Students in the Master's Degree program in Materials Science:
- develop an innovative perspective and viewpoint, ready to quickly learn new theoretical as well as experimental concepts and methods;
- acquire a flexible mentality and robust work methodology which allows them to quickly acquaint themselves with a range of work and cultural environments;
- are prepared to successfully continue their studies in a doctoral or Level 2 Master's program in Materials Science or a related subject area, with a significant degree of independence;

The ability to learn new concepts and methods is achieved as a result of participating in the life of the department, through the compulsory laboratory sessions, attendance at lectures, participation in seminars, involvement in a practical internship and preparation of their thesis. The second year will focus on preparing students for independence, flexibility and work in a group setting.
Learning outcomes will be assessed through exams, written papers and oral presentations, in addition to opportunities for discussion and exchange of ideas in research groups.

## ART. 4 Career opportunities

Students in the Master's Degree program have the preparation and training to play roles of responsibility in the field of innovation, advanced engineering, development, qualification and diagnostics of materials, in setting up a moderately broad scientific project, and managing complex systems.

### 4.1 Functions

Graduates of the program will have acquired methodological and scientific competences from this course of study and will be prepared to take on roles of responsibility in the field of innovation and material development, advanced engineering, qualification and diagnostics of materials, in setting up development projects and managing complex systems.

## 4.2 Competences

The profile of the Master's Degree program in Materials Science is the multidisciplinary nature of the competences and methodological approach. This aspect is essential in high-level production environments, in which it is vital to tackle the aspects related to production and elements regarding the functional design of the materials.
Based on the knowledge acquired on the theoretical and scientific aspects of materials science and engineering, master's degree graduates will be prepared to identify, develop responses to and resolve complex problems with innovative thinking.
Graduates will have the competences necessary to design the properties of the materials, starting with the atomic and molecular structures that comprise them.
Students are prepared to conceive, plan, design and manage complex and innovative systems, processes and services, and design and conduct highly complex experiments.
Graduates have knowledge of specific contexts and gain transferrable skills.

## 4.3 Employment opportunities

Graduates of the Master's Degree program in Materials Science will find work in manufacturing, processing and development of semiconductors, metals, polymers, ceramics, glass and composite materials for application in the fields of chemistry, mechanical and electrical fields, electronics, telecom, energy, construction, transportation, biomedical, environmental and cultural heritage; in addition, in laboratories in private industry and public and private research institutions.

**The course prepares students to enter the following professions**

| Class | | Category | | Professional units | |
|---|---|---|---|---|---|
| 2.1.1 | Specialists in mathematics IT, chemistry, physics and natural sciences | 2.1.1.1 | Physicists and astronomers | 2.1.1.1.1 | Physicists |
| 2.1.1 | Specialists in mathematics IT, chemistry, physics and natural sciences | 2.1.1.2 | Chemists and similar professions | 2.1.1.2.1 | Chemists and similar professions |

## ART. 5 Rules for admission

Admission to the Master's Course is subject to holding:

- a three-year university degree in one of the below listed programs (as per Min. Decree 270/04 or Min. Decree 509/99) or equivalent, recognized degree earned abroad:

L-2 Biotechnology or Class 1 Biotechnology,
L-7 Civil or Environmental Engineering or Class 8 Civil or Environmental Engineering;
L-8 Information engineering or Class 9 Information engineering,
L-9 Industrial engineering or Class 10 Industrial engineering,
L-13 Biology or Class 12 Biology,
L-23 Construction science and technology or Class 4 Architecture and Construction Engineering and Construction Technology or Class 4 Architecture and Construction Engineering,
L-25 Agriculture and forestry or Class 20 Agricultural Science and Technology, Agronomy and Forestry,
L-26 Agronomy Science and Technology or Class 20 Agricultural Science and Technology, Agronomy and Forestry,
L-27 Chemistry Science and Technology or Class 21 Chemistry Science and Technology,
L-28 Navigation and Maritime Science or Class 22 Navigation and Aerial and Maritime Science,
L-29 Pharmaceutical Science and Technology or Class 24 Pharmaceutical Science and Technology,
L-30 Physics and Technology or Class 25 Physics or Technology,
L-31 Information Technology and Science or Class 26 Information Technology and Science, L-32 Environmental Science and Technology or Class 27 Environmental Science and Technology,
L-34 Geological Science or Class 16 Earth Science,
L-35 Mathematics or Class 32 Mathematics,
L-38 Zootechnical Sciences and Animal Husbandry or Class 40 Zootechnical Sciences and Animal Husbandry,
L-41 Statistics or Class 37 Statistical Science,
L-43 Diagnostics for Cultural Heritage Conservation or Class 41 Technologies for Conservation And Restoration of Cultural Heritage.

- Certification of English language proficiency, issued by the university or by an institution accredited by the university, corresponding to level B2 proficiency.

Admission to the Master's degree program is subject to review of the student's qualifications by an admissions panel and an interview. Specifically, the student must have:

- sound basic knowledge of the chemistry and physics of materials and ability to apply them in real-life contexts;
- knowledge, including practical, of the most used modern laboratory instruments and techniques for acquisition, processing and quantitative and qualitative analysis of the experimental data;
- adequate knowledge and understanding of mathematics as a general tool for system modelling and analysis.

## ART. 6 Admission process

The Master's Degree Program in Materials Science has no maximum admission number. Students are admitted based on the results of an interview. Interview dates and details are published on the Master's Degree Program website www.mater.unimib.it/cdl. For the academic year 2017/2018, up to two non-EU citizen students will be admitted to the program, provided they can show evidence of their basic knowledge and personal preparedness.

## ART. 7 Organization of the course

### 7.1 – Description of the training process

The Master's Degree program envisages classroom lectures and mandatory attendance in laboratory activities for a total of 54 CFU credits (*Crediti Formativi Universitari*) in core courses and 18 CFU of related courses. Furthermore, the program includes 12 CFU in elective courses of the student's choosing, 3 CFU for internships, 3 CFU for "language learning". The program concludes with a final exam of 30 CFU. All classes are conducted in English.

FIRST YEAR

REQUIRED COURSES

- Solid State Physics (core), FIS/03, 8 Credits
- Physical Characterization of Materials with Laboratory (core), FIS/01, 8 Credits
- Thermodynamics and Kinetics of Materials (core), CHIM/02, 6 Credits
- Applied Physical Chemistry with Laboratory (core), CHIM/02, 8 Credits
- Functional Analysis (core), MAT/05, 6 Credits

REQUIRED ELECTIVES (core)
Students must select 6 credit points from the following class offerings:

• Physics of Semiconductors, FIS/03, 6 Credits
• Physics of Homogeneous and Nanostructured Dielectrics, FIS/01, 6 Credits
• Molecular Electronics and Photonics, FIS/03, 6 Credits

Students must select 6 credit points from the following class offerings:

• Physical Chemistry of Solid State and Surfaces, CHIM/02, 6 Credits
• Chemistry of Inorganic Materials, CHIM/03, 6 Credits
• Chemistry of Molecular Materials, CHIM/06, 6 Credits

Students must select 6 credit points from the following class offerings:

• Chemistry and Technology of Polymers and Industrial Applications, CHIM/04, 6 Credits (first year)
• Low Environmental Impact Materials and Processes, CHIM/06, 6 Credits (first year)
• Physics and Technology of Electronic Devices with Laboratory, FIS/03, 6 Credits (second year)

REQUIRED ELECTIVES (related)
Students must select 6 credit points from the following class offerings:

• Metals Science and Sustainability, FIS/03, 6 Credits
• Radiation Matter Interaction, FIS/07, 6 Credits
• Surfaces and Interfaces, FIS/03, 6 Credits

SECOND YEAR

REQUIRED COURSES
- Nanotechnology and Innovation (core), ING-IND/22, 6 Credits

REQUIRED ELECTIVES (related)
Students must select 6 credit points from the following class offerings:

• Synthesis and Special Organic Techniques in Materials Chemistry, CHIM/06, 6 Credits
• Materials and Devices for Energy Engineering, ING-INF/01, 6 Credits
• Statistical Thermodynamics of Materials, FIS/03, 6 Credits

The training process is completed by the following required activities:

- Student-selected electives, 12 Credits
- Internship, 3 Credits
- Additional language or Laboratory of scientific language, 3 Credits (see section 7.5)
- Master's Thesis, 30 Credits

### 7.2 – Core requirements

These activities provide the students in the Master's Degree program in Materials Science with the specific theoretical and experimental skills regarding the properties of materials and experimental abilities to prepare and understand materials and skills to use them in an applied environment.

### 7.3 – Related or additional activities

Related or additional courses offer the student a broad range of subject areas offering advanced interdisciplinary training typical of Materials Science, an area of study with extraordinary facets (from modelling to the characterization and synthesis of every type of material, whether inorganic-organic-composite, nano, micro and macro), in the midst of rapid development and with not easily predicted contours. Related or additionaly courses give students a state-of-the-art and appropriately in-depth background in Materials Science and the possibility to choose a personal training path that can provide them with a solid foundation, coherent training objectives and appropriate information on new materials.

### 7.4 –Student selected courses (art.10, section 5, letter a)

Students have 12 credit points from which they can choose any courses offered by the university in the Master's Degree programs, including the classes established by the Teaching Coordination Committee. Elective courses are an integral part of the study plan and are subject to approval by the Teaching Coordination Committee which ascertains that the electives selected fit in the training plan. According to regulations currently in force, in order to compute the total number of credits, elective courses chosen by the student are only worth one course credit.

### 7.5 – Other language proficiencies

Students may acquire 3 credit points for "other language proficiencies" as described in the method detailed below.

Italian students:
- Successfully passing a university administered test of proficiency in a language other than English at the B2 level, either French, Spanish or German;
or
- successfully passing a university administered test of proficiency in English, at the C1 level,
or
- attendance at, and successfully passing a test of, a laboratory of scientific English for materials science; the assessment will be either “pass/fail”.

If students hold certification issued by the University or institutions accredited by the university attesting to their language skills at or above the B2 level for French, Spanish or German, or attesting to language proficiency at or above the C1 level for English, will be exempted from the test and will have their credits honored.

International students:
- successfully passing a university administered test of proficiency in Italian at the A2 level. Students already holding certification issued by the University or institutions accredited by the university attesting to their language skills at or above the A2 level for Italian will be exempted from the test and their earned credits will be recognized.

Information related to conducting the language proficiency tests are defined on a university-wide basis and are available on the university website, http://www.unimib.it/go/262336.

### 7.6 – Internship

The course of study envisages a compulsory internship (3 credit points). The purpose of the internship is to provide the student with an opportunity to acquire applied and technical skills learned through their studies. These skills are acquired in experimental and computational activities, as well as in depth bibliographic research, so as to develop an investigation into materials science and acquire skills related to analysis and presentation of the results in the written form and in presentation and critical discussion. The internship may internal or external.

Internal internship
This consists in experimental and computational activities in materials science, performed by the student with a university department research group under the guidance of a university mentor and a tutor responsible for the activities in the research group. The internship normally leads to preparation for the final examination under the guidance of an advisor.

External internship
This consists in experimental and computational activities in materials science, performed by the student for a research body or a business that partners with the university to be the location of external internships, under the guidance of a university mentor and a company tutor.

Successful accomplishment of the internship, whether internal or external, is assessed through periodic feedback given by the student with periodic reports (written and oral) to the tutors.
At the end of the internship, the advisor certifies the conclusions and correct performance of the internship. The internship normally leads to preparation for the final exam under the guidance of an advisor.

### 7.7 – Teaching formats

The teaching formats implemented by the Master's Degree include a combination of classroom lectures, practical exercises on applications of theoretical content, hands-on lessons to introduce and train for the experimental disciplines and laboratory activities, seminars on advanced research topics, and the thesis. The teaching formats related to exercises and practical laboratory lessons (identified as Exercises and Laboratory, conducted in any event by the course professor, as lectures, classroom learning or laboratories equipped for chemistry or physics experiments) are specific to course work in scientific fields of study. These teaching formats are the most prevalent and important part of the training, in which the student is guided, with the direct help of the professor, toward not only knowledge but also skills in learning operations and design, based on the information learned and according to tools and methods specific to the scientific fields. Students are tested on the learning outcomes in final exams and are awarded university credits, also denominated CFU. The credits represent a measure of the learning outcomes, including the courses described above, the effort made by the student in his or her work, and by other individual activities. One CFU corresponds to a total of 25 hours of total study, classroom and individual, and can be broken down as classroom lectures (7-8 hours/CFU), practical exercises (8-12 hours/CFU), laboratory (8-12 hours/CFU), and the thesis.

### 7.8 – Assessment of learning outcomes

All the above activities include a final exam. The formats of final exams are approved by the Teaching Coordination Committee and professors will inform students of the format at the start of every course and formats will also be included in the student's annual curriculum guide. Lecture courses generally include an oral examination, which may be preceded by a written exam. Labs generally conclude with an oral exam in which the student will discuss a written report on the laboratory experiences.Please refer to the designated section for information on the thesis.

### 7.9 – Attendance

Attendance in laboratory courses is compulsory and strongly recommended for all other learning activities (lectures, exercises and seminars). Compulsory attendance equates to participation in at least 75% of the activities in each of the teaching formats.

### 7.10 – Curriculum

The curriculum is the set of class requirements, whether core or elective courses, and training activities conducted independently by the student in accordance with the regulations of the course of study. Students are automatically assigned a statutory curriculum when they enroll in the first year. Students must subsequently submit their own personal study plan, which includes their chosen core and elective courses. Study plans must be approved by the Teaching Coordination Committee.
The methods and deadline for submitting the personal study plan are decided by the university. Students may sit exams related to course work only if such course work was included in their most recently approved study plan. Additional information can be found in the University's Regulations for Students

### 7.11 – Prerequisites

There are no prerequisites to the Master's Degree in Materials Science.

### 7.12 – Guidance and tutoring

Guidance in choosing the final exam.
Students complete the Master's Degree in Materials Science by discussing before a Commission the result of their independent studies - the Master's Thesis (see Art. 8) – contained in a written report submitted within the deadline to the program's administrative office which forwards it to the Committee.
To guide students toward a decision appropriate to their expectations and individual characteristics, the Teaching Coordination Committee provides information on suitable research topics and on laboratories or research groups with whom the student might work, through the website and presentations organized for this purpose.

### 7.13 – Course and exam schedule

The academic year comprises two semesters. Most of the teaching is done in a single semester so that students have time at the end of the semester to prepare for the exams for the courses just ended. Courses held on an annual basis are exceptions to this rule.
Students earn credit for each of the courses included in the training plan by passing the related written and/or oral final exams, as described above. Exams will be scheduled at specific times of year (exam notices) as established by the Teaching Coordination Committee. Exams will be scheduled when the courses are discontinued, which is generally in February, June, July, August and September.
Courses will also be put on hold at the halfway point of the first semester (approximately in late November) and in the second semester (approximately early May) to allow students to make up exams for previous courses. Final exams may also be scheduled at other times of year if necessary to meet professors' schedules. Exam schedules are published on the University website.

### 7.14 – Agreements for international mobility of students

The Erasmus program gives students the opportunity to experience study abroad for periods between three months and one year; exams sat abroad may be allowed if they are included in the study plan for the purpose of career development of the student.

The European universities that have active Erasmus agreements for student exchange for the Master's Degree in Materials Science include:
-École normale supérieure (CLMA) (Cachan FRANCE)
-Université Claude Bernard (Lyon 1) (Lyon FRANCE)
-Université d'Aix-Marseille (Marseilles FRANCE)
-Technische Universität Darmstadt (Darmstadt GERMANY)
-Technische Universität (Munich GERMANY)
-Universidad del Pais Vasco (Bilbao SPAIN)

In addition, the EXTRA program of the university allows students in the Master's Degree courses

to take advantage of a study and research experience abroad to prepare them for their graduate thesis.

A panel, made up of professors from the Master's Degree course, works with the University's International Exchange office to forge agreements for students' international mobility.
In this framework, the panel ensures that existing agreements with the partner organizations are renewed and also promotes agreements with new partner universities to suggest to students. The Panel also ensures that interested students will have the necessary guidance to identify the campus that best meets their needs, to prepare the Learning Agreement related to the training period abroad and, finally, to earn credit for study activities conducted abroad. Credits to approve must be included in the Learning Agreement in the timetable set by the plan.
Plans are currently underway for a double degree agreement with the University of Leuven (Belgium) and Grenoble (France).
Further information on the Erasmus Program and on the EXTRA program are available on the following pages http://www.unimib.it/go/47689/Home/Italiano/Studenti/Per-gliiscritti/ Erasmus/Erasmus-studenti/Bandi/destinazioni-materiali

## ART. 8 Final examination

The final examination consists in the student preparing a thesis of original scientific content, written in English, resulting from the research work conducted by the student, under the guidance of a mentor, with a scientific or industrial research group in the field of Materials Science.

## ART. 9 Format of the final examination

The final examination will relate to the work of the Master's Degree and represents an important step in acquiring practical and transferrable skills in the field of research and development of new materials. The activity is internal if conducted with a departmental research group or external if conducted by a company or abroad with a foreign university or research group.
Students should review the department section of the website at www.mater.unimib.it for rules related to the admissions process for internship and final examination process and to the rules for assigning a point score for the final examination. See also the department website at www.mater.unimib.it/cdl for a course calendar.

## ART. 10 Recognition of credits (CFU) and the transfer process

Students from another Master's Degree course at this or any other university may request to register at this Master's Degree course and have the credits earned in previous examinations recognized, provided a) the examinations sat in the prior course have been approved by the Admissions Committee for equivalency with the objectives and regulations of this Master's Degree; b) passing an interview with the Admissions Committee to ascertain the level of preparedness (review the above section: Rules for Admission); and c) subsequent recognition by the Teaching Coordination Committee. Based on Min. Decree 270/2004 and Law 240/2010, universities may award credits for individually certified professional skills and abilities pursuant to the relevant current regulations, and for other skills and abilities acquired during post-secondary learning activities that the university contributed to designing and delivering. However, it should be noted that no more than 12 credits can be assigned on the basis of Bachelor's and Master's courses.

## ART. 11 Research to support core degree courses

The teaching specific to Materials Science, through which students gradually integrate different interdisciplinary approaches (chemistry and physics, macroscopic and microscopic, classic and quantitative, experimental, theoretical and simulated) into the study of the materials are provided by a teaching body belonging to the Department of Materials Science. These professors, while from different backgrounds such as chemistry, physics, and materials sciences, have experience on the teaching and scientific sides of the spectrum.
The research activity of the Department aims at the study of materials in a variety of settings and applications, which can be concisely related to the following classes of materials: organic materials and polymers, microelectronic and photonic materials, environment and energy, and cultural heritage. For more detail on the active research topics and on the recent results obtained, see the annual report of the Department on the website http:// www.mater.unimib.it/
In view of the interdisciplinary nature of the research conducted within the Department of Materials Science and the exceptional skills of the Department faculty in their diverse fields, a doctorate level course is also available, with intensive seminar format, which is open to students in the Master's Degree program who wish to increase their knowledge of the subject matter. A number of young Italian and international researchers, some post-docs and some visiting staff, work in the Department where they conduct research in key areas related to the above subject matter.
Part of the teaching activity is performed by using skills and equipment of highly specialized laboratories in the Department of Materials Science, where research is conducted in the following areas:

- applying thin film for molecular bands
- optical and electrical properties of semiconductors;
- synthesis of molecular and macromolecular materials;
- defraction of X rays and nuclear and electronic spin resonance;
- characterization of insulation, glass and materials for energy accumulation;
- calculation and modelling;
- photo physics of molecular materials
- dating and characterization of materials of interest for cultural heritage.

## ART. 12 Faculty

Faculty members are:
L. Beverina, PA, CHIM/06
S. Binetti, PA, CHIM/02
A. Comotti, PA, CHIM/04
M. Fanciulli, PO, FIS/03
C. Mari, PO, CHIM/02
M. Martini, PO, FIS/07
L. Miglio, PO, FIS/03
F. Meinardi, PA, FIS/03
F. Montalenti, PA, FIS/03
M. Moret, PA, CHIM/03
B. Di Blasio, PA, MAT/05
A. Paleari, PO, FIS/01
A. Papagni, PO, CHIM/06
A. Vedda, PO, FIS/01

## ART. 13 Additional information

The Master's Degree course is held at the Department Materials Science:
Via R. Cozzi 55 – Building U5
Milan, 20125

Students can obtain more information at:

Administrative staff of the course:
Via R. Cozzi 55– Building U5, first floor
Ph: 02.6448.5102
Fax: 02.6448.5400
e-mail: segreteria.didattica@mater.unimib.it
Additional information for students is available at:
website: http://www.mater.unimib.it/ or www.unimib.it
These Regulations are subject to minor amendments. Specifically, elective courses may only be offered only if the minimum number of student enrolments is reached.
The tables below describe the learning activities based on their type, field and scientific sector, and breakdown by course year.