

UNIVERSITY OF CRETE



STUDY GUIDE

MSc in Materials Science and Engineering /
Επιστήμη και Μηχανική των Υλικών



DEPARTMENT OF MATERIALS SCIENCE AND
TECHNOLOGY

2024

DEPARTMENT OF MATERIALS SCIENCE AND TECHNOLOGY

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Overview of the Department of Materials Science and Technology

The Department of Materials Science and Technology (MST) was founded 2001, and the first undergraduate students were enrolled in the academic year 2001-2002. The postgraduate (MSc) program was initiated shortly after, in the academic year 2003-2004. The Department is located in the Voutes campus. Its Secretariat can be found in the Mathematics Building, lecture rooms and undergraduate laboratories are spread in the buildings of the School of Science and Technology. The infrastructure of the adjacent Foundation for Research & Technology – Hellas (including the laboratories of microelectronics, polymers, semiconductors, superconductors, surfaces, biochemistry, biomaterials, medical applications, laser applications for materials processing) is also available to conduct senior thesis and post-graduate (MSc, PhD and Post-Doc level) research work in conjunction with the various group leaders.

The aspiration of the Department of Materials Science and Technology is emerge as a first-rate centre for teaching and research in this cutting-edge field, and prepare its students to meet the needs of industry and society.

The Department's research activities focus on the development of new materials through the understanding of the composition – structure – processing – properties interplay. The current program leads to the Master of Science (M.Sc.) degree.

Departmental Administration

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Subject of the MSc in Materials Science and Engineering Program

The Postgraduate Program focuses on Science, Technology and Mechanics of Materials. Its purpose is to create and fully prepare human resources in the critical for the country and rapidly developing interdisciplinary field of science, technology and materials engineering.

The purpose of the Postgraduate Program is to promote the Science of Technology and Engineering of Materials through research and development of innovative materials and the education of young researchers and scientists with excellent career prospects.

Learning Outcomes – Qualifications

The qualifications acquired by successfully attending the MSc include knowledge, abilities and skills in Materials Science and Engineering with deepening in the areas of optoelectronics, magnetic materials, nanoscience and nanotechnology, polymers, colloids, theoretical and computational materials science, synthetic materials chemistry, biomaterials and biomolecules and materials engineering. Its educational and research activities are designed with the aim of developing an integrated view of the material, combining structure and composition with the properties and performance of materials.

The above are known, understood, possessed and applied by students in private and public organizations, businesses, production units, research and educational institutions and education after the successful completion of the relevant specialization of the Postgraduate Program.

Duration of Studies, number of ECTS credits

The duration of studies for the award of the Postgraduate Diploma is set at a minimum of four (4) academic semesters, with the possibility of extension as specified in article 10 of the Internal Regulation of Operation of the Postgraduate Program. The total number of credits (ECTS) awarded is 120.

Organization of the Educational Process

The teaching of the courses of the Postgraduate Program will be carried out with physical presence with the possibility of using synchronous distance learning methods, which, however, may not exceed thirty percent (30%) of the credits of the Postgraduate Program.

The language of instruction of the courses and the preparation of the dissertation is English.

Sources of funding, tuition fees

The sources of funding of the MSc may be:

- a. Tuition fees
- b. Resources from research projects or programmes
- c. Donations, benefits, bequests and all kinds of sponsorships of public sector bodies, as defined in the indent. A' of para. 1 of article 14 of Law 4270/2014 (A' 143), or the private sector
- d. Own resources of the University of Crete
- e. The state budget or public investment programme

Tuition fees

Postgraduate students from countries of origin outside the EEA are obliged to pay tuition fees of 2,000 euros for the entire studies of the Program.

Tuition fees are paid in equal installments of €1,000 at the beginning of each academic year, in October and February.

Students must have paid all their financial obligations before the issuance of a certificate of completion of studies and the award of the Postgraduate Diploma.

Graduate Categories, Selection Criteria

Graduates of Universities or of the former technological sector of Higher Education, or equivalent recognized foreign institutions of a related subject are admitted to the Program, following a judgement of their qualifications.

The necessary selection criteria for the students admitted to the Postgraduate Program are the following:

- α) the grade of the degree,
- β) Performance at the personal interview
- (c) adequate knowledge of English at least B2 level based on the Common European Framework of Reference.

In addition, the following are taken into account:

- and grades in undergraduate courses related to the subject of the Postgraduate Program, and the duration of the candidate's undergraduate studies in relation to the normal duration,
- (f) the dissertation, where provided for at the undergraduate level, which has been prepared in a related field with the subject of the Postgraduate Program.
- ζ) any research activity, and the evaluation of letters of recommendation

Candidates' applications are accompanied by the required supporting documents, according to the announcement which at least include: 1) the Application Form, 2) Copy of Degree or Degrees or certificate of completion of studies. In the case of a Degree from a foreign institution, the Certificate of Equivalence (if any) is also required. In case of non-possession of a certificate of equivalence by DOATAP, the verification of the recognition of the foreign institution and the foreign institution title granted is made by the University, in accordance with the provisions of article 304 of Law 4957/2022, 3) Certificate of transcript of course grades, 4) Certificate of knowledge of English language at least B2 level based on the Common European Framework of Reference. In case the candidate's title or degrees have been obtained by an educational institution abroad in an English-speaking curriculum, the presentation of language certificates is not required, 5) Curriculum vitae 6) Interest report 7) Letters of recommendation (up to three).

Candidates who are expected to have completed the requirements for obtaining a degree before the beginning of the new academic year may also apply.

The number of students admitted to the Postgraduate Program is set at a maximum of thirty (30) students and at least (5) students per year.

Selection Process – Evaluation of Candidates

Following a decision of the General Assembly, a call for expression of interest per academic semester for the selection of students in the Postgraduate Program is published, in any appropriate way, including posting on the website of the Department and the University of Crete. Before the beginning of the semester and for reasons of planning or attracting a sufficient number of candidates, the invitation may be repeated. The invitation shall indicate the criteria and the way they are evaluated, the deadlines for the submission of applications, the date of the interviews, the supporting documents required as described in Article 2 hereof, as well as the way of their submission as well as anything else defined by the Regulation of Postgraduate Studies of the University of Crete and the applicable legislation.

The interviews are conducted by the Coordinating Committee of the Postgraduate Program, on the date specified by the invitation. In the interview process, the C.E. may be assisted by other faculty members of the Department. After the completion of the interviews, the C.C. meets, chaired by the Director of the Postgraduate Program, selects the students admitted to the Postgraduate Program by evaluating the file of each candidate and the personal interview, and draw up the selection minutes. Successful candidates are listed alphabetically into two categories: a) those admitted and b) those admitted under certain conditions. The second category includes candidates who have not completed the requirements for obtaining a degree or have obtained a degree from a foreign institution but do not hold a certificate of equivalence or have not completed the verification of recognition of the foreign institution and the title awarded by the foreign institution on the date of the meeting. Under the responsibility of the Director of the Postgraduate Program, the minutes are forwarded to the Assembly of the Department for approval and ratification.

Under the responsibility of the Secretariat of the Department, the final results are announced, for the publication of which the rules of personal data protection are in any case, and the successful candidates are invited within a deadline to enroll in the Postgraduate Program.

The registration of postgraduate students in the Program takes place in two periods: a) before the beginning of the courses of the first winter semester of studies and b) before the beginning of the courses of the second spring semester of studies. Special care is taken to support foreign postgraduate students. For this purpose, the Postgraduate Program cooperates throughout their studies with the Support Unit for Foreign Students of the University of Crete and ensures their smooth integration into the academic environment. In addition, in cases where there is a significant delay in the administrative procedures required for the registration of foreign students, which are due to force majeure, the Postgraduate Program Committee may recommend to the General Assembly of the Department the exceptional registration in the next registration period or in the next academic year.

For successful candidates who belong to the category of people with disabilities or people with special educational needs, the Postgraduate Program collaborates with the Equal Access Unit for People with Disabilities and Special Educational Needs of the University of Crete

The Postgraduate Program aims to provide equal opportunities in education and training. The Postgraduate Program ensures equal opportunities in the admission and completion of postgraduate studies without discrimination based on gender, color, nationality, religion, or personal status, in accordance with Greek law.

Curriculum

The total number of ECTS required to obtain the BMI amounts to one hundred and twenty (120) and is broken down as follows:

- a) 60 ECTS (40+20) in total from successful course attendance as follows:
 - (i) 40 ECTS from the successful attendance of the compulsory General Specialization courses described below,
 - (ii) 20 ECTS from the successful attendance of Research Elective courses described below. Compared to the 20 ECTS courses of Elective Research direction, postgraduate students can receive 5 ECTS for each publication in a valid international scientific journal with reviewer or reviewers and 2 ECTS for poster presentation or oral speech at a scientific conference (up to 10 ECTS total for these categories, which must be approved by the S.E.),
- b) 30 ECTS in total from the successful attendance of:
 - i) Scientific Bibliographic Search Methods (10 ECTS),
 - ii) Research Laboratory 1 (10 ECTS),
 - iii) Research Laboratory 2 (10 ECTS)
- c) 30 ECTS in total from the preparation, writing, and successful public oral presentation of the Master's Thesis, and participation in research and teaching activities of the Department.

The curriculum per academic semester is as follows:

A' SEMESTER		SEMESTER B	
Courses	ECTS	Courses	ECTS
Compulsory General Courses	20	Compulsory General Courses	20
Electives	10	Electives	10
Total	30	Total	30

C' SEMESTER		SEMESTER D	
Courses	ECTS	Courses	ECTS
Scientific Methods Bibliographic Search	10	Postgraduate Thesis Writing	30
Research Laboratory 1	10		
Research Laboratory 2	10		
Total	30	Total	30

Modification of the curriculum and redistribution between semesters may be made by decision of the Assembly of the Department.

Below is a list of Compulsory General Courses as well as a list of Elective Courses of Research Direction.

CODE	Course Title (English-Greek)	ECTS
MEMY-501	Advanced Solid-State Materials and Nanostructures	10
POI-502	Theoretical Materials Science and Engineering	10
MEMY-503	Soft Matter Science and Engineering (Loose Matter and Engineering)	10
POI-504	Biomaterials and Biomedical Engineering (<i>Biomaterials and Biomedical Engineering</i>)	10

List of elective courses of research direction

CODE	Course Title (English-Greek)	ECTS
MEMY-428	Sustainable (Bio)polymers (<i>Sustainable Biopolymers</i>)	7
MEMY-446	Transmission Electron Microscopy	7
MEMY-447	Computational Materials Science (<i>Computational Materials Science</i>)	7
MEMY-450	Polymer Physics (<i>Polymer Physics</i>)	7
MEMY-452	Polymer Synthesis (<i>polymer synthesis</i>)	7
MEMY-453	Crystal Chemistry (<i>Crystal chemistry</i>)	7
MEMY-456	Rheology and Polymer Processing Processes (<i>Rheology and Polymer Processing Processes</i>)	7
MEMY-471	Elements of Colloidal Dispersions (<i>Colloidal dispersion data</i>)	7
MEMY-483	Elements of Magnetic Materials (<i>Magnetic Materials Data</i>)	7
MEMY-490	Photonic Materials and Devices (<i>Photonic Materials and Devices</i>)	7
MEMY-491	Organic Materials and Synthetic Biomaterials (<i>Biological Materials and Synthetic Biomaterials</i>)	7
MEMY-496	Tissue Engineering (<i>Tissue Engineering</i>)	7
MEMY-512	Computational Materials Science II (<i>Computational Materials Science II</i>)	7
MEMY-580	Optoelectronics and Lasers (<i>Optoelectronics and Laser</i>)	7
MEMY-582	Advanced Organic Materials for Energy and Environment (<i>Advanced organic materials for energy and environment</i>)	7
MEMY-598	Bio-organic nanostructures - Supramolecular Chemistry (<i>Bio-organic Nanostructures - Supramolecular Chemistry</i>)	7
MEMY-901	Foundations of Modern Optics	7

CODE	Course Title (English-Greek)	ECTS
	<i>(Foundations of Modern Perspective)</i>	
MEMY-902	Optical Engineering and Metrology <i>(Optical engineering and metrology)</i>	7

List of Research Laboratories

CODE	Course Title (English-Greek)	ECTS
MEMY-601	Methods of Scientific Bibliographic Search <i>(Scientific Bibliographic Search Methods)</i>	10
MEMY-602	Research Laboratory 1	10
MEMY-603	Research Laboratory 1 <i>(Research Lab 2)</i>	10
MEMY-604	Preparation of the Postgraduate Thesis <i>(Postgraduate Thesis Writing)</i>	30

On an annual basis and upon the recommendation of the Academic Committee, the General Assembly of the Department may add to the list of Research Specialization Elective courses postgraduate courses offered by other Postgraduate Programs of the University of Crete and taught in English. In this case, in its proposal, the C.E. may, based on its relevance and educational burden, propose only a part of the ECTS, which cannot be less than three (3) ECTS, of the above postgraduate courses to be counted for obtaining a degree and the rest to be listed in the Diploma Supplement.

In exceptional cases, the C.E. may approve the attendance of postgraduate courses offered by other Postgraduate Programs of the University of Crete and taught in Greek. In this case, ECTS from attending the above courses are not taken into account for obtaining a degree but are listed only in the diploma supplement with the indication that they have been taught in Greek.

The outline of the postgraduate courses offered is given in Appendix 1.

Organization of Teaching

The teaching of the courses of the Postgraduate Program is carried out with physical presence with the possibility of using synchronous distance learning methods that may not exceed thirty percent (30%) of the credits of the Postgraduate Program. The teachers inform the C.E. at the beginning of each semester about the use of synchronous distance learning methods during the teaching of courses, the total teaching hours with it, and the reasons why it is necessary. The C.E. is responsible for monitoring that the 30% limit is observed in the total credits of the Postgraduate Program.

The method of examination of the courses as well as other obligations for successful attendance of the courses is determined by the teachers who inform the S.E. accordingly at the beginning of each semester. PhD students are informed in a timely manner and by any appropriate means about the above obligations, in accordance with the applicable legislation and the regulation of postgraduate studies of UoC. All the above obligations of the courses, such as the execution of assignments and exercises, must be fully completed within the duration of the semester, and by the end of the examinations, as defined by the Academic calendar. The scoring scale is from

one (1) to ten (10) and it is considered that Students have been successfully examined if the score is greater than or equal to five (5).

The final exam in the course, if provided, can be given only once, immediately after the end of the semester. There is no repeat examination. A student who fails a compulsory course must repeat the same course in the corresponding semester of the next academic year. After two (2) failures in a compulsory course, the student is proposed for deletion from the MSc. In this case, the student, according to the current legislation, is entitled, upon his/her application to the Steering Committee., to be reviewed by a three-member committee. The CC appoints the above committee, in accordance with the applicable legislation.

Students who enroll in the program after their previous disenrollment, are required to attend and be examined again in all courses of the program. Courses from previous undergraduate and postgraduate programs of study are not recognized.

Evaluation of postgraduate students

The evaluation of the M.P.S is carried out by the S.E. of the Postgraduate Program per semester of study. After the end of the 1st semester, the M.F. must have been successfully evaluated in at least one (1) course, while after the end of the 2nd semester he must have been successfully evaluated in at least four (4) courses, of which at least two (2) of the 2nd Semester of study. At the end of the 3rd semester, the M.Sc. should accumulate at least 30 ECTS from the compulsory general courses and at least 10 ECTS from elective research courses of the Postgraduate Program.

In the event that the evaluation of the Postgraduate Program shows that the above conditions are not met, the Director of the Postgraduate Program informs the Assembly of the Department that there is a question of deletion of the M.P. The final evaluation and decision is taken by the Assembly of the Department, which has the responsibility for the evaluation of the M.P. following the recommendation of the Postgraduate Program.

Postgraduate Thesis

Each Master's Thesis, within the framework of the MSc, compulsorily prepares a postgraduate thesis during the second year of study. For the preparation of a postgraduate dissertation, the postgraduate student at the end of the second semester and in any case not later than the middle of the 3rd semester submits an application to the steering committee of the Postgraduate Program with the proposed title of the thesis, the proposed supervisor and the members of the examination committee as well as the summary of the proposed thesis. The right to supervise Diploma Thesis has the categories defined by the current legislation and par. 4 of Article 11 of the Regulation of Postgraduate Programs of the University of Crete. In case the proposed supervisor is not a faculty member of the department, then at least one member of the examination committee, with the same or related scientific specialty with the subject of the proposed Diploma Thesis, should be a faculty member of the department.

After examining the application, the CC may request clarifications or resubmission due to deficiencies. In case the postgraduate thesis is conducted in collaboration with another Department or Institution, a member of the proposed examination committee, who is a faculty member of the department, is appointed as an advisor faculty member. The role of the advising

faculty member is to act as a liaison of the department with the other Department or Institution, thus facilitating the preparation of the dissertation. Under the responsibility of the Director of the Postgraduate Program, the above applications, as well as possible comments of the Postgraduate Thesis, are forwarded to the Assembly of the Department responsible for approving the preparation of the proposed Postgraduate Diploma Thesis.

In order for the assignment to be approved, the student must publicly defend it before the examination committee. The postgraduate thesis is examined by the examination committee in accordance with the applicable provisions and includes oral support of the dissertation before an audience at a date and time set by the examination committee.

After the completion of the public support of the dissertation by the postgraduate student, the committee grades it on a scale of 0-10 and informs the secretariat with a written report.

If the dissertation is considered by the committee as unsatisfactory and scored below base 5, then the committee may ask the graduate student to improve it, modify some parts of it, or radically reform it. The committee sets a specific time frame within which the dissertation should be resubmitted and modified according to its suggestions.

The text of the paper must meet the specifications and structure of a scientific paper, i.e. include a description of the topic of the work, a description of the findings - results of the work, the methodology, assumptions, bibliography and any other necessary supporting or explanatory elements (necessary shapes, diagrams, photographs, images, etc.). It is written in English and is accompanied by a short summary of up to approximately 300 words in Greek and English. In the first pages of the paper, the MF must state that this work is not plagiarized either in whole or in individual parts of it.

Copies of the diploma thesis must be submitted by the postgraduate student to the Secretariat of the Department and the Library of the University of Crete to complete his/her postgraduate studies.

For the copyright on the postgraduate thesis, the provisions of the Regulation of Postgraduate Studies Programs of the University of Crete and the current legislation apply.

Mentor

For each postgraduate student, a professor that will act as a Mentor is appointed upon the recommendation of the Steering Committee from among all the professors of the postgraduate Program. The Mentor monitors the progress of the student, advises the student on academic, organizational or administrative issues and makes suggestions to the Steering Committee on issues related to the specific student. The appointment of the Mentor takes place after the registration of the student in the Postgraduate Program.

Commencement and Duration of Postgraduate Studies

The first semester of studies usually starts in October and the second semester of studies usually starts in February. The exact dates are decided by the General Assembly of the Department upon the recommendation of the Director of the Postgraduate Program.

Registrations for the following semesters of study are made after the end of the examination period. At the beginning of each academic semester, within a regular deadline, each postgraduate student enrolls in the next semester and declares the courses he/she is going to

attend. The course statement is co-signed by the Director of the Postgraduate Program or the supervisor of the Diploma Thesis, if he has been appointed.

The typical duration of the Postgraduate Program leading to the acquisition of a postgraduate specialization degree is 4 academic semesters of study and cannot exceed 3 (three) calendar years. Upon reasoned request of the interested postgraduate student and the relevant recommendation of the Postgraduate Program to the Assembly of the Department, it is possible to extend the study time for six (6) months and in exceptional cases for one (1) year.

After two years from the beginning of their postgraduate studies, M.F. lose their student status if the above extension has not been granted.

In specially justified cases, the Steering Committee. of the Postgraduate Program may recommend to the Assembly of the Department that permission be granted for a temporary interruption of studies for a reasonable period. In exceptional cases (e.g. military service, serious illness, etc.) it is possible, following a reasoned request by master student, for the Steering Committee of the Postgraduate Program to recommend to the General Assembly of the Department, not to count part of the study time in the above-mentioned time limits.

Diploma Supplement

Graduates of the Postgraduate Program are provided with a diploma supplement in accordance with the applicable legislation and the type of diploma determined by the University of Crete. The Diploma Supplement contains all additional information about the studies, such as Postgraduate Thesis Title, transcript of postgraduate courses, Postgraduate Thesis grade (Good, Very Good, and Excellent), and thematic units of research activities.

Publication of Research Papers - Ethics

Postgraduate theses, publications and patents resulting from research activity within the framework of the MSc must follow the rules of research publication and ethics as described by the legislation, the Internal Regulation and the Regulation of Postgraduate Studies Programs of the University of Crete. They must also follow academic practices and rules summarized as follows:

The authors of a research paper, in accordance with the rules of international scientific ethics, should be only those researchers who have actively participated in it. Active participants are those who design the study, collect, analyze and evaluate the data, provide unpublished material that is absolutely necessary for the conduct of the research, as well as those who write it. All authors are responsible for the data that appears in this publication. All authors must study the final text before it is submitted for publication, as well as study in detail all the data on which the work is based. The corresponding author is responsible for ensuring that all other authors receive a copy of the paper to be signed before it is submitted. All researchers who have contributed to a specific work with research data must keep this data in their possession for at least 5 years. There should be a laboratory book, in which the realization of experiments should be described in detail. For the observance of all the above, the supervisor and the other members of the three-member examination committee are responsible.

The MSc operates with the certainty that the highest ethical standards are applied in scientific research. The program promotes the generation of knowledge through original research while

promoting and protecting academic freedom. It is recognized that the possibility of misconduct in research is a very serious matter, which can seriously affect the Postgraduate Studies and the careers of all people involved in Research and the Academy.

Research misconduct occurs when research data is either falsified or copied by others or the data is deliberately misprocessed so that the results do not represent reality. All lecturers participating in the program have an obligation to maintain high standards in the way they conduct their research.

All researchers should publish original papers in internationally recognized journals. They should present their research work at regular intervals and should receive any critical comments from their colleagues. The honesty with which the work is done is of paramount importance for its quality. The treatment of occasional misconduct in research will be done in accordance with the procedures provided by the applicable legislation, the Internal Regulation and the Regulation of Postgraduate Studies Programs of the University of Crete.

Rights of postgraduate students

Postgraduate students have the rights deriving from the current legislation, the relevant provisions of the Regulation of Postgraduate Studies Programs of the University of Crete and the decisions of the competent university governing bodies.

Postgraduate students have the right to: use of the facilities and means of the Foundation, unhindered access to the Institution's library by displaying their student identity card and the specific rules provided, the use of digital services and databases to support their teaching and research needs, the use of laboratories, in compliance with the security rules provided for by the relevant regulations, good use of scientific instruments and facilities in general.

Scholarships and awards

The Postgraduate Program may award excellence scholarships and awards to its students, at the expense of its budget, based on their performance in studies. The Assembly of the Department is responsible for determining the number of scholarships and awards, the criteria for granting them, as well as for any other relevant matter.

Obligations of postgraduate students

Postgraduate students have the obligations deriving from the current legislation, the Internal Regulation of the University of Crete, the Regulation of Postgraduate Studies Programs of the University of Crete and the decisions of the competent university governing bodies. In addition, they have the following obligations:

1. Postgraduate studies in the Postgraduate Program include mandatory participation in the educational activities of the Department, at least for one semester, such as:

- a) participation in the teaching of tutorial courses or as assistants in laboratories for undergraduate students of the Department, The nature of the work and the number of hours of employment of postgraduate students are determined by the Assembly of the

Department following a proposal by the Steering Committee. The above teaching experience is recognized by issuing a relevant certificate signed by the Director of the Postgraduate Program. The Department ensures the financial support of postgraduate students who offer auxiliary educational work, if possible.

b) Also, postgraduate students must participate in supervision during examinations for undergraduate students, if requested.

2. Postgraduate students evaluate each course they attend and the respective instructor, by anonymously completing the relevant Evaluation Form provided by the Secretariat of the Department

Annex I

Detailed Course Outlines

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	GRADUATE		
COURSE CODE	MEMY-501	SEMESTER	1st
COURSE TITLE	Advanced Solid-State Materials and Nanostructures		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>	WEEKLY TEACHING HOURS	CREDITS	
Lectures	3	10	
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	SPECIALISED GENERAL KNOWLEDGE		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	ENGLISH		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mscs.uoc.gr/dmst/?courses=course-b		

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

The course aims to educate postgraduate students in the field of nanotechnology, especially on inorganic nanomaterials and their magnetic and opto-electronic properties. The course syllabus includes the following topics:

- (1) Modern techniques and methods (physical and chemical) for synthesis of single-crystals and

inorganic nanostructured materials, with emphasis on those of nanochemistry. The study focuses on development of thin films, nanoparticles, nanotubes/nanowires and porous nanostructures.

(2) An introduction to the opto-electronic and magnetic properties of semiconductor nanostructures. The basic principles of spin-electronics (spintronics) as well as the spin-dynamics in semiconductor nanostructures are described. Also, the optical and electronic properties of two-dimensional crystals, with particular emphasis on the transition metal dichalcogenides, are presented.

Students become familiar with the topics of the course through reference to the fundamental principles as well as selected examples from recent literature.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 7.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

<i>Search for, analysis and synthesis of data and information, with the use of the necessary technology</i>	<i>Project planning and management</i>
<i>Adapting to new situations</i>	<i>Respect for difference and multiculturalism</i>
<i>Decision-making</i>	<i>Respect for the natural environment</i>
<i>Working independently</i>	<i>Showing social, professional and ethical responsibility and sensitivity to gender issues</i>
<i>Team work</i>	<i>Criticism and self-criticism</i>
<i>Working in an international environment</i>	<i>Production of free, creative and inductive thinking</i>
<i>Working in an interdisciplinary environment</i>	<i>.....</i>
<i>Production of new research ideas</i>	<i>Others...</i>
	<i>.....</i>

- Development of interdisciplinary and critical thinking
- Search for, analysis and synthesis of data and information, with the use of the necessary technologies
- Working independently
- Working in an interdisciplinary environment
- Production of free, creative and inductive thinking

(3) SYLLABUS

A. Inorganic nanostructures and nanomaterials

1. Introduction to nanochemistry concepts

Why nano? What is Nanochemistry? Self-assembly of molecules and materials, Molecular vs. Supramolecular chemistry, "Bottom-Up" and "Top-Down" synthetic routes, Hierarchical assembly, Directing self-assembly, Size tunable physical and chemical properties of nanostructured materials, Surface vs. bulk properties of nanomaterials.

2. Chemical patterning and lithography

Scanning probe nanolithography (SPN): Scanning tunneling microscope (STM) and atomic force microscopy (AFM), Photolithography, Electron-beam and focused ion-beam lithography, Nanoimprinting, Soft lithography and self-assembled monolayers (SAMs), Dip pen nanolithography (DPN).

3. Nanostructured materials

0D nanostructures: Synthesis of metal (Au, Pt) and metal oxide (ZnO, Ga₂O₃, SnO₂) nanoparticles, Colloidal synthesis of semiconductor nanoparticles (CdQ, PbQ, Q=S, Se, Te; ZnS, InP, GaP), Self-assembly of nanoclusters and nanoparticles. 1D and 2D nanostructures: nanorods and nanowires from soft and hard templates, Semiconducting nanowires (GaN, GaAs, InAs), Carbon nanotubes.

4. 3D Nanostructures: Nanoporous materials

Supramolecular self-assembly of microporous materials (Zeolites and coordination polymers), Synthesis of periodic ordered mesoporous materials: liquid-crystal template of amphiphilic molecules and hard templating (nanocasting), Mesoporous semiconductors (Ge, GeQ, Q=S, Se, Te; CdS).

B. Synthesis and growth techniques in the solid state

5. Introduction to solid state synthesis and crystal growth

Reactions in the solid state. Ion diffusion. Epitaxy vs. Topotaxy. Crystal growth mechanisms. Laboratory Scale Crystal Growth Methods (Supersaturation in Solution, Growth from the Melt, Vapor Transport, Autoclave Growth). Industrial Scale methods (Bridgeman, Czochralski, Molecular Beam Epitaxy Methods, Autoclave Growth).

6. Deposition methods in thin films

Homogeneous Deposition (*Bottom-Up Methods*: Spin Coating, Spray Pyrolysis, Electro-spraying, Combustion, "Dr. Blade" method, Sputtering, Printing *Top-Down Methods*: Mechanical exfoliation, Chemical exfoliation, Cleavage across Crystallographic Planes). Heterogeneous Deposition (Chemical Vapor Deposition, Atomic Layer Deposition, Sublimation).

7. Application of semiconductor thin-films

Emerging Photovoltaics Technologies, CdTe, CIGS, CZTS, organic solar cells, Graetzel cells. Performance evaluation and Characterization.

8. Halide perovskite Semiconductors

Synthesis and Crystal Growth of Halide Perovskites, Structure and Properties of Halide Perovskites, Optical and Electrical Properties of Halide Perovskites.

C. Opto-electronic and magnetic materials

9. Semiconductor physics and spin

Basic semiconductor physics (the role of impurities, optical orientation, selection rules and spin detection), Spin-dynamics in semiconductor quantum wells (QWs) and quantum dots (QDs), Spin scattering in semiconductor quantum wells (QWs) and quantum dots (QDs), Spin scattering in semiconductors, the Hanle effect and the measurement of the exciton recombination and spin relaxation times, spin interactions (exchange, orbital and spin coupling).

10. Spin-LEDs: Fundamental principles and applications

Si and GaAs based light emitting diodes (spin-LEDs), Spin injection contacts (Schottky and oxide-based contacts), Magnetic contacts (magnetic semiconductors and ferromagnetic metals), Faraday and Voigt geometries.

11. Spin injection from magnetic contacts to semiconductor nanostructures III-V

Spin injection, transport and dynamics from magnetic contacts (magnetic semiconductors and ferromagnetic metals) in semiconductor quantum wells and quantum dots, electrical injection and optical spin detection and selection rules.

12. Magnetism and magnetic materials

Diamagnetism, Paramagnetism (Langevin classical theory and Brillouin quantum theory), Ferromagnetism (molecular field theory), Domain walls, Fine particles and thin films (single versus multi-domain behavior, superparamagnetism in nanoparticles and alloys), Soft and hard magnetic materials (Fe-Co alloys, rare earth magnets).

13. 2D Materials: Optical and electronic properties

Graphene, transition metal dichalcogenides, optical and electronic properties, photoluminescence, reflection, and Raman spectroscopy, spin-valley polarization, valley-electronics (valleytronics).

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY <i>Face-to-face, Distance learning, etc.</i>	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i> <i>Use of ICT in teaching, laboratory education, communication with students</i>	Use of Power Point Videos with demonstration/understanding experiments. <ul style="list-style-type: none">• Use of an asynchronous e-learning platform (e-class) where the following are provided:<ul style="list-style-type: none">◦ Bibliography of the course

	<ul style="list-style-type: none"> <i>o Slides of the course</i> <i>o Solved and unsolved exercises</i> <i>o Self-study Exercise Set</i> <i>o Demonstration videos and simulations</i> <i>o Communication through the e-class platform, use of the discussion area facility with topics, email as well as fixed office hours announced.</i> 																						
<p align="center">TEACHING METHODS</p> <p><i>The manner and methods of teaching are described in detail.</i></p> <p><i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</i></p> <p><i>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</i></p>	<table border="1"> <thead> <tr> <th align="center">Activity</th> <th align="center">Semester workload</th> </tr> </thead> <tbody> <tr> <td>Lectures</td> <td align="center">39</td> </tr> <tr> <td>Exercises</td> <td align="center">10</td> </tr> <tr> <td>Non-directed learning activity</td> <td align="center">98</td> </tr> <tr> <td>Directed learning activity (office hours)</td> <td align="center">26</td> </tr> <tr> <td>Writing project</td> <td align="center">74</td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td>Course total</td> <td align="center">247</td> </tr> </tbody> </table>	Activity	Semester workload	Lectures	39	Exercises	10	Non-directed learning activity	98	Directed learning activity (office hours)	26	Writing project	74									Course total	247
Activity	Semester workload																						
Lectures	39																						
Exercises	10																						
Non-directed learning activity	98																						
Directed learning activity (office hours)	26																						
Writing project	74																						
Course total	247																						
<p align="center">STUDENT PERFORMANCE EVALUATION</p> <p><i>Description of the evaluation procedure</i></p> <p><i>Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</i></p> <p><i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i></p>	<p>Students are evaluated by completing projects in English that includes a combination of:</p> <ul style="list-style-type: none"> - Written work (60%) - Public presentation (25%) - Oral examination (15%) <p>Students have the right to view their written work after the grading results are published and to ask questions.</p> <p>The evaluation process of the students is described during the first lecture and presented on the web site of the course:</p> <p>https://mscs.uoc.gr/dmst/?courses=course-b</p>																						

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. G.A. Ozin, A.C. Arsenault, Nanochemistry: A Chemical Approach to Nanomaterials, RSC Publishing, Cambridge, UK, 2005.
2. G. Cao, Nanostructures and Nanomaterials: Synthesis, Properties and Applications, Imperial College Press, London, UK, 2004.
3. M. Dyakonov, Spin Physics in Semiconductors, Springer Series in Solid-State Sciences 157, Springer, 2008.

4. B.D. Cullity and C.D. Graham, Introduction to Magnetic Materials, Wiley, 2009.
5. A. R. West, Solid State Chemistry and Its Applications, Wiley, 2014.

- *Related academic journals:*

Nature Nanotechnology
Nature Materials
Nature Reviews Materials
ACS Nano
ACS Applied Nano Materials
Nano Letters
Materials Horizons
Nanoscale Horizons
Nanomaterials

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	MEMY-502	SEMESTER	A
COURSE TITLE	THEORETICAL MATERIALS SCIENCE		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>	WEEKLY TEACHING HOURS	CREDITS	
Lectures	4	10	
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	SKILLS DEVELOPMENT, SPECIALIZED GENERAL KNOWLEDGE		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	ENGLISH		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mcs.uoc.gr/dmst/?courses=theoretical-materials-science		

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

The course is an introduction to the relationship between the atomic/electronic structure of solid materials and their macroscopic properties as well as the properties that render them invaluable in modern technology. The first part of the course is basic quantum mechanics and the second part is an introduction to the basic principles of solid-state physics. The course covers topics such as the

postulates of quantum mechanics and implications, the relation between atomic configuration and electronic structure (electronic energy states, bands and gaps), how this determines conductors, semiconductors and insulators, the interaction of materials with the electromagnetic field. The learning goals that should have been achieved by the end of the course are:

1. Students learn the basics of quantum theory of matter.
2. Students understand the role of quantum theory in the stability of solids as well as their mechanical and electronic properties.
3. Students should be able to explore the interaction of materials with electromagnetic fields.
4. Students become familiar with the most important aspects of the electronic properties of materials so that they can understand the design and operation of electronic devices.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 7.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

<i>Search for, analysis and synthesis of data and information, with the use of the necessary technology</i>	<i>Project planning and management</i>
<i>Adapting to new situations</i>	<i>Respect for difference and multiculturalism</i>
<i>Decision-making</i>	<i>Respect for the natural environment</i>
<i>Working independently</i>	<i>Showing social, professional and ethical responsibility and sensitivity to gender issues</i>
<i>Team work</i>	<i>Criticism and self-criticism</i>
<i>Working in an international environment</i>	<i>Production of free, creative and inductive thinking</i>
<i>Working in an interdisciplinary environment</i>
<i>Production of new research ideas</i>	<i>Others...</i>

- Production of free, creative and inductive thinking
- Working independently
- Search for, analysis and synthesis of data and information, with the use of the necessary technology

(3) SYLLABUS

A) Quantum Mechanics:

1. Background:
Waves and Particles, Hilbert space, Hermitian operators and observables, operator algebra, the postulates of Quantum mechanics.
2. The basic theorems:
Eigenvalues of position, energy and momentum, Ehrenfest theorem, Uncertainty principle.
3. Harmonic Oscillator:
Algebraic method, eigenstates and eigenvalues, applications.
4. Angular momentum:
Ladder operators, eigenvalues and eigenstates for rotations and for spin, addition of angular momenta, spin-orbit coupling, singlet-triplet states.
5. Many-body systems:
Spin-statistics theorem, Slater Determinants, Pauli principle, exchange and correlation effects,

Density-Functional Theory.

B) Quantum Theory of Solids:

6. From atoms (ions – external electrons) to solids:
Equilibrium structures at minimum energy, Coulomb potential energy and quantum kinetic energy, Heisenberg's uncertainty principle and minimum kinetic energy. Atoms size and energy, formation of molecules and solids, estimate of values for basic properties of elemental solids using fundamental principles and dimensional analysis.
7. Electron motion, the problem of electrical resistivity and the basic approximations in solid state physics:
Drude formula. Atomic structure and bonding and the properties of solids, crystal lattices. Adiabatic (Born-Oppenheimer), independent particle, harmonic approximation. Periodicity, Bloch theorem, origin of energy bands and gaps. One-dimensional "crystals", chain of classical coupled harmonic oscillators and phonon bands.
8. Linear combination of atomic orbitals:
Diatomic molecule. One-dimensional tight-binding model, bands and gaps for more than one orbital per atom, diatomic unit cell. Analogy with wave propagation in one-dimensional "crystals" of coupled harmonic oscillators and phonons.
9. Semiclassical theory of conduction in metals :
Electrons in a conduction band, free electron model, Fermi energy, total (kinetic) energy, density of states, effective mass, DC conductivity, materials response to EM field, oscillators model for conductivity and dielectric function, properties and uses of dielectric function.
10. Conduction in semiconductors:
Electrons and holes, carrier effective mass, intrinsic semiconductor conductivity, carrier mobility and concentration, temperature dependence, chemical potential and Fermi energy. Impurities, donors and acceptors, Fermi level in extrinsic semiconductors, temperature dependence, carriers lifetime.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY <i>Face-to-face, Distance learning, etc.</i>	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	<p>Use of ICT for communication with students who are encouraged to search for online resources for better understanding material taught in class and for lecture presentations.</p> <ul style="list-style-type: none"> • Videos with demonstration/understanding experiments. • Use of an asynchronous e-learning platform (e-class) where the following are provided: <ul style="list-style-type: none"> <i>o Bibliography of the course</i> <i>o Slides of the course</i> <i>o Solved and unsolved exercises</i> <i>o Self-study Exercise Set</i> <i>o Lecture videos</i>

	<p><i>o Demonstration videos and simulations</i></p> <p><i>o Communication through the e-class platform, use of the discussion area facility with topics, email as well as fixed office hours announced</i></p>	
<p align="center">TEACHING METHODS</p> <p><i>The manner and methods of teaching are described in detail.</i></p> <p><i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</i></p> <p><i>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</i></p>	Activity	Semester workload
	Lectures	52
	Projects/Assignments	44
	Non-directed learning activity	126
	Directed learning activity (office hours)	26
	Course total	248
<p align="center">STUDENT PERFORMANCE EVALUATION</p> <p><i>Description of the evaluation procedure</i></p> <p><i>Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</i></p> <p><i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i></p>	<p>Student performance evaluation consists of short written exams or homework on a weekly basis, a written midterm exam and a written final exam that includes developing questions and problem solving.</p> <p>Students have the right to view their exam scripts after the grading results and to ask questions.</p>	

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- Eugen Merzbacher, Quantum Mechanics, 3rd Edition, John Wiley & Sons (1998).
- Stefanos Trachanas, An Introduction to Quantum Physics: A First Course for Physicists, Chemists, Materials Scientists, and Engineers, 1st Edition, Wiley-VCH (2017).
- Charles Kittel, Kittel's Introduction to Solid State Physics, Global Edition, 8th Edition, Wiley (2018)
- E.N. Economou, The Physics of Solids Essentials and Beyond, 1st Edition, Springer (2010).
- W.D. Callister, Jr., D.G. Rethwisch, Materials Science and Engineering: An Introduction, 10th Edition, Wiley (2018).
- I. Harald, L. Hans, Solid-State Physics: An Introduction to Principles of Materials Science, 4th Edition, Springer (2009).

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	MEMY-503	SEMESTER	B
COURSE TITLE	Soft Matter Science and Engineering		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>	WEEKLY TEACHING HOURS	CREDITS	
Lectures	4	10	
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	SKILLS DEVELOPMENT, SPECIALIZED GENERAL KNOWLEDGE		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	ENGLISH		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mcs.uoc.gr/dmst/?courses=soft-mater		

(2) LEARNING OUTCOMES

Learning outcomes <i>The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.</i> Consult Appendix A <ul style="list-style-type: none">• Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area• Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B• Guidelines for writing Learning Outcomes
The aim of the course is to introduce students to fundamental concepts of soft matter synthesis and physics. The course covers topics such as various synthetic routes for polymers, spectroscopic characterization of polymers and introductory polymer-colloid physics (characteristic sizes and times, thermodynamics and phase behavior, flow properties of

polymers in relation to their processability).

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 7.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	Project planning and management
Adapting to new situations	Respect for difference and multiculturalism
Decision-making	Respect for the natural environment
Working independently	Showing social, professional and ethical responsibility and sensitivity to gender issues
Team work	Criticism and self-criticism
Working in an international environment	Production of free, creative and inductive thinking
Working in an interdisciplinary environment
Production of new research ideas	Others...

1. Understanding of basic concepts and utilization of soft materials in technological applications.
2. Critical and creative thinking with logic that combines concepts
3. Work in interdisciplinary environment that combines physical and chemical properties.
4. Individual .and autonomous projects

(3) SYLLABUS

A. Synthesis

Poly-condensation polymerization and kinetics ; Free Radical Polymerization, Kinetics ; Ionic and Cationic polymerization ; Controlled Radical Polymerization ; Characterization (NMR, IR, GPC)

B. Polymer Physics

Main characteristic of soft matter (length, time and energy scales) ; Fractal concepts, volume fraction, overlap concentration, molecular weight distribution ; Ideal and Real polymer chains (Freely Rotating Chain, Kuhn Chain, Excluded Volume, Solvent quality) ; Thermodynamics of Polymer Solutions ; Deformation, entropic elasticity, relation of characteristic sizes to moduli ; Polymer Dynamics (Rouse, Zimm, Reptation) ; Forces and Interaction in colloidal suspensions, Brownian Motion ; Phase behaviour of Brownian Hard Spheres, Rods and Discs ; Softness: From polymers to Colloids

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY <i>Face-to-face, Distance learning, etc.</i>	Face-to-face
USE OF INFORMATION AND	Use of ICT for communication with students who are

<p>COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i></p>	<p>encouraged to search for online resources for better understanding material taught in class and for lecture presentations.</p> <p>Videos with demonstration/understanding experiments.</p> <ul style="list-style-type: none"> • Use of Demonstration experiments • Use of an asynchronous e-learning platform (e-class) where the following are provided: <ul style="list-style-type: none"> o <i>Bibliography of the course</i> o <i>Slides of the course</i> o <i>Solved and unsolved exercises</i> o <i>Self-study Exercise Set</i> o <i>Lecture videos*</i> o <i>Demonstration videos and simulations</i> o Communication through the e-class platform, use of the discussion area facility with topics, email as well as fixed office hours announced <p>Students' assignments are received and corrected via the platform (e-class)</p>																			
<p>TEACHING METHODS</p> <p><i>The manner and methods of teaching are described in detail.</i></p> <p><i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</i></p> <p><i>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</i></p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Activity</th> <th style="text-align: center;">Semester workload</th> </tr> </thead> <tbody> <tr> <td>Lectures</td> <td style="text-align: center;">52</td> </tr> <tr> <td>Assignments/Projects</td> <td style="text-align: center;">40</td> </tr> <tr> <td>Non-directed learning activity</td> <td style="text-align: center;">128</td> </tr> <tr> <td>Directed learning (office hours)</td> <td style="text-align: center;">130</td> </tr> <tr> <td>Office hours</td> <td style="text-align: center;">26</td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td>Course total</td> <td style="text-align: center;">246</td> </tr> </tbody> </table>		Activity	Semester workload	Lectures	52	Assignments/Projects	40	Non-directed learning activity	128	Directed learning (office hours)	130	Office hours	26					Course total	246
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Directed learning (office hours)	130																			
Office hours	26																			
Course total	246																			
<p>STUDENT PERFORMANCE EVALUATION</p> <p><i>Description of the evaluation procedure</i></p> <p><i>Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</i></p>	<p>Language of Evaluation: English</p> <p>The final grade is the</p> <p>Course participation</p> <p>Quiz</p> <p>Project</p>																			

<p><i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i></p>	<p>Final exam</p>
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(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- *Related academic journals:*

Macromolecules, ACS Macro Letters , Soft Matter

(1) GENERAL

SCHOOL	School of Sciences and Engineering		
ACADEMIC UNIT	Department of Materials Science and Technology		
LEVEL OF STUDIES	Post-graduate		
COURSE CODE	MEMY-50 4	SEMESTER	B
COURSE TITLE	Biomaterials and Biomedical Engineering		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>	WEEKLY TEACHING HOURS	CREDITS	
	4	10	
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	SPECIALISED GENERAL KNOWLEDGE		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	ENGLISH		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mscs.uoc.gr/dmst/?courses=biomaterials-biomolecules		

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

The course outline includes the study of biomaterials and biomolecules, their physicochemical and mechanical properties, their degradation mechanisms, their biocompatibility criteria and evaluation, the biological responses following an implantation. The learning goals that students should have achieved at the end of the lesson are the following:

- To become familiar with the properties and attributes of biomaterials.
- To become familiar with biomaterial functionalization methodologies.
- To be able for principle-based design of biomaterials and apply them in biomedical research and medicine.
- To know the basic methods for the mathematical modelling of tissue constructs and biomedical systems.

- To understand the need of biomolecule functionalization.
- To consolidate the notions of the structural mechanisms used by Nature to create materials with defined properties.
- To use their knowledge in the design of biocompatible materials
- To be conceptually prepared to perform a Masters thesis in a research laboratory in the area of biomolecules, biomaterials, bioengineering, tissue engineering and regenerative medicine

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 7.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology

Project planning and management

Respect for difference and multiculturalism

Adapting to new situations

Respect for the natural environment

Decision-making

Showing social, professional and ethical responsibility and sensitivity to gender issues

Working independently

Criticism and self-criticism

Team work

Production of free, creative and inductive

Working in an international environment

thinking

Working in an interdisciplinary

<i>environment</i>
<i>Production of new research ideas</i>	<i>Others...</i>

<ul style="list-style-type: none"> - Development of interdisciplinary and critical thinking - Search for, analysis and synthesis of data and information, with the use of the necessary technology - Production of free, creative and inductive thinking

(3) SYLLABUS

<ul style="list-style-type: none"> • Natural and synthetic biomaterials used in biomedicine (metal, metal alloys, ceramics, natural and synthetic polymers). Definitions and properties. • Principles of biomaterial functionalization. • Rational design of synthetic biomaterials., • Principles in Tissue Engineering • Bone, cartilage, dental, cardiovascular tissue engineering • Cell adhesion • Mechanical properties and biocompatibility of implantable biomaterials • Methods & tools for mathematical modelling of tissue constructs and biomedical systems: solid mechanics, fluid mechanics, dynamic systems. • Biofabrication methods: capabilities, technologies, hardware. • Applications of biomaterials in biomedical engineering.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY	Face-to-Face	
<i>Face-to-face, Distance learning, etc.</i>		
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point and e-class, Supportive learning through the use of valid online scientific tools	
<i>Use of ICT in teaching, laboratory education, communication with students</i>		
TEACHING METHODS	Activity	Semester workload
<i>The manner and methods of teaching are described in detail.</i> <i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</i>	Lectures	52
	Projects/ Assignments	20
	Non-directed learning	148
	Directed learning (office hours)	26
	Office hours	20

<p><i>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</i></p>	<p>Course total</p>	<p>240</p>
<p>STUDENT PERFORMANCE EVALUATION</p> <p><i>Description of the evaluation procedure</i></p> <p><i>Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</i></p> <p><i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i></p>	<p>Students are evaluated by a final written examination in English that includes critical development of topics. Students have the right to view their exam scripts after the grading results are published and to ask questions.</p>	

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Bioconjugate Techniques, Greg T. Hermanson, Academic Press, Inc., 2008
2. J. S. Temenoff, A. G. Mikos, Biomaterials: The Intersection of Biology and Materials Science, 2nd edition, Pearson, 2022.
3. C. M. Agrawal, J. L. Ong, M. R. Appleford, G. Mani, "Introduction to Biomaterials Basic Theory with Engineering Applications" Cambridge Texts in Biomedical Engineering, 2013.
4. "An Introduction to Biomaterials, Second edition" Ed. J. Hollinger, Taylors and Francis, 2012.
5. J.P. Fisher, A.G. Mikos, J.D. Bronzino "Tissue Engineering", CRC Press, 2007
6. Cindy Chung, Jason A. Burdick, Engineering cartilage tissue, Advanced Drug Delivery Reviews 60, 243–262, 2008
7. B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts, and P. Walter, "Molecular Biology of the Cell, 4th edition", Garland Science 2002, chapter 19
8. Stephanie Willerth, Shelly Sakiyama-Elbert, Stem book, Combining stem cells and biomaterial scaffolds for constructing tissues and cell delivery

- *Related academic journals:*

9. Tissue Engineering Part A, B & C, Mary Ann Liebert
10. Journal of Tissue Engineering and Regenerative Medicine, Wiley
11. Biomaterials, Elsevier
12. Acta Biomaterialia, Elsevier
13. Advanced Healthcare Materials, Wiley
14. Biomaterials Science and Engineering, ACS
15. Biomaterials Science, RCS
16. Biomacromolecules, ACS
17. Annals of biomedical engineering, springer
18. Nature biomedical engineering, springer
19. Nature reviews bioengineering, springer

COURSE CODE	MEMY -428	SEMESTER	A
ΤΙΤΛΟΣ ΜΑΘΗΜΑΤΟΣ	Sustainable (Bio)polymers		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g., lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>		WEEKLY TEACHING HOURS	CREDITS
Lectures		4	7
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	special background		
PREREQUISITE COURSES	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English		
IS THIS COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mcs.uoc.gr/dmst/?courses=sustainable-biopolymers		

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

This course aims to provide up-to-date knowledge on principles of sustainability, sustainable polymers chemistry and a grasp on the design and applications of biodegradable and/or biobased plastics as an alternative to petroleum-based plastics.

Upon completion of the course the students should be able to:

- Understand the basic definitions and principles of sustainable polymers and biodegradable polymers,
- Incorporate the principles of sustainability into polymer science concepts.
- Assess the main features of polymeric materials in terms of sustainability.
- Describe how biomass can be transformed into chemical building blocks and biobased polymers.
- Understand how biomass can be transformed into valuable chemical synthons and polymers.
- Evaluate the application and fate of polymers as a function of their chemical structure.
- Incorporate innovative techniques which could potentially enhance the sustainability

- on lab and industrial scale (photochemistry, electrochemistry, flow chemistry...)
- Work in multidisciplinary environments requiring basic polymer chemistry sustainability understanding (within the framework of a diploma thesis or Erasmus).

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology

Project planning and management

Adapting to new situations Decision-making Working independently Teamwork

Respect for difference and multiculturalism

Respect for the natural environment

Working in an international environment Working in an interdisciplinary environment Production of new research ideas

Showing social, professional and ethical responsibility and sensitivity to gender issues

Criticism and self-criticism

Production of free, creative and inductive thinking

Others...

.....

- Search, analyze and synthesize data and information, using the necessary technologies
- Adapting to new situations
- Autonomous work
- Teamwork
- Working in an interdisciplinary environment
- Generation of new research ideas
- Respect for the natural environment
- Project planning and management

(3) SYLLABUS

Polymer and biopolymer synthesis aimed to provide sustainable solutions on biotechnological applications.

- 1) Introduction to plastic pollution and proposed solutions: Recycling, Biodegradable polymers. (Definitions: Bio-based, Biodegradable, Compostable, Biomass, Carbon footprint, Life cycle analysis (LCA)). Basic principles of sustainable chemistry: prevention, atom economy and other sustainability metrics, use of renewable resources, safety, reduction of energy requirements.
- 2) Monomers (and polymers) derived from biomass: Biorefinery.
- 3) Natural polymers (cellulose, starch, lignin, gelatine, chitin, chitosan etc.): Structures, properties, advantages and disadvantages.
- 4) Bio-based, non-biodegradable polymers: polyethylene (PE), Polypropylene (PP), Polyethylene Terephthalate (PETE or PET), polyurethane (PU), polyamide (PA).
- 5) Petroleum-based biodegradable polymers: poly(butylene adipate-co-terephthalate) (PBAT), polycaprolactone (PCL), poly(butylene succinate) (PBS).
- 6) Sustainable polymers from biomass: a. polylactic acid (PLA) synthesis, crystallization, properties, processing, biodegradation, applications, b. polyhydroxyalkanoates (PHAs) types, properties, synthesis, processing, applications.
- 7) Biocomposites, classification, natural fibers.
- 8) Applications of bioplastics and biocomposites: packaging, food, foams, medicine (drugs and drug delivery), personal care, textiles etc.

- 9) End of life options for plastics: Recycling (mechanical, chemical), composting, waste-to energy, land fill operations.
- 10) Environmental assessments, LCA of sustainable plastics, biodegradation standards for polymers (industrial composting, marine composting, anaerobic digestion, active landfill, home compost, solid biodegradation), determination of bio-based carbon content.
- 11) Laboratory project on: synthesis of biopolymers, or 3D printing of biopolymers, or preparation of biopolymer composites or preparation of biopolymer gels or depolymerization.

(4) TEACHING and LEARNING METHODS - EVALUATION

Delivery <i>Face-to-face, Distance learning, etc.</i>	Face-to-face	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	<ul style="list-style-type: none"> • Use of slides • Communication through the e-class platform, use of the discussion area facility with topics, email as well as fixed office hours announced 	
TEACHING METHODS <i>The manner and methods of teaching are described in detail.</i> <i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</i> <i>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</i>	Activity	Semester workload
	Lectures	52
	Assignments/Projects	30
	Directed learning activity (office hours)	26
	Non-directed learning activity	66
	Course total	174
STUDENT PERFORMANCE EVALUATION	Language of Evaluation: English The final grade is the sum of 50% Final exam 30% Laboratory Report 20% Laboratory Performance	

(5) ATTACHED BIBLIOGRAPHY

Bibliography-

1. Applied Biopolymer Technology and Bioplastics: Sustainable Development by Green

Engineering Materials, Tatiana G. Volova, A. K. Haghi, Neha Kanwar Rawat (Editors), 1st Edition, CRC Press, USA, 2021.

2. Green Plastics: An Introduction to the New Science of Biodegradable Plastics, E. S. Stevens, Princeton University Press, 2002.
3. Soil Degradable Bioplastics for a Sustainable Modern Agriculture, Ed. Mario Malinconico, Springer-Verlag GmbH Germany 2017.

Related academic journals

- [Sustainable Chemistry & Engineering, ASC](#)
- [Sustainable Materials and Technologies, Elsevier](#)

GENERAL

SCHOOL	SCHOOL OF SCIENCE AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	MEMY -446	SEMESTER	B
TΙΤΛΟΣ ΜΑΘΗΜΑΤΟΣ	Transmission Electron Microscopy		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g., lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>		WEEKLY TEACHING HOURS	CREDITS
Lectures		3	7
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	Special background		
PREREQUISITE COURSES	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English		
IS THIS COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mscs.uoc.gr/dmst/?courses=transmission-electron-microscopy		

(2) LEARNING OUTCOMES

<p>Learning outcomes</p> <p><i>The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.</i></p> <p>Consult Appendix A</p> <ul style="list-style-type: none"> • Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area • Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B • Guidelines for writing Learning Outcomes <ul style="list-style-type: none"> • Introduction to the basic principles governing electron scattering and the operation of electromagnetic lenses. • To prepare students to understand the basic principles that characterize the electron microscopy, electron scattering and diffraction, and imaging. <p><i>The course according to the European Qualifications Framework for Lifelong Learning belongs to level 7.</i></p>
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General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology

Adapting to new situations Decision-making
Working independently Teamwork

Working in an international environment Working in an interdisciplinary environment Production of new research ideas

Project planning and management

Respect for difference and multiculturalism

Respect for the natural environment

Showing social, professional and ethical responsibility and sensitivity to gender issues

Criticism and self-criticism

Production of free, creative and inductive thinking

Others...

.....

- Development of interdisciplinary and critical thinking
- Search for, analysis and synthesis of data and information, with the use of the necessary technologies
- Production of free, creative and inductive thinking

(3) SYLLABUS

This course includes an introduction to the basic principles of electron microscopy with emphasis on scanning electron microscopy (SEM) and transmission electron microscopy (TEM). The principles of electron microscopy and electromagnetic lenses are described.

A. Principles of the TEM

1. Introduction to TEM

History of TEM. Electron vs. light microscopy.

2. Electron Scattering and Diffraction

Coherent and incoherent scattering. Elastic and inelastic scattering.

3. Optical Theory and Electron Lenses

Resolution. Electromagnetic lens. Electrostatic lens.

B. Design of the TEM

4. Electron Guns and Electron lenses

Thermionic guns and field-emission guns (FEGs). Condenser, objective and projector lens. Apertures and diaphragms. Lens aberrations (spherical aberration, chromatic aberration and astigmatism). Depth of focus and depth of field.

5. Imaging System

Electron detectors. Image recording.

6. Vacuum Systems

Mechanical pump. Diffusion pump. Sputter-ion pump. Turbomolecular pump.

C. Other modes on TEM

7. X-ray microanalysis

X-ray formation. Energy-dispersive X-ray spectroscopy.

8. Electron diffraction

Atomic scattering factor. Diffraction by crystals and Bragg's law. Camera length and camera constant. Producing the diffraction pattern.

D. Sample preparation

9. Specimens' preparation for materials science

Specimen support grids. Creating thin disks (Electropolishing, Ion Milling). Microtomy.

(4) TEACHING and LEARNING METHODS - EVALUATION

Delivery <i>Face-to-face, Distance learning, etc.</i>	Face-to-face	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	<ul style="list-style-type: none"> • Use of slides • Videos with demonstration/understanding experiments. • Demonstration experiments • Use of an asynchronous e-learning platform (e-class) where the following are provided: <ul style="list-style-type: none"> o <i>Bibliography of the course</i> o <i>Slides of the course</i> • Communication through the e-class platform, use of the discussion area facility with topics, email as well as fixed office hours announced 	
TEACHING METHODS <i>The manner and methods of teaching are described in detail.</i> <i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</i> <i>The student's study hours for each learning activity are given as well as the hours of non- directed study according to the principles of the ECTS</i>	Activity	Semester workload
	Lectures	39
	Educational visits	6
	Directed learning activity (office hours)	36
	Non-directed learning activity	93
	Course total	174
STUDENT PERFORMANCE EVALUATION <i>Description of the evaluation procedure</i> <i>Language of evaluation, methods of evaluation, summative or conclusive, multiple-choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</i> <i>Specifically defined evaluation criteria are given, and if and where they are accessible to students.</i>	<p>Students are evaluated by final written examination in English that includes a combination of:</p> <ul style="list-style-type: none"> - Problem solving - Developing of topics - Oral examination (for students with learning disabilities) <p>Students have the right to view their exam scripts after the grading results are published and to ask questions.</p> <p>The evaluation process of the students is described during</p>	

	the first lecture and presented on the web site of the course.
--	--

(5) ATTACHED BIBLIOGRAPHY

Bibliography

- 1) D.B. Williams, C.B. Carter, Transmission Electron Microscopy: A Textbook for Materials Science, Plenum Press, New York, 1996.
- 2) Brent Fultz, James M. Howe. Transmission Electron Microscopy and Diffractometry of Materials, 3rd Ed., Springer, Berlin, 2008

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCE AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	MEMY -447	SEMESTER	B
ΤΙΤΛΟΣ ΜΑΘΗΜΑΤΟΣ	Computational Materials Science		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g., lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>	WEEKLY TEACHING HOURS	CREDITS	
Lectures	4	7	
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	SPECIAL BACKGROUND, SKILLS DEVELOPMENT, SPECIALIZED GENERAL KNOWLEDGE		
PREREQUISITE COURSES	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English		
IS THIS COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mscs.uoc.gr/dmst/?courses=computational-materials-science		

(2) LEARNING OUTCOMES

Learning outcomes
<p>The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.</p> <p>Consult Appendix A</p> <ul style="list-style-type: none">• Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area• Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B• Guidelines for writing Learning Outcomes
<p>The course introduces the basic techniques used for the theoretical study of materials using computers. The course combines lectures and laboratory exercises in order for the students to get familiar with appropriate modeling and simulation methods for understanding the materials structure-properties relationship as well as the processes involved in several materials science</p>

problems. The learning goals that should be achieved by the end of the course are:

1. Students acquire a fundamental background in state-of-the-art programming, modelling and simulation of materials.
2. Students develop scientific computing and software related technical skills.
3. Students acquire hands-on experience in modeling complex phenomena and in solving challenging problems in materials science.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 7.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

<i>Search for, analysis and synthesis of data and information, with the use of the necessary technology</i>	<i>Project planning and management</i>
<i>Adapting to new situations Decision-making Working independently Teamwork</i>	<i>Respect for difference and multiculturalism</i>
<i>Working in an international environment Working in an interdisciplinary environment Production of new research ideas</i>	<i>Respect for the natural environment</i>
	<i>Showing social, professional and ethical responsibility and sensitivity to gender issues</i>
	<i>Criticism and self-criticism</i>
	<i>Production of free, creative and inductive thinking</i>
	<i>Others...</i>
	<i>.....</i>

- Production of free, creative and inductive thinking
- Working independently
- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Project planning and management

(3) SYLLABUS

1. Introduction to materials models for computer simulations

Length and time scales hierarchy in modeling materials structure and processes (quantum mechanical, atomistic, mesoscopic, continuum).

2. Fundamental background for classical simulations

Brief review of classical mechanics, statistical physics, methods of numerical integration and solution of differential equations.

3. Atomic-level simulations

Interatomic interaction potentials. Molecular dynamics method. Monte Carlo method. Initial conditions, crystal lattice construction, defects. Boundary conditions. Methods for constant temperature or/and pressure simulations.

<p>4. Results analysis</p> <p>Equilibrium properties, structural, mechanical, dynamical properties. Specific materials properties calculation with realistic interaction potentials and comparison with experiments.</p> <p>5. Introduction to first principles calculations</p> <p>The basics of density functional theory. Structural and elastic properties calculations.</p> <p>6. Mesoscopic and continuum simulations</p> <p>Coarse-grain method. Space discretization. Finite difference and finite element methods. Applications (e.g., dislocation dynamics, electromagnetic wave propagation). Cellular automata.</p> <p>7. Combining methods</p> <p>Concurrent and hierarchical combination of models. Multiple scale simulations.</p>

(4) TEACHING and LEARNING METHODS - EVALUATION

<p>Delivery <i>Face-to-face, Distance learning, etc.</i></p>	Face-to-face	
<p>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i></p>	<ul style="list-style-type: none"> • Use of slides • Videos with demonstration/understanding experiments. • Demonstration experiments • Use of an asynchronous e-learning platform (e-class) where the following are provided: <ul style="list-style-type: none"> o Bibliography of the course o Slides of the course* o Solved and unsolved exercises* o Self-study Exercise Set o Lecture videos* o Demonstration videos and simulations* o Communication through the e-class platform, use of the discussion area facility with topics, email as well as fixed office hours announced • Students' assignments are received and corrected via the platform (e-class) 	
<p>TEACHING METHODS <i>The manner and methods of teaching are described in detail.</i></p> <p><i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity,</i></p>	<p>Activity</p>	<p>Semester workload</p>
	Lectures	52
	Assignments/Projects	30
	Directed learning activity (office hours)	26
	Non-directed learning activity	66

<p>etc.</p> <p>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</p>	<table border="1"> <tr><td></td><td></td></tr> <tr><td></td><td></td></tr> <tr><td></td><td></td></tr> <tr><td></td><td></td></tr> <tr><td>Course total</td><td>174</td></tr> </table>									Course total	174
Course total	174										
<p align="center">STUDENT PERFORMANCE EVALUATION</p> <p><i>Description of the evaluation procedure</i></p> <p><i>Language of evaluation, methods of evaluation, summative or conclusive, multiple-choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</i></p> <p><i>Specifically defined evaluation criteria are given, and if and where they are accessible to students.</i></p>	<p>Language of Evaluation: English</p> <p>Student performance evaluation consists of mandatory exercises handed out and graded during the course of the semester and a final project with in class presentation at the end of the semester</p>										

(5) ATTACHED BIBLIOGRAPHY

<p>Bibliography-</p> <ul style="list-style-type: none"> • J.M. Thijssen, Computational Physics, Cambridge University Press, Cambridge, New York (1999). • D. Raabe, Computational Materials Science: the Simulation of Materials Microstructures and Properties, Wiley-VCH, Weinheim, New York (1998). • M. P. Allen, D.J. Tildesley, Computer Simulation of Liquids, Clarendon Press, Oxford (1990). • D. Frenkel, B. Smit, Understanding Molecular Simulation: from Algorithms to Applications, Academic Press, San Diego, (1996). • K. Ohno, K. Esfarjani, and Y. Kawazoe, Introduction to Computational Materials Science: from Ab Initio to Monte Carlo Methods, Springer-Verlag, Berlin, New York (1999). • K. Binder, D.W. Heermann, Monte Carlo Simulation in Statistical Physics: an Introduction, Springer, Berlin, New York (1997). • K. Binder, Monte Carlo and Molecular Dynamics Simulations in Polymer Sciences, Oxford University Press, Oxford, New York (1995).

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCE AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	MEMY -450	SEMESTER	β
ΤΙΤΛΟΣ ΜΑΘΗΜΑΤΟΣ	Polymer Physics		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g., lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>	WEEKLY TEACHING HOURS	CREDITS	
Lectures	4	7	
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	special background		
PREREQUISITE COURSES	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English		
IS THIS COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mscs.uoc.gr/dmst/?courses=polymer-physics		

(2) LEARNING OUTCOMES

Learning outcomes
<p>The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.</p> <p>Consult Appendix A</p> <ul style="list-style-type: none">• Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area• Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B• Guidelines for writing Learning Outcomes
<p>The students are expected to become familiar with basic concepts of polymer physics and the relation between molecular structure and properties</p> <p>They are also expected to solve problems related to properties of polymers (size, structure, characteristic times, phase diagrams)</p>

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 7.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	Project planning and management
Adapting to new situations Decision-making Working independently Teamwork	Respect for difference and multiculturalism Respect for the natural environment
Working in an international environment Working in an interdisciplinary environment Production of new research ideas	Showing social, professional and ethical responsibility and sensitivity to gender issues Criticism and self-criticism Production of free, creative and inductive thinking Others...

1. Understanding of main physical characteristics of macromolecules and their use in applications and biological relevance
2. Critical and creative thinking
3. Work in interdisciplinary environment that combines physical properties and understanding of molecular characteristics.
4. Individual .and autonomous projects

(3) SYLLABUS

The course covers the following modules:

Macromolecules and macromolecular sizes
 Macromolecular time and length scale, Glass, crystal, rubber, melt.
 Polymer chain statistics, Chain elasticity
 Solutions and solvent quality.
 Phase diagrams , Polymeric mixtures
 Networks and gels
 Macromolecular motion. Coarse graining. Viscoelasticity and diffusion
 Molecular models: Short chains: dumbbell, Rouse, Zimm. Flow and diffusion predictions. Dynamic structure factor. Dynamic light scattering, Mechanical spectroscopy and time-temperature superposition, Long chains – entanglements. Reptation and model of deGennes–Doi–Edwards, Solutions: dilute, semi-dilute, dense.

Special topics

(4) TEACHING and LEARNING METHODS - EVALUATION

Delivery <i>Face-to-face, Distance learning, etc.</i>	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory eon, communication with students</i>	<ul style="list-style-type: none"> • Use of slides • Videos with demonstration/understanding experiments. • Demonstration experiments • Use of an asynchronous e-learning platform (e-class) where the following are provided:

	<ul style="list-style-type: none"> o Bibliography of the course o Slides of the course o Solved and unsolved exercises o Self-study Exercise Set o Lecture videos* o Demonstration videos and simulations o Communication through the e-class platform, use of the discussion area facility with topics, email as well as fixed office hours announced <ul style="list-style-type: none"> • Students' assignments are received and corrected via the platform (e-class) 																						
<p style="text-align: center;">TEACHING METHODS</p> <p><i>The manner and methods of teaching are described in detail.</i></p> <p><i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</i></p> <p><i>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</i></p>	<table border="1"> <thead> <tr> <th style="text-align: center;"><i>Activity</i></th> <th style="text-align: center;"><i>Semester workload</i></th> </tr> </thead> <tbody> <tr> <td>Lectures</td> <td style="text-align: center;">52</td> </tr> <tr> <td>Assignments/Projects</td> <td style="text-align: center;">30</td> </tr> <tr> <td>Directed learning activity (office hours)</td> <td style="text-align: center;">26</td> </tr> <tr> <td>Non-directed learning activity</td> <td style="text-align: center;">66</td> </tr> <tr> <td></td> <td></td> </tr> <tr> <td></td> <td></td> </tr> <tr> <td></td> <td></td> </tr> <tr> <td></td> <td></td> </tr> <tr> <td></td> <td></td> </tr> <tr> <td>Course total</td> <td style="text-align: center;">174</td> </tr> </tbody> </table>	<i>Activity</i>	<i>Semester workload</i>	Lectures	52	Assignments/Projects	30	Directed learning activity (office hours)	26	Non-directed learning activity	66											Course total	174
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(5) ATTACHED BIBLIOGRAPHY

<p>Bibliography-</p> <p>M. Rubinstein, R. H. Colby, <i>Polymer physics</i>, Oxford, 2003</p> <ul style="list-style-type: none"> • <u>Related academic journals:</u> <p>Macromolecules, ACS Macro Letters , Soft Matter</p>
--

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	MEMY-452	SEMESTER	B
COURSE TITLE	Polymer Synthesis		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>		WEEKLY TEACHING HOURS	CREDITS
		3	5
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	Special background, Specialized		
PREREQUISITE COURSES:	MATERIALS II: POLYMERS & COLLOIDS (ETY-243)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY452/		

(2) LEARNING OUTCOMES**Learning outcomes**

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

In this course the basic polymerization methods used in polymer synthesis are described. The mechanisms of the polymerisation methods and the kinetics of the reactions are discussed in detail. The effect of the reaction kinetics on the reaction rate and the polymer characteristics are also discussed. Finally, the basic macromolecular characterization techniques are presented. The students

choose contemporary research topics in polymer synthesis for presentation (Project-Compulsory).
The learning objectives of the course are the following:

- Understanding the effect of the polymerization method on the polymer characteristics.
- Consolidate the basic principles of the polymerization kinetics and be able to predict the macromolecular characteristics.
- Familiarize the students with the macromolecular characterization techniques
- Gain experience in studying the international scientific literature and present scientific topics

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 7.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

<i>Search for, analysis and synthesis of data and information, with the use of the necessary technology</i>	<i>Project planning and management</i>
	<i>Respect for difference and multiculturalism</i>
<i>Adapting to new situations</i>	<i>Respect for the natural environment</i>
<i>Decision-making</i>	<i>Showing social, professional and ethical responsibility and sensitivity to gender issues</i>
<i>Working independently</i>	
<i>Team work</i>	<i>Criticism and self-criticism</i>
<i>Working in an international environment</i>	<i>Production of free, creative and inductive thinking</i>
<i>Working in an interdisciplinary environment</i>
<i>Production of new research ideas</i>	<i>Others...</i>

- Development of interdisciplinary and critical thinking
- Search for, analysis and synthesis of data and information, with the use of the necessary technologies
- Working independently
- Team work
- Project planning and management
- Production of free, creative and inductive thinking

(3) SYLLABUS

1. Basic Concepts – Polymer Nomenclature
2. Classification of polymers
3. Polymer Microstructure: Monomer architecture, orientation, tacticity, isomers
4. Average molecular weights - Properties
5. Size and shape of macromolecules
6. Types of polymerization reactions
7. Condensation or step-growth polymerization
 - Type of step reactions
 - Molecular weight and polydispersity
 - Kinetics of condensation polymerization
 - Examples

<ul style="list-style-type: none"> • Industrial methods of condensation polymerization
<ol style="list-style-type: none"> 1. Addition of Chain-growth Polymerization <ul style="list-style-type: none"> • Free-radical polymerization • Mechanism of free-radical polymerization • Molecular weight and polydispersity • Kinetics of free-radical polymerization • Examples • Industrial methods of free-radical polymerization • Copolymerization • Copolymerization Kinetics 2. Anionic Polymerization <ul style="list-style-type: none"> • Mechanism of anionic polymerization • Molecular weight and polydispersity • Kinetics of anionic polymerization • Macromolecular architectures accessible via anionic polymerization 3. Group Transfer Polymerization 4. Cationic Polymerization <ul style="list-style-type: none"> • Mechanism of cationic polymerization • Molecular weight and polydispersity • Kinetics of cationic polymerization 5. Polymer modification reactions 6. Polymer Characterization <ul style="list-style-type: none"> • Determination of molecular weight and molecular weight distribution • Determination of polymer composition • Determination of polymer tacticity

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY <i>Face-to-face, Distance learning, etc.</i>	Face-to-Face	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	Use of Power Point, communication via the departmental website and e-mail. Use of valid online scientific sources to find references and present related topics to the students	
TEACHING METHODS <i>The manner and methods of teaching are described in detail.</i> <i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</i> <i>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</i>	Activity	Semester workload
	Lectures	39
	Exercises	16
	Homework study	60
	Assignments/Projects	24
	Directed learning activity (office hours)	26
		114
	Course total	39

STUDENT PERFORMANCE EVALUATION	<p>The students are evaluated via 4 sets of exercises (one on each polymerization method) during the semester, a final written examination in Greek, which includes a combination of problem solving and questions on developing related topics, and a project/presentation on a related topic from the international literature at the end of the semester.</p> <p>Students with learning disabilities are examined orally.</p> <p>The students have the right to check their exam script after the grades are announced and ask the tutor questions on the exam.</p> <p>The evaluation process is presented in detail to the students orally and in written form, together with the course syllabus, during the first lecture and is uploaded on the course web site:</p> <p>https://www.materials.uoc.gr/el/undergrad/courses/ETY452/</p>
<p><i>Description of the evaluation procedure</i></p> <p><i>Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</i></p> <p><i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i></p>	

(5) ATTACHED BIBLIOGRAPHY

<p>- <i>Suggested bibliography:</i></p> <ol style="list-style-type: none"> Allcock, H.R.; Lampe, F.W. Contemporary Polymer Chemistry, 2nd ed., Prentice Hall, Englewood Cliffs, 1990. Hiemenz, P.C. Polymer Chemistry: The Basic Concepts, Marcel Dekker, NY, 1984. Young, R.J.; Lovell, P.A. Introduction to Polymers, 2nd ed., Chapman & Hall, 1996. Stevens, M.P. Polymer Chemistry: An Introduction, 2nd ed., Oxford Univ. Press, 1990. <p>- <i>Additional bibliography:</i></p> <ol style="list-style-type: none"> Brandrup, J. and Immergut, E.H., eds., Polymer Handbook, 3rd ed., John Wiley & Sons, New York, 1989. Odian, G. Principles of Polymerization, 3rd ed., John Wiley & Sons, New York, 1991. Rempp, P.; Merill, E.W. Polymer Synthesis, 2nd ed., Huthig & Wepf, Basel, 1991. Cowie, L.M.G. Polymers: Chemistry and Physics of Modern Materials, 2nd ed., Chapman & Hall, Padstow, Cornwall, UK, 1998. Flory, P.J. Principles of Polymer Chemistry, Ithaca, NY, Cornell University Press, 1953. Σμιτζή, Ι. Χρ. Επιστήμη Πολυμερών, Έκδοση Εθνικού Μετσοβείου Πολυτεχνείου, Αθήνα, 1994. Παναγιώτου Κ. Επιστήμη και Τεχνολογία Πολυμερών, Εκδόσεις Πήγασος 2000, Θεσσαλονίκη, 1996. Seymour, Raymond B. and Carraher, Charles E., Giant Molecules, JohnWiley and Sons, Inc., New York, 1990. <p>- <i>Related academic journals:</i></p> <ol style="list-style-type: none"> Macromolecules, American Chemical Society Polymer Chemistry, Royal Society of Chemistry Langmuir, American Chemical Society Chemistry of Materials, American Chemical Society Biomacromolecules, American Chemical Society
--

18. Advanced Materials, Wiley
19. Advances in Polymer Science, Springer-Verlag
20. Polymer, Elsevier
21. Journal of Colloid and Interface Science, Elsevier
22. Journal of Material Chemistry, Royal Society of Chemistry
23. Journal of the American Chemical Society, American Chemical Society
24. Angewandte Chemie International Edition, Wiley

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCE AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	MEMY-453	SEMESTER	A
COURSE TITLE	Crystal Chemistry		
INDEPENDENT TEACHING ACTIVITIES		WEEKLY TEACHING HOURS	CREDITS
Lectures		4	7
COURSE TYPE	special background		
PREREQUISITE COURSES:	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mscs.uoc.gr/dmst/?courses=crystal-chemistry		

(2) LEARNING OUTCOMES

Learning outcomes
<p>The course discusses the study of inorganic crystalline solids. The crystal structures of the elements, binary, ternary and modular compounds is presented. Correlation between electronic structure and crystal structure using the LCAO approach. Defects in crystals and how those affect the physical properties of the solids (semiconductors, scintillators, transparent conducting oxides, etc.). Methods of crystal growth and structural characterization with X-ray diffraction. Modern technological applications of inorganic materials. The main educational goals that the students will achieve upon completion of the course include:</p> <ol style="list-style-type: none"> The structure of solids: Description and classifications of crystals through polyhedral representations of inorganic crystal structures. Band structure: Electronic structure derived from crystal structure. Structure-property relations. Non-stoichiometry and defects in crystals: Manipulation and control of the physical properties of solids. Synthetic methods and characterization in inorganic solids: Crystal Growth of single-crystals, polycrystalline and amorphous solids

5. Application of Inorganic compounds in technology

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 7.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology

Project planning and management

Adapting to new situations Decision-making Working independently Teamwork

Respect for difference and multiculturalism

Respect for the natural environment

Working in an international environment Working in an interdisciplinary environment Production of new research ideas

Showing social, professional and ethical responsibility and sensitivity to gender issues

Criticism and self-criticism

Production of free, creative and inductive thinking

Others...

.....

-Relating the structure of matter with the physical properties of solids.

-Relating the structure of matter with technological applications of advanced materials.

-Practical exercise on crystal structure determination from X-ray diffraction data.

-Skill development in writing scientific manuscripts in English

- Skill development in public presentation of a scientific topic.

(3) SYLLABUS

1. Structure types of Solids

α) Metals and Nonmetals

β) Binary compounds: AB, AB₂, AB₃, A₂B₃, A_xB_y

γ) Ternary compounds: ABX₂, ABX₃, AB₃, AB₂X₄, A₂BX₄, AB₂X₂

δ) Intermetallics and Zintl Phases

ε) Modular compounds: Polytypes, Homologous series and misfit layered compounds

2. Band structure (based on R. Hoffmann review).

α) Constructing "Spaghetti" diagrams starting from molecular orbitals.

β) Electronic instability (Peierls distortion, Jahn-Teller effect)

γ) Density of states, band folding, direct and indirect bandgap

δ) Quantum confinement: Low-dimensional materials, Quantum wells, Quantum wires, Quantum dots

3. Non-Stoichiometry and Defects in Crystals

- α) Nonstoichiometry and diffusion. Thermal quenching, sintering, and annealing.
- β) Phase diagrams, eutectics, spinodal decomposition and solid solutions.
- γ) Phase transitions. Phase transitions in inorganic solids, crystals and amorphous solids.

4. Synthesis methods

α) Solid-state synthesis, wet synthesis, solvothermal synthesis

β) Crystal Growth

Growth from melts, solutions and vapor transport.

γ) Structural characterization

Structure determination from single-crystals and crystalline powders. Characterization of amorphous solids (Pair Distribution Functions (PDF))

5. Applications of Inorganic Compounds in Modern Era Technology

- *Inorganic Semiconductors in Optoelectronics*

Photodiodes in Photovoltaics, Detectors and LED's

- *Porous Materials*

Gas Separation and Catalysis

- *Hydrogen Technology*

Production, Storage and Reactivity

- *Energy Storage*

Solid State Batteries

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY.	Face-to-Face	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point, Use of interactive online databases, eg <u>database of ionic radii</u> , <u>physical properties of semiconductors</u> , <u>ICSD</u> , <u>CSD</u> Use of visualization and analysis software of the crystal structure.	
TEACHING METHODS	Activity	Semester workload
	Lectures	52
	Non-directed learning activity, Study bibliography at home	94

	Directed learning activity (office hours)	26
	Course total	172
<p align="center">STUDENT PERFORMANCE EVALUATION</p> <p><i>Description of the evaluation procedure</i></p> <p><i>Language of evaluation, methods of evaluation, summative or conclusive, multiple-choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</i></p> <p><i>Specifically defined evaluation criteria are given, and if and where they are accessible to students</i></p>	<p>Language of Evaluation: English</p> <p>Successful completion of the course involves the writing of a scientific manuscript in English (40%) (JACS Communication format) on a topic related with the technological application of inorganic materials, and its oral presentation in the class (40%). The remaining (20%) is evaluated based on the class participation and understanding throughout the course. The topic will be chosen by the student after consultation with the instructor.</p>	

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- **1) Ulrich Müller, «Inorganic Structural Chemistry», 2nd Edition, Wiley 2006.**
- 2) Alexander F. Wells, «Structural Inorganic Chemistry», 5th Edition, Oxford University Press 1984.
- 3) Roald Hoffmann, «How Chemistry and Physics Meet in the Solid State», *Angew. Chem. Int. Ed. Engl.* (1987) 846-878
- 4) Anthony R. West. «Solid State Chemistry and Its Applications», 2nd Edition, Wiley 2014.
- 5) Richard J. D. Tiley, «Defects in Solids», Wiley 2008
- 6) Giovanni Ferraris, Emil Mackovicky, Stefano, Merlino, «Crystallography of Modular Materials», IUCr 2004.
- 7) Erwin Parthé «Crystal Chemistry of Tetrahedral Structures» CRC Press 1964

- Related Scientific Journals:

Chemistry of Materials

Materials Horizons

Nature Materials

Advanced Materials

Journal of Solid State Chemistry

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCE AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	MEMY -456	SEMESTER	B
ΤΙΤΛΟΣ ΜΑΘΗΜΑΤΟΣ			
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g., lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>	WEEKLY TEACHING HOURS	CREDITS	
Lectures	4	7	
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	special background		
PREREQUISITE COURSES	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English		
IS THIS COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mcs.uoc.gr/dmst/?courses=1161		

(2) LEARNING OUTCOMES

Learning outcomes
<p>The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.</p> <p>Consult Appendix A</p> <ul style="list-style-type: none">• Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area• Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B• Guidelines for writing Learning Outcomes
<p>The course according to the European Qualifications Framework for Lifelong Learning belongs to level 7.</p>

The students are expected to obtain familiarity with basic concepts in rheology and processing of materials, and the different rheological phenomena and processes

They are also expected to solve problems in processing, using appropriate assumptions, and also to understand the pertinent experimental data.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

- | | |
|--|---|
| Search for, analysis and synthesis of data and information, with the use of the necessary technology | Project planning and management |
| Adapting to new situations Decision-making
Working independently Teamwork | Respect for difference and multiculturalism
Respect for the natural environment |
| Working in an international environment Working in an interdisciplinary environment Production of new research ideas | Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
Others...
..... |

1. Understanding of basics concepts and use of rheology in materials processing.

2. Critical and creative thinking

3. Analysis of problems, use of assumptions, abstract thinking.

4. Individual and autonomous project

(3) SYLLABUS

The course covers the following modules:

- Non-Newtonian fluids and linear viscoelasticity.
- Constitutive Equations and nonlinear phenomena.
- Introduction to polymer processing. Flow of polymeric melts in pipelines.
- Examples of polymer processing (film blowing, extrusion, calendaring, injection molding).
- Solution of flow problems
- Energy balances
- Special topics

0

(4) TEACHING and LEARNING METHODS - EVALUATION

Delivery	Face-to-face
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Face-to-face, Distance learning, etc.																								
<p>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY Use of ICT in teaching, laboratory education, communication with students</p>	<ul style="list-style-type: none"> • Use of slides • Videos with demonstration/understanding experiments. • Demonstration experiments • Use of an asynchronous e-learning platform (e-class) where the following are provided: <ul style="list-style-type: none"> o Bibliography of the course o Slides of the course o Solved and unsolved exercises o Self-study Exercise Set o Lecture videos[*] o Demonstration videos and simulations • Communication through the e-class platform, use of the discussion area facility with topics, email as well as fixed office hours announced • Students' assignments are received and corrected via the platform (e-class) 																							
<p>TEACHING METHODS</p> <p>The manner and methods of teaching are described in detail.</p> <p>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</p> <p>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</p>	<table border="1"> <thead> <tr> <th data-bbox="671 786 1018 824">Activity</th> <th data-bbox="1018 786 1359 824">Semester workload</th> </tr> </thead> <tbody> <tr> <td data-bbox="671 824 1018 862">Lectures</td> <td data-bbox="1018 824 1359 862">52</td> </tr> <tr> <td data-bbox="671 862 1018 900">Assignments/Projects</td> <td data-bbox="1018 862 1359 900">30</td> </tr> <tr> <td data-bbox="671 900 1018 967">Directed learning activity (office hours)</td> <td data-bbox="1018 900 1359 967">26</td> </tr> <tr> <td data-bbox="671 967 1018 1034">Non-directed learning activity</td> <td data-bbox="1018 967 1359 1034">66</td> </tr> <tr> <td data-bbox="671 1034 1018 1072"></td> <td data-bbox="1018 1034 1359 1072"></td> </tr> <tr> <td data-bbox="671 1072 1018 1111"></td> <td data-bbox="1018 1072 1359 1111"></td> </tr> <tr> <td data-bbox="671 1111 1018 1149"></td> <td data-bbox="1018 1111 1359 1149"></td> </tr> <tr> <td data-bbox="671 1149 1018 1187"></td> <td data-bbox="1018 1149 1359 1187"></td> </tr> <tr> <td data-bbox="671 1187 1018 1225"></td> <td data-bbox="1018 1187 1359 1225"></td> </tr> <tr> <td data-bbox="671 1225 1018 1263">Course total</td> <td data-bbox="1018 1225 1359 1263">174</td> </tr> </tbody> </table>	Activity	Semester workload	Lectures	52	Assignments/Projects	30	Directed learning activity (office hours)	26	Non-directed learning activity	66											Course total	174	
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Course total	174																							
<p>STUDENT PERFORMANCE EVALUATION</p> <p>Description of the evaluation procedure</p> <p>Language of evaluation, methods of evaluation, summative or conclusive, multiple-choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</p> <p>Specifically defined evaluation criteria are given, and if and where they are accessible to students.</p>	<p>Language of Evaluation: English</p> <p>The final grade is the sum of</p> <ul style="list-style-type: none"> Course participation Quiz and homework problems Individual project Final exam 																							

(5) ATTACHED BIBLIOGRAPHY

Bibliography-

Related academic journals:

Journal of Rheology, Rheologica Acta, Journal of Non-Newtonian Fluid Mechanics, Physics of Fluids

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	Post-graduate		
COURSE CODE	MEMY-471	SEMESTER	A
COURSE TITLE	Elements of Colloidal Dispersions		
INDEPENDENT TEACHING ACTIVITIES		WEEKLY TEACHING HOURS	CREDITS
Lectures		4	7
COURSE TYPE	special background		
PREREQUISITE COURSES:	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mscs.uoc.gr/dmst/?courses=elements-of-colloidal-dispersions		

(2) LEARNING OUTCOMES

Learning outcomes
<p>The course is an introduction to colloidal dispersions aiming in providing a basic knowledge on colloidal interactions, phase behavior and colloidal dynamics The learning goals that students should have achieved at the end of the lesson are the following:</p> <ol style="list-style-type: none"> 1. Familiarize with Colloidal systems and the main physical mechanisms governing their behavior 2. Understand the role of colloidal interactions in the stability of colloidal dispersions and the thermodynamic phase behavior as well as in the formation of out of equilibrium states such as glasses and gels 3. To understand Brownian motion, and the characteristics of diffusion

4. Effects of Hydrodynamic Interactions on the dynamics and their volume fraction dependence

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 7.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology

*Adapting to new situations Decision-making
Working independently Teamwork*

Working in an international environment Working in an interdisciplinary environment Production of new research ideas

Project planning and management

Respect for difference and multiculturalism

Respect for the natural environment

Showing social, professional and ethical responsibility and sensitivity to gender issues

Criticism and self-criticism

Production of free, creative and inductive thinking

Others...

.....

- Development of interdisciplinary and critical thinking
- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Production of free, creative and inductive thinking

(3) SYLLABUS

Introduction

Examples of Soft Matter systems: Polymers, Colloids, Biomaterials, Surfactants and Micelles, Liquid Crystals, Emulsions and Foams.

Polymers

1. Introduction
2. Types and names of polymeric systems
3. Basic examples in Polymer Synthesis
4. Macromolecular characterization, Chain architecture, Molecular weight, End-to-end distance and Radius of gyration
5. Solutions, concentration regimes, interactions
6. Phase behavior
7. Amorphous and Crystalline polymers. Elastomers
8. Polymer mixtures and copolymers

Colloids

1. Introduction
2. Types of colloidal systems
3. Colloidal Interaction, colloidal stabilization
4. Colloid-polymer mixtures

5. Dense suspensions and crystals
6. Colloidal glasses and gels

Presentation of a research topic or recent break through study or modern application of colloidal systems

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY.	Face-to-face	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	Use of Power Point and video material from the internet Communication through the e-class platform, use of the discussion area facility with topics, email as well as fixed office hours announced	
TEACHING METHODS <i>The manner and methods of teaching are described in detail.</i> <i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</i> <i>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</i>	Activity	Semester workload
	Lectures	52
	Directed learning activity (office hours)	26
	Non-directed learning activity	95
	Σύνολο Μαθήματος	173
STUDENT PERFORMANCE EVALUATION <i>Description of the evaluation procedure</i> <i>Language of evaluation, methods of evaluation, summative or conclusive, multiple-choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</i> <i>Specifically defined evaluation criteria are given, and if and where they are accessible to students</i>	Language of Evaluation: English Students are evaluated by a final written that includes a combination of: - Questions on theory - Exercises including calculations Oral exam is foreseen for students with specific learning difficulties -Presentation from graduate students (bonus 20%) - Students have the right to view their exam scripts after the grading results are published and to ask questions.	

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Course notes (G. Petekidis)
2. R. J. Hunter, Foundations of Colloid Science, Oxford, University Press, New York, 2001
3. W.B. Russel, D.A. Saville, W.R.Schowalter, Colloidal Dispersions, Cambridge University Press, 1989
4. Panagiotou, Interfacial phenomena and Colloidal systems 1998.
5. D. F. Evans, H. Wennerström, The Colloidal Domain, Where Physics, Chemistry, Biology and Technology meet, 2nd Edition, John Willey and Sons, New York, 1999.
6. R. M. Fitch, "Polymer Colloids, A comprehensive introduction", Academic Press, London, 1997

- Related academic journals:

Soft Matter, Macromolecules, Langmuir, Journal of Colloid and Interface Science, Physical Review Letters, Physical Review E

GENERAL

SCHOOL	SCHOOL OF SCIENCE AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	MEMY -483	SEMESTER	B
COURSE TITLE	Fundamentals of Magnetic Materials		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g., lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>		WEEKLY TEACHING HOURS	CREDITS
Lectures		3	7
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	special background		
PREREQUISITE COURSES	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English		
IS THIS COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mcs.uoc.gr/dmst/?courses=fundamentals-of-magnetic-materials		

(2) LEARNING OUTCOMES

Learning outcomes
<p>The course combines a general overview of the field of nanotechnology of Magnetic Materials with an in-depth introduction to the basic principles of Applied Magnetism. Special emphasis is given in methods of characterization and applications of magnetic materials in cutting edge technologies and devices.</p> <p>The course according to the European Qualifications Framework for Lifelong Learning belongs to level 7.</p>
General Competences

- Development of interdisciplinary and critical thinking
- Analysis and synthesis of data and information, with the use of the necessary technology
- Ability to conduct independent research

(3) SYLLABUS

- Magnetostatics
- Methods of magnetic measurements
- Magnetic domains
- Ferromagnetic particles
- Thin films
- Applications of ferromagnetic materials
- Magnetic recording technology

(4) TEACHING and LEARNING METHODS - EVALUATION

Delivery <i>Face-to-face, Distance learning, etc.</i>	Face-to-face	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	<ul style="list-style-type: none"> • Use of slides • Use of an asynchronous e-learning platform (e-class) where the following are provided: <ul style="list-style-type: none"> o <i>Bibliography of the course</i> o <i>Slides of the course</i> o <i>Solved and unsolved exercises</i> o Communication through the e-class platform, use of the discussion area facility with topics, email as well as fixed office hours announced 	
TEACHING METHODS <i>The manner and methods of teaching are described in detail.</i> <i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</i> <i>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</i>	Activity	Semester workload
	Lectures	39
	Assignments/Projects	35
	Directed learning activity (office hours)	26
	Non-directed learning activity	65
	Course total	165
STUDENT PERFORMANCE EVALUATION <i>Description of the evaluation procedure</i> <i>Language of evaluation, methods of evaluation, summative or conclusive, multiple-choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public</i>	Language of Evaluation: English The evaluation is based on a short exam during the semester, a report and oral presentation on a project and a final exam at the end of the semester.	

<p><i>presentation, laboratory work, clinical examination of patient, art interpretation, other</i></p> <p><i>Specifically defined evaluation criteria are given, and if and where they are accessible to students.</i></p>	
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(5) ATTACHED BIBLIOGRAPHY

<p>Bibliography-</p> <ul style="list-style-type: none">• <i>D. Jiles, Introduction to Magnetism and Magnetic Materials, Chapman & Hall (1991).</i>• <i>B.D. Cullity, Introduction to Magnetic Materials, Addison Wesley (1972).</i>• <i>J.M.D. Coey, Magnetism and Magnetic Materials, Cambridge Univ. Press (2012)</i>
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(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES & ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF MATERIAL SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	MEMY-490	SEMESTER	B
COURSE TITLE	Photonic Materials		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>	WEEKLY TEACHING HOURS	CREDITS	
Credits awarded for the whole course (lectures and practice)	4	7	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	special background		
PREREQUISITE COURSES:	A good knowledge of Electromagnetism and/or Optics is recommended.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mcs.uoc.gr/dmst/?courses=photonic-materials		

(2) LEARNING OUTCOMES

Learning outcomes <i>The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.</i> Consult Appendix A <ul style="list-style-type: none">• Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area• Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B• Guidelines for writing Learning Outcomes
Elective postgraduate course that gives a broad view of the field of Photonics, with emphasis on modern applications, like in telecommunications and nano-photonics.
General Competences <i>Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?</i> Search for, analysis and synthesis of data and Project planning and management

<i>information, with the use of the necessary technology</i>	<i>Respect for difference and multiculturalism</i>
<i>Adapting to new situations</i>	<i>Respect for the natural environment</i>
<i>Decision-making</i>	<i>Showing social, professional and ethical responsibility and sensitivity to gender issues</i>
<i>Working independently</i>	<i>Criticism and self-criticism</i>
<i>Team work</i>	<i>Production of free, creative and inductive thinking</i>
<i>Working in an international environment</i>
<i>Working in an interdisciplinary environment</i>	<i>Others...</i>
<i>Production of new research ideas</i>

Autonomous and group work.

Analytic and synthetic ability for solving complex problems.

Critical thinking.

Bibliographic study, analysis, synthesis and presentation of modern research work.

(3) SYLLABUS

- *Light and matter, light waves, absorption and emission, optical properties of matter*
- *Modern lasers: operation principles, new technologies and applications*
- *Optics of short laser pulses: theory and applications*
- *Nonlinear optics: materials, systems and spatio-temporal phenomena*
- *Optical fibers – Telecommunications*
- *Photonic crystals*
- *Metamaterials*
- *Terahertz photonics*

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY <i>Face-to-face, Distance learning, etc.</i>	Face-to-face	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	Use of ICT in delivery and communication with students Use of slides <ul style="list-style-type: none"> • Communication through the e-class platform, use of the discussion area facility with topics, email as well as fixed office hours announced 	
TEACHING METHODS <i>The manner and methods of teaching are</i>	Activity	Semester workload
	Lectures	52

<p><i>described in detail.</i></p> <p><i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</i></p> <p><i>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</i></p>	Assignments/Projects	30
	Directed learning activity (office hours)	26
	Non-directed learning activity	66
	Course total	174
<p align="center">STUDENT PERFORMANCE EVALUATION</p> <p><i>Description of the evaluation procedure</i></p> <p><i>Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</i></p> <p><i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i></p>	<p>Language of Evaluation: English</p> <p>The final grade is the sum of</p> <p>:</p> <p>Written exam 40%,</p> <p>Research project 60%.</p>	

(5) ATTACHED BIBLIOGRAPHY

<p>- Suggested bibliography:</p> <ul style="list-style-type: none"> • <i>Fundamentals of Photonics, B.E.A. Saleh and M.C. Teich, 2nd edition Wiley</i> • <i>Photonics, A. Yariv and P. Yeh, 6th edition Oxford University Press</i>

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES & ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF MATERIAL SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	MEMY-490	SEMESTER	B
COURSE TITLE	Photonic Materials and Devices		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>	WEEKLY TEACHING HOURS	CREDITS	
Credits awarded for the whole course (lectures and practice)	4	7	
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	special background		
PREREQUISITE COURSES:	A good knowledge of Electromagnetism and/or Optics is recommended.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mscs.uoc.gr/dmst/?courses=photonic-materials		

(2) LEARNING OUTCOMES

Learning outcomes <i>The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.</i> Consult Appendix A <ul style="list-style-type: none">• Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area• Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B• Guidelines for writing Learning Outcomes
Elective postgraduate course that gives a broad view of the field of Photonics, with emphasis on modern applications, like in telecommunications and nano-photonics.
General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	Project planning and management
Adapting to new situations	Respect for difference and multiculturalism
Decision-making	Respect for the natural environment
Working independently	Showing social, professional and ethical responsibility and sensitivity to gender issues
Team work	Criticism and self-criticism
Working in an international environment	Production of free, creative and inductive thinking
Working in an interdisciplinary environment
Production of new research ideas	Others...

- Work independently and in Teamwork.
- Analytical and synthetic ability to solve problems.
- Critical thinking.
- Manages complex physical theories and mathematical techniques.
- Bibliographic research, analysis, synthesis and presentation of contemporary research findings.

(3) SYLLABUS

- Light and matter, light waves, absorption and emission, optical properties of matter
- Modern ultrashort and powerful lasers
- Optics of short laser pulses: theory and applications
- Nonlinear optics: materials, systems and spatio-temporal phenomena
- Optical fibers – Telecommunications
- Photonic crystals
- Metamaterials
- Terahertz photonics and devices

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY <i>Face-to-face, Distance learning, etc.</i>	Face-to-face	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	Use of ICT in delivery and communication with students Use of slides <ul style="list-style-type: none"> • Use of an asynchronous e-learning platform (e-class) where the following are provided: <ul style="list-style-type: none"> o Bibliography of the course o Slides of the course o Solved and unsolved exercises o Self-study Exercise Set o Lecture videos o Demonstration videos and simulations o Communication through the e-class platform Students' assignments are received and corrected via the platform (e-class)	
TEACHING METHODS <i>The manner and methods of teaching are described in detail.</i> <i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational</i>	Activity	Semester workload
	Lectures	52
	Assignments/Projects	30
	Directed learning activity (office hours)	26
	Non-directed learning	66

<p>visits, project, essay writing, artistic creativity, etc.</p> <p>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</p>	activity	
	Course total	174
<p>STUDENT PERFORMANCE EVALUATION</p> <p>Description of the evaluation procedure</p> <p>Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</p> <p>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</p>	<p>Language of Evaluation: English</p> <p>Evaluation methods: Active participation in the class (questions and quizzes) 10%, Homework/Presentations 30 %, Research project 60%.</p>	

(5) ATTACHED BIBLIOGRAPHY

<p>- Suggested bibliography:</p> <ul style="list-style-type: none"> • <i>Fundamentals of Photonics</i>, B.E.A. Saleh and M.C. Teich, 2nd edition Wiley • <i>Photonics</i>, A. Yariv and P. Yeh, 6th edition Oxford University Press

GENERAL

SCHOOL	SCHOOL OF SCIENCE AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	MEMY -491	SEMESTER	A
COURSE TITLE	Organic Materials and Synthetic Biomaterials		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g., lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>		WEEKLY TEACHING HOURS	CREDITS
Lectures		4	7
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	special background		
PREREQUISITE COURSES	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English		
IS THIS COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mcs.uoc.gr/dmst/?courses=biological-materials-and-synthetic-biomaterials		

(2) LEARNING OUTCOMES

<p>Learning outcomes</p> <p><i>The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.</i></p> <p><i>Consult Appendix A</i></p> <ul style="list-style-type: none"> <i>Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area</i> <i>Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B</i> <i>Guidelines for writing Learning Outcomes</i> <p>The course gives a broad overview of the field of organic and synthetic biomaterials, presenting examples of biomaterial applications in medicine but also ethical issues that arise for the development of new biomaterials.</p> <p><i>The course according to the European Qualifications Framework for Lifelong Learning belongs to level 7.</i></p> <p>General Competences</p>
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Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology

Project planning and management

Adapting to new situations Decision-making
Working independently Teamwork

Respect for difference and multiculturalism

Respect for the natural environment

Working in an international environment Working in an interdisciplinary environment Production of new research ideas

Showing social, professional and ethical responsibility and sensitivity to gender issues

Criticism and self-criticism

Production of free, creative and inductive thinking

Others...

.....

- Work independently and in Teamwork.
- Analytical and synthetic ability to solve problems.
- Critical thinking
- Bibliographic research, analysis, synthesis and presentation of contemporary research findings.

(3) SYLLABUS

The course covers the following modules:

- Properties of materials, categories of materials used in Medicine,
- History of biomaterials,
- Examples of biomaterials in organs and systems of the body,
- The role of protein adsorption in the biological response, Cells, tissues, extracellular matrix, Cell-biomaterial interactions, Host reactions in biomaterials and their evaluation: inflammation, infection, infection, treatment, immunization, hypersensitivity, toxicity, tumorigenesis, blood clotting,
- Biological control of biomaterials: in vivo, and in vitro, compatibility,
- Degradation of materials in biological environment,
- Applications of biomaterials in orthopedics, hip and knee prosthetics,
- Dental implantation, Surgical suture threads, Implant failure,
- Ethical issues for the development of new biomaterials,
- Prospects and possibilities in Biomaterials Science

(4) TEACHING and LEARNING METHODS - EVALUATION

Delivery <i>Face-to-face, Distance learning, etc.</i>	Face-to-face	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	<ul style="list-style-type: none"> • Use of slides • Communication through the e-class platform, use of the discussion area facility with topics, email as well as fixed office hours announced 	
TEACHING METHODS <i>The manner and methods of teaching are described in detail.</i>	Activity	Semester workload
	Lectures	52
	Assignments/Projects	30

<p>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</p> <p>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</p>	Directed learning activity (office hours)	26
	Non-directed learning activity	66
	Course total	174
<p>STUDENT PERFORMANCE EVALUATION</p> <p>Description of the evaluation procedure</p> <p>Language of evaluation, methods of evaluation, summative or conclusive, multiple-choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</p> <p>Specifically defined evaluation criteria are given, and if and where they are accessible to students.</p>	<p>Language of Evaluation: English</p> <p>The final grade results from the grade in the final written examination and the grade of the assignments</p>	

(5) ATTACHED BIBLIOGRAPHY

<p>Bibliography-</p>

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCE AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	MEMY -496	SEMESTER	B
COURSE TITLE	Tissue Engineering		
INDEPENDENT TEACHING ACTIVITIES		WEEKLY TEACHING HOURS	CREDITS
	Lectures	4	7
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	special background		
PREREQUISITE COURSES	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English		
IS THIS COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mscs.uoc.gr/dmst/?courses=tissue-engineering		

(2) LEARNING OUTCOMES

Learning outcomes
<p>To get acquainted with the structure of various tissues, organs and organ systems.</p> <p>To get acquainted with basic principles of developmental biology.</p> <p>To know the components of tissue constructs: biomaterials, cells and bioactive molecules.</p> <p>To know the various types of biomaterials utilized in tissue engineering.</p> <p>To know the basic biology and applications of stem cells in tissue engineering.</p> <p>To know the basic biofabrication methods utilized in tissue engineering.</p> <p>To know the basic principles of mechanics (solid mechanics, fluid mechanics, dynamics) that describe tissue constructs.</p> <p>To know the major experimental means used for tissue construct characterization.</p> <p>Exposure to the state of the art of the major applications of tissue engineering: emphasis on regenerative medicine grafts, drug delivery systems, in vitro tissue models.</p>
General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
 Adapting to new situations Decision-making
 Working independently Teamwork
 Working in an international environment Working in an interdisciplinary environment Production of new research ideas

Project planning and management
 Respect for difference and multiculturalism
 Respect for the natural environment
 Showing social, professional and ethical responsibility and sensitivity to gender issues
 Criticism and self-criticism
 Production of free, creative and inductive thinking
 Others...

Find, read and analyze recent scientific literature.

Work in teams.

Working in an interdisciplinary environment.

(3) SYLLABUS

The course covers the following modules:

- Structure of tissues, organs and organ systems. Case studies.
- Introduction – major concepts of tissue engineering.
- Biomaterials in tissue engineering: types, fabrication, characteristics, modification, characterization, case studies.
- Stem cells in tissue engineering: types, characterization, case studies.
- Drug delivery systems.
- Biofabrication: methods, hardware, case studies.
- Mathematic modelling in tissue engineering: solid mechanics, fluid mechanics, dynamic systems. Overview of relevant software.
- Applications of tissue engineering in regenerative medicine: cases of induced regeneration in the therapy of tissue loss or organ function loss.
- Applications of tissue engineering in drug delivery: concepts, technologies, characterization, case studies.
- Applications of tissue engineering in *in vitro* tissue organs: types, technologies, case studies.

(4) TEACHING and LEARNING METHODS - EVALUATION

Delivery <i>Face-to-face, Distance learning, etc.</i>	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	<ul style="list-style-type: none"> • Use of slides • Reading and discussion on published research papers. • Use of an asynchronous e-learning platform (e-class) where the following are provided: <ul style="list-style-type: none"> o <i>Bibliography of the course</i> o <i>Slides of the course</i> o <i>Research papers and scientific articles.</i> o Communication through the e-class platform, use of the discussion area facility with topics, email as well as fixed office hours announced

	<ul style="list-style-type: none"> Students' assignments are received and corrected via the platform (e-class) 												
<p style="text-align: center;">TEACHING METHODS</p> <p><i>The manner and methods of teaching are described in detail.</i></p> <p><i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</i></p> <p><i>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</i></p>	<table border="1"> <thead> <tr> <th style="text-align: center;"><i>Activity</i></th> <th style="text-align: center;"><i>Semester workload</i></th> </tr> </thead> <tbody> <tr> <td>Lectures</td> <td style="text-align: center;">52</td> </tr> <tr> <td>Assignments/Projects</td> <td style="text-align: center;">30</td> </tr> <tr> <td>Directed learning activity (office hours)</td> <td style="text-align: center;">26</td> </tr> <tr> <td>Non-directed learning activity</td> <td style="text-align: center;">66</td> </tr> <tr> <td>Course total</td> <td style="text-align: center;">174</td> </tr> </tbody> </table>	<i>Activity</i>	<i>Semester workload</i>	Lectures	52	Assignments/Projects	30	Directed learning activity (office hours)	26	Non-directed learning activity	66	Course total	174
	<i>Activity</i>	<i>Semester workload</i>											
	Lectures	52											
	Assignments/Projects	30											
	Directed learning activity (office hours)	26											
	Non-directed learning activity	66											
Course total	174												
<p style="text-align: center;">STUDENT PERFORMANCE EVALUATION</p> <p><i>Description of the evaluation procedure</i></p> <p><i>Language of evaluation, methods of evaluation, summative or conclusive, multiple-choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</i></p> <p><i>Specifically defined evaluation criteria are given, and if and where they are accessible to students.</i></p>	<p>Language of Evaluation: English</p> <p>The final grade is the sum of</p> <ol style="list-style-type: none"> 1) final exam that includes multiple-choice questionnaires and short-answer questions, 2) class participation, 3) oral presentation and examination of semester project. 												

(5) ATTACHED BIBLIOGRAPHY

<p>Bibliography-</p> <p>J.P. Fisher, A.G. Mikos, J.D. Bronzino "Tissue Engineering", CRC Press, 2007.</p>
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GENERAL

SCHOOL	SCHOOL OF SCIENCE AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	MEMY -512	SEMESTER	B
COURSE TITLE	Computational Materials Science II		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g., lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>		WEEKLY TEACHING HOURS	CREDITS
Lectures		4	7
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	special background		
PREREQUISITE COURSES	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English		
IS THIS COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)			

(2) LEARNING OUTCOMES

<p>Learning outcomes</p> <p><i>The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.</i></p> <p>Consult Appendix A</p> <ul style="list-style-type: none"> • Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area • Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B • Guidelines for writing Learning Outcomes <p>By the end of the course, students are expected to:</p> <ul style="list-style-type: none"> • Become familiar with the modern theory of electronic structure, and more specifically with DFT (Density Functional Theory), by employing large software packages.
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- Know the basic principles of solving quantum mechanical problems in materials science as well as how to perform computational experiments in order to study properties of standard materials.
- Develop scientific computing and software related technical skills.
- Acquire hands-on experience in first principles calculations for solving challenging problems in materials science.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 7.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology

*Adapting to new situations Decision-making
Working independently Teamwork*

Working in an international environment Working in an interdisciplinary environment Production of new research ideas

Project planning and management

Respect for difference and multiculturalism

Respect for the natural environment

Showing social, professional and ethical responsibility and

sensitivity to gender issues

Criticism and self-criticism

Production of free, creative and inductive thinking

Others...

.....

- Production of free, creative and inductive thinking
- Working independently
- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Project planning and management

(3) SYLLABUS

1. Introduction to DFT.
Schrödinger equation for polyelectronic systems and methods for its solution. Exchange and correlation potential. Calculation of molecules energy and reactions enthalpy.
2. Crystalline solids.
Density and bulk modulus calculation using Bloch theorem. Energy bands.
3. Extension of theory to semi-periodic structures. The concept of surface tension. Influence of adsorbed molecules on surface properties. Adsorption enthalpy.
4. Magnetic materials. The role of spin in the magnetic properties of materials, such as iron, as well as in the cohesion of nonmagnetic molecules, such as H₂ The concept of density of states and its calculation. Oscillations of simple molecules.
5. Experimental techniques.
Basic principles of experiments for the depiction of the electronic structure, such as STM (Scanning Tunneling Microscope) and their simulation. Electronic band structure calculations in metals, insulators, and semiconductors.
6. Reaction speeds.
TST (Transition State Theory) and nudged elastic band method for the calculation of the speed of a chemical reaction. Application to diffusion constants calculation.

(4) TEACHING and LEARNING METHODS - EVALUATION

<p style="text-align: center;">Delivery <i>Face-to-face, Distance learning, etc.</i></p>	Face-to-face													
<p style="text-align: center;">USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i></p>	<ul style="list-style-type: none"> • Use of slides • Videos with demonstration/understanding experiments. • Use of an asynchronous e-learning platform (e-class) where the following are provided: <ul style="list-style-type: none"> o <i>Bibliography of the course</i> o <i>Slides of the course</i> o <i>Solved and unsolved exercises</i> o <i>Self-study Exercise Set</i> o <i>Lecture videos</i>[*] o <i>Demonstration videos and simulations</i> o Communication through the e-class platform, use of the discussion area facility with topics, email as well as fixed office hours announced • Students' assignments are received and corrected via the platform (e-class) 													
<p style="text-align: center;">TEACHING METHODS</p> <p><i>The manner and methods of teaching are described in detail.</i></p> <p><i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</i></p> <p><i>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</i></p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;"><i>Activity</i></th> <th style="text-align: center;"><i>Semester workload</i></th> </tr> </thead> <tbody> <tr> <td>Lectures</td> <td style="text-align: center;">52</td> </tr> <tr> <td>Assignments/Projects</td> <td style="text-align: center;">30</td> </tr> <tr> <td>Directed learning activity (office hours)</td> <td style="text-align: center;">26</td> </tr> <tr> <td>Non-directed learning activity</td> <td style="text-align: center;">66</td> </tr> <tr> <td>Course total</td> <td style="text-align: center;">174</td> </tr> </tbody> </table>		<i>Activity</i>	<i>Semester workload</i>	Lectures	52	Assignments/Projects	30	Directed learning activity (office hours)	26	Non-directed learning activity	66	Course total	174
<i>Activity</i>	<i>Semester workload</i>													
Lectures	52													
Assignments/Projects	30													
Directed learning activity (office hours)	26													
Non-directed learning activity	66													
Course total	174													
<p style="text-align: center;">STUDENT PERFORMANCE EVALUATION</p> <p><i>Description of the evaluation procedure</i></p> <p><i>Language of evaluation, methods of evaluation, summative or conclusive, multiple-choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</i></p> <p><i>Specifically defined evaluation criteria are given, and if and where they are accessible to students.</i></p>	<p>Language of Evaluation: English</p> <p>Student performance evaluation consists of mandatory exercises handed out and graded during the course of the semester and a final project with in class presentation at the end of the semester.</p>													

(5) ATTACHED BIBLIOGRAPHY

<p>Bibliography-</p> <ul style="list-style-type: none"> • Frank Jensen, <i>Introduction to Computational Chemistry</i>, Wiley-VCH, 2nd edition 2006. • Efthimios Kaxiras, <i>Atomic and Electronic Structure of Solids</i>, Cambridge University Press, 2003.
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- Richard M. Martin, *Electronic Structure: Basic Theory and Practical Methods*, Cambridge University Press, 2004.
- Jos M. Thijssen, *Computational Physics*, Cambridge University Press, 1999

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	MEMY-580	SEMESTER	A
COURSE TITLE	OPTOELECTRONICS & LASER		
INDEPENDENT TEACHING ACTIVITIES		WEEKLY TEACHING HOURS	CREDITS
		3	7
COURSE TYPE	special background		
PREREQUISITE COURSES:	Without being strict prerequisites, in this course is assumed that students have been taught an introductory course in Semiconductor Physics such as ETY 242 and ETY 481, and an introductory course in Solid State Physics such as ETY 305		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mcs.uoc.gr/dmst/?courses=optoelectronics-and-laser		

(2) LEARNING OUTCOMES

(2) Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

The course combines a general overview of the field of Optoelectronics with an in-depth introduction to the operating principles of perhaps the most characteristic and exciting optoelectronic device, which is the laser diode. Special emphasis is given in handling problems of practical interest that require the use of computer and of basic computational methods.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 7.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

<i>Search for, analysis and synthesis of data and information, with the use of the necessary technology</i>	<i>Project planning and management</i>
<i>Adapting to new situations Decision-making Working independently Teamwork</i>	<i>Respect for difference and multiculturalism</i>
<i>Working in an international environment Working in an interdisciplinary environment Production of new research ideas</i>	<i>Respect for the natural environment</i>
	<i>Showing social, professional and ethical responsibility and sensitivity to gender issues</i>
	<i>Criticism and self-criticism</i>
	<i>Production of free, creative and inductive thinking</i>
	<i>Others...</i>
	<i>.....</i>

Search, analyze and synthesize data and information, using the necessary technologies

- Promotion of free but structured, creative and inductive thinking

- Autonomous work

SYLLABUS

- Brief review of the optical properties of semiconductors, quantum wells and waveguides
- General presentation of diode lasers and other optoelectronic devices
- Conditions for lasing action
- Operating principles of diode lasers
- Special reflectors and cavities for diode lasers
- Optical gain in quantum wells
- Tunable semiconductor laser

(3) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY.	Face-to-Face	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	Use of a video projector during lectures with Power Point or pdf slides. Posting announcements and communicating with students through an e-class environment.	
TEACHING METHODS	Activity	Semester workload
	Lectures	39
	Assignments/Projects	60

	Directed learning activity (office hours)	10
	Non-directed learning activity	66
	Course total	174
STUDENT PERFORMANCE EVALUATION	<p>Language of Evaluation: English</p> <p>The evaluation of students is done by delivering sets of exercises during the semester corresponding to 40% of the grade and a final exam in the form of a take-home exam corresponding to 60% of the grade.</p> <p>The book by L. Coldren and S. Corzine, is followed in the course</p>	

(4) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- L. Coldren and S. Corzine, Diode lasers and photonic integrated circuits, Wiley Series in Microwave and Optical Engineering, John Wiley & Sons (1995)
- P. Yeh, Optical Waves in Layered Media, Wiley Series in Pure and Applied Optics (1988)
- G. P. Agrawal and N. K. Dutta, Semiconductor Lasers, 2nd Edition, International Thomson Publishing (1993)
- J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill (1995)

GENERAL

SCHOOL	SCHOOL OF SCIENCE AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	MEMY -582	SEMESTER	A
COURSE TITLE	Advanced Organic Materials for Energy and Environment		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g., lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>		WEEKLY TEACHING HOURS	CREDITS
Lectures		4	7
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	special background		
PREREQUISITE COURSES	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English		
IS THIS COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mcs.uoc.gr/dmst/?courses=advanced-organic-materials-for-energy-and-environment		

(2) LEARNING OUTCOMES

<p>Learning outcomes</p> <p>The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.</p> <p>Consult Appendix A</p> <ul style="list-style-type: none"> • Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area • Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B • Guidelines for writing Learning Outcomes <p>The course aims to introduce students to contemporary issues of loose material, and more specifically to organic and polymeric materials of particular technological impact in the field of energy. More specifically, the course will introduce students to the basic principles of synthesis of Organic Conductive Materials (HIO), their optoelectronic properties and special</p>

emphasis will be given to the structure-properties correlation of nanostructured active materials for their use in: 1) innovative organic solar cells, 2) electrochemical energy storage devices and 3) fuel cells. The main axis of the course is the study of new advanced energy materials, the understanding of their properties at the nanoscale and how they affect/determine their macroscopic properties as well as the understanding of the operating mechanisms of organic energy production and storage devices. The aim of the course is for students to combine existing knowledge with what they will acquire in the course in order to deepen in modern research issues the loose material for energy production and storage. In the last part of the course, students will be asked, in collaboration with the instructor, to select and present a recent research article whose performance will determine 25% of the grade.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 7.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

<i>Search for, analysis and synthesis of data and information, with the use of the necessary technology</i>	<i>Project planning and management</i>
<i>Adapting to new situations</i>	<i>Respect for difference and multiculturalism</i>
<i>Decision-making</i>	<i>Respect for the natural environment</i>
<i>Working independently</i>	<i>Showing social, professional and ethical responsibility and sensitivity to gender issues</i>
<i>Teamwork</i>	<i>Criticism and self-criticism</i>
<i>Working in an international environment</i>	<i>Production of free, creative and inductive thinking</i>
<i>Working in an interdisciplinary environment</i>	<i>Others...</i>
<i>Production of new research ideas</i>	<i>.....</i>

- Search, analyze and synthesize data and information, using the necessary technologies
- Promotion of free but structured, creative and inductive thinking
- - Autonomous work

(3) SYLLABUS

The course includes:

Introduction-Description and classification of Organic Conductive Materials (HIO), Optical and Optoelectronic Properties of Advanced HIO, Basic Principles of Operation of Organic Photovoltaics, Correlation of Structure – Properties of Nanostructured Active Films, Organic Electrolytes, Electrochemical Energy Storage Devices, Mechanisms of Operation of Solid Organic Electrolytes, Solid State Batteries, Basic Principles of Fuel Cell Operation, Hybrid Nanomaterial Systems for Advanced Energy Production and Storage Technologies, Advanced Materials for Batteries Other than Lithium-Ion.

(4) TEACHING and LEARNING METHODS - EVALUATION

Delivery <i>Face-to-face, Distance learning, etc.</i>	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	<ul style="list-style-type: none"> • Use of slides • Communication through the e-class platform, use of the discussion area facility with topics, email as well as fixed

	office hours announced	
<p style="text-align: center;">TEACHING METHODS</p> <p><i>The manner and methods of teaching are described in detail.</i></p> <p><i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</i></p> <p><i>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</i></p>	Activity	Semester workload
	Lectures	52
	Assignments/Projects	30
	Directed learning activity (office hours)	26
	Non-directed learning activity	66
	Course total	174
STUDENT PERFORMANCE EVALUATION	Language of Evaluation: English	
<p><i>Description of the evaluation procedure</i></p> <p><i>Language of evaluation, methods of evaluation, summative or conclusive, multiple-choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</i></p> <p><i>Specifically defined evaluation criteria are given, and if and where they are accessible to students.</i></p>	<p>The final grade results from the presentation of a research paper and the final examination</p>	

(5) ATTACHED BIBLIOGRAPHY

<p>Bibliography-</p> <ul style="list-style-type: none"> • M. Geoghegan and G. Hadziioannou, Polymer Electronics , Oxford University Press, 2013 • D. M. Santos, C.A.C Sequeira, Polymer Electrolytes, Elsevier, 2010 • M. Eikerling and A. Kulikovsky, Polymer Electrolyte Fuel Cells: Physical Principles of Materials and Operation, Taylor & Francis Group, 2015

GENERAL

SCHOOL	SCHOOL OF SCIENCE AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	MEMY -598	SEMESTER	A
COURSE TITLE	Bioorganic Nanostructures – Supramolecular Chemistry		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g., lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>		WEEKLY TEACHING HOURS	CREDITS
Lectures		3	7
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	special background		
PREREQUISITE COURSES	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English		
IS THIS COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mscs.uoc.gr/dmst/?courses=bioorganic-nanostructures-supramolecular-chemistry		

(2) LEARNING OUTCOMES

<p>Learning outcomes</p> <p>The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.</p> <p>Consult Appendix A</p> <ul style="list-style-type: none"> • Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area • Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B • Guidelines for writing Learning Outcomes <p>The course aims to provide knowledge of the basic definitions and concepts of supramolecular chemistry, an overview of the fundamental interactions governing self-assembly and its application to living organisms and synthetic nanostructures, and finally a first consideration of current trends in the design of supramolecular assemblies and devices based on current literature.</p> <p><i>The course according to the European Qualifications Framework for Lifelong Learning</i></p>

belongs to level 7.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	Project planning and management
Adapting to new situations Decision-making	Respect for difference and multiculturalism
Working independently Teamwork	Respect for the natural environment
Working in an international environment Working in an interdisciplinary environment	Showing social, professional and ethical responsibility and sensitivity to gender issues
Production of new research ideas	Criticism and self-criticism
	Production of free, creative and inductive thinking
	Others...

- Autonomous work
- Teamwork
- Working in an interdisciplinary environment
- Generation of new research ideas
- Promoting free, creative and inductive thinking

(3) SYLLABUS

The course provides an analytical first overview of supramolecular chemistry and methods for the construction of self-organizing (bio)nanostuctures. It aims at understanding the principles of supramolecular chemistry of intermolecular interactions that determine the formation of supramolecular structures. The fundamental interactions of self-organizing host-guest systems and functional supramolecular devices are analyzed using examples from nature and modern scientific literature. The most important approaches to the design of supramolecular systems are presented along with their properties and functions.

1. Nanotechnology: definition, approaches, perspectives.
2. Supramolecular chemistry: Definition and basic principles. Self-organization.
3. Intermolecular interactions. Self-organization: Amphiphilic molecules. Polymers, helical polymers, supramolecular polymers. Peptides. Proteins. Oligonucleotides.

(4) TEACHING and LEARNING METHODS - EVALUATION

Delivery <i>Face-to-face, Distance learning, etc.</i>	Face-to-face	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	<ul style="list-style-type: none"> • Use of slides • Communication through the e-class platform, use of the discussion area facility with topics, email as well as fixed office hours announced 	
TEACHING METHODS <i>The manner and methods of teaching are described in detail.</i> <i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational</i>	Activity	Semester workload
	Lectures	39
	Assignments/Projects	40
	Directed learning activity (office hours)	26
	Non-directed learning activity	66

visits, project, essay writing, artistic creativity, etc. <i>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</i>	Course total	175
STUDENT PERFORMANCE EVALUATION <i>Description of the evaluation procedure</i> <i>Language of evaluation, methods of evaluation, summative or conclusive, multiple-choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</i> <i>Specifically defined evaluation criteria are given, and if and where they are accessible to students.</i>	Language of Evaluation: English The final grade is the sum of Oral presentation 70% Quizzes 15% Final Examination 15%	

(5) ATTACHED BIBLIOGRAPHY

<p>Bibliography-</p> <ul style="list-style-type: none"> • “Core Concepts in Supramolecular Chemistry and Nanochemistry”, Jonathan W. Steed, David R. Turner and Karl J. Wallace. John Wiley & Sons, Ltd: Chichester. 2007. • “Supramolecular chemistry: Concepts and perspectives”, J.-M. Lehn, VCH, Weinheim 1995. • “Application of supramolecular chemistry”, Schneider, H.J., , CRC Press 2012.

GENERAL

SCHOOL	SCHOOL OF SCIENCE AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	MEMY -901	SEMESTER	A
ΤΙΤΛΟΣ ΜΑΘΗΜΑΤΟΣ	Foundations of Modern Optics		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g., lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>	WEEKLY TEACHING HOURS	CREDITS	
Lectures	4	7	
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	special background		
PREREQUISITE COURSES	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English		
IS THIS COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mscs.uoc.gr/dmst/?courses=foundations-of-modern-optics-2		

(2) LEARNING OUTCOMES

<p>Learning outcomes</p> <p><i>The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.</i></p> <p>Consult Appendix A</p> <ul style="list-style-type: none"> • Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area • Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B • Guidelines for writing Learning Outcomes <p>Upon successful completion of the course students will be able to:</p> <ul style="list-style-type: none"> • Be familiar with the basic principles of optics. • Be familiar with the principles of electromagnetism with emphasis on their application to optics. • Be familiar with the basic principles governing wave propagation, the description of transverse E/M waves in various media and the phenomena of contribution and diffraction.
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- Be able to describe in detail the polarization of optical waves as they are imparted to complex optical devices.
- To know the principles of operation and design of imaging optical systems and to solve problems of designing optical light systems within complex optical systems.
- Be able to independently describe and solve optical design problems.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology

Project planning and management

Adapting to new situations Decision-making
Working independently Teamwork

Respect for difference and multiculturalism

Respect for the natural environment

Working in an international environment Working in an interdisciplinary environment Production of new research ideas

Showing social, professional and ethical responsibility and sensitivity to gender issues

Criticism and self-criticism

Production of free, creative and inductive thinking

Others...

.....

- Capacity to address complex problems.
- Development of scientific thought
- Use of the University Library and multiple bibliographic references
- Searching sources, simulations, and electronic courses on the internet
- Taking notes and development of independent methods of studying
- Writing research reports
- Efficient management of time and deadlines
- Development of the ability to present concepts in a succinct form

(3) SYLLABUS

The syllabus covers the following topics organized in the following 4 units:

- 1. Introduction:** Historical introduction, Waves: harmonic waves, longitudinal, transverse, complex description, phase velocity, wave front types.
- 2. Fundamentals:** Electromagnetism, Maxwell's equations: wave equation, velocity of wave propagation, Poynting vector, radiation intensity. Spectrum of electromagnetic radiation, refractive index, dispersion – absorption, classical dispersion theory
 - a) Detection of radiation:** The photoelectric effect, photomultipliers, photoresistors, photodiodes, phototransistors, CDD detectors, film Photometry – Radiometry
 - b) Sources of radiation:** Black body radiation, incandescent, arc, spectral gas, fluorescence lamps, LEDs, LASERS: basic principles, pumping – amplification of light, laser cavity, gas lasers, solid state lasers, diode lasers
 - c) Polarization:** Polarization state, degree of polarization, non polarized light. Linear, elliptical, circular polarization, Jones vectors and matrices, Stokes parameters and Mueller matrices, Linear polarizers, retardation plates. Birefringence: birefringent crystals, the dielectric tensor, refractive index ellipsoid, wavefront surface, eigen polarizations, optical activity, Polarization by scattering, Polarization by reflection, evanescent waves
 - d) Interference:** Group velocity, coherence, interference conditions, types and localization of interference fringes Two wave interference, multiple plane wave interference, Wavefront splitting interferometers: Young's experiment, Amplitude splitting interferometers: Equal inclination fringes (thin film interference), Equal thickness fringes, interference under multiple reflections.
- 3. Imaging:**

- a) **Geometrical optics:** Optical rays, the geometrical optics approximation, The concept of Imaging, stigmatic imaging, Reflection, Refraction (Snell equation), total internal reflection, Reflectivity (Fresnel coefficients), Fermat's principle, application in reflection and refraction, Reflection prisms, Dispersion prisms: minimum deviation, monochromators
- b) **Simple optical systems:** Reflection from plane mirror, retro-reflectors. Refraction from a plane interface, propagation through a transparent plate, Spherical interfaces, Spherical lenses, Spherical mirrors. Paraxial approximation, Imaging with thin lenses and mirrors, the use of cardinal points, examples, 3D objects, Magnification
- c) **The matrix method:** The ray vector. Ray translation, refraction, reflection matrices, matrix of an optical system, estimation of cardinal points, imaging using matrices, optical system composition (equal subsystems, symmetrical systems, magnification, Basic principles of analysis and design of optical systems using ray matrices
- d) **Image illumination:** aperture stop, field stop, entrance-exit pupil, entrance-exit window, telecentric systems.
- e) **Optical Abberations:** ray aberration, wavefront aberration, Monochromatic aberrations. Seidel primary aberrations: spherical, comma, astigmatism, field curvature, distortion. Chromatic aberrations: longitudinal -transverse, Sphero- chromatic. Achromatic lenses, apochromatic lenses, aspherical lenses
- f) **Eikonal equation :** Optical rays, Derivation of the eiconal equation, geometrical wave surfaces, ray equation, paraxial approximation Propagation in inhomogeneous media.
4. **Wave propagation:**
- a) **Diffraction:** Fresnel zones, Helmloltz-Kirchhoff integral theorem, Kirchhoff diffraction theory. Fraunhofer and Fresnel diffraction: slit, rectangular, circular opening. Resolution, diffraction limited systems. Array of diffracting openings: multiple slits
- b) **Gaussian beams:** Propagation, beam waist, confocal parameter. Imaging of Gaussian beams, matrix description

(4) TEACHING and LEARNING METHODS - EVALUATION

Delivery <i>Face-to-face, Distance learning, etc.</i>	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	<ul style="list-style-type: none"> • Use of slides • Videos with demonstration/understanding experiments. • Demonstration experiments of basic optical phenomena • Use of an asynchronous e-learning platform (e-class) where the following are provided: <ul style="list-style-type: none"> o Bibliography of the course o Slides of the course* o Solved and unsolved exercises* o Self-study Exercise Set o Lecture videos* o Demonstration videos and simulations* o Operating code for wave propagation simulations

	<p>(The code has been developed for the needs of the course on a free software platform)</p> <ul style="list-style-type: none"> • Communication through the e-class platform, use of the discussion area facility with topics, email as well as fixed office hours announced • Students' assignments are received and corrected via the platform (e-class) <p>* Creative Commons CC-BY-ND-3.0 licenses</p>																							
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(5) ATTACHED BIBLIOGRAPHY

<ul style="list-style-type: none"> • Lecture notes • "Optics", E. Hecht, Addison-Wesley, (2001). • "Principles of Optics", M. Born, E. Wolf. • "Introduction to Modern Optics", G.R. Fowles, Dover, (1989). • "Introduction to Fourier Optics", J. W. Goodman, McGraw-Hill, (1996).
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Bibliography: exercises with solutions

- “Solved exercises in Optics”, D. Papazoglou, UoC, (2022).

GENERAL

SCHOOL	SCHOOL OF SCIENCE AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	MEMY -902	SEMESTER	B
ΤΙΤΛΟΣ ΜΑΘΗΜΑΤΟΣ	Optical Engineering and Metrology		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g., lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>	WEEKLY TEACHING HOURS	CREDITS	
Lectures	4	7	
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	special background		
PREREQUISITE COURSES	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English		
IS THIS COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mcs.uoc.gr/dmst/?courses=foundations-of-modern-optics-2		

(2) LEARNING OUTCOMES

<p>Learning outcomes</p> <p><i>The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.</i></p> <p>Consult Appendix A</p> <ul style="list-style-type: none"> • Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area • Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B • Guidelines for writing Learning Outcomes <p>.Upon successful completion of the course, students will be able to:</p> <ul style="list-style-type: none"> • Become familiar with the basic principles of Optical Mechanics and Metrology. • Know the basic principles and become familiar with the design of simple optical systems. • Know and use computational methods and tools to study wave propagation phenomena. • To know the principles of operation of the basic metrological applications of optics. • Be able to autonomously describe and solve problems of optical metrology and mechanics <p>General Competences</p>

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology

Project planning and management

Adapting to new situations Decision-making Working independently Teamwork

Respect for difference and multiculturalism

Respect for the natural environment

Working in an international environment Working in an interdisciplinary environment Production of new research ideas

Showing social, professional and ethical responsibility and sensitivity to gender issues

Criticism and self-criticism

Production of free, creative and inductive thinking

Others...

.....

- Capacity to address complex problems.
- Development of scientific thought
- Use of the University Library and multiple bibliographic references
- Searching sources, simulations, and electronic courses on the internet
- Taking notes and development of independent methods of studying
- Writing research reports
- Efficient management of time and deadlines
- Development of the ability to present concepts in a succinct form

(3) SYLLABUS

The course covers the following topics organized into modules as follows:

- 1) **Basic principles of analysis and design of optical systems**
Lighting, Image quality, Imaging errors, Computer optical design (raytracing)
- 2) **Wave propagation:**
Computational methods of wave propagation, Angular spectrum, Numerical solutions and examples,
- 3) **Optical Metrology:**
 - a. *Methods: Interferometry, Spectroscopic Interferometry, Holography, Spectroscopy*
 - b. *Applications: Characterization of materials, Surface topology, Optical radar, Distribution measurement of refractive index, concentration.*
- 4) **Wave front modulation:**
Spatial modulators, Creation of complex wavepackets, applications

(4) TEACHING and LEARNING METHODS - EVALUATION

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USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	<ul style="list-style-type: none"> • Use of slides • Videos with demonstration/understanding experiments. • Demonstration experiments of basic optical

	<p>phenomena</p> <ul style="list-style-type: none"> • Use of an asynchronous e-learning platform (e-class) where the following are provided: <ul style="list-style-type: none"> o <i>Bibliography of the course</i> o <i>Slides of the course</i> o <i>Solved and unsolved exercises*</i> o <i>Self-study Exercise Set</i> o <i>Lecture videos</i> o <i>Demonstration videos and simulations*</i> o <i>Operating code for wave propagation simulations</i> <p style="text-align: center;"><i>(The code has been developed for the needs of the course on a free software platform)</i></p> • Communication through the e-class platform, use of the discussion area facility with topics, email as well as fixed office hours announced • Students' assignments are received and corrected via the platform (e-class) <p>* <i>Creative Commons CC-BY-ND-4.0 licenses</i></p>														
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(5) ATTACHED BIBLIOGRAPHY

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