



School of Physics ATh

**Postgraduate Studies Program:
Advanced Functional Materials**

A8. Study Guide of MSc Course

December 2023

1. General Information

Advanced functional materials, a modern branch of Materials Science & Technology, is a rapidly evolving interdisciplinary sector, developing methods for the growth and synthesis of new high-tech materials and includes areas of Physics, Chemistry, Engineering and Biotechnology. State-of-the-art materials are the cornerstone of today's innovative technology. Therefore, material research and development are crucial in the search for solutions to many of the critical problems of today's society, such as sustainable growth including shortage of critical raw materials and energy. The sectors of industry that need specific personnel are metallurgy, polymers-plastics-composites, ceramics-refractory-bioceramics, semiconductors, optical technology, telecommunications-electronic components, microelectronics, surface treatments, conception of quality specifications and product certification, development of smart systems, petrochemicals, waste management.

The Postgraduate Studies Program "Advanced Functional Materials" covers all types of materials, such as inorganic, organic, hybrid and nanomaterial, soft matter and interfaces with specific functions and aims to expand the research and professional capabilities of its graduates. The emphasis is on applications covered by smart materials, energy materials, electronics/optoelectronics materials, magnetic and optical materials. This includes applications for smart utilization of inactivated materials and industrial waste. It is an educational program that leads to the acquisition of a Master's Degree (MSc), with emphasis on the education and specialization of its students in the study, combined with the technological applicability, of materials in order to create graduate material scientists, efficient to respond to modern market and society demands on issues related to research, study, management, consulting, development of applications and services.

Through the knowledge that graduates of the Postgraduate Studies Program "Advanced Functional Materials" acquire, it is expected that they will be able to offer high quality services: a) to Universities and Research Centers, b) to local government and public bodies dealing with construction and materials, c) to the private sector, to companies that offer products and services in matters of materials, and d) international organizations such as the European Union Observatory for nanomaterials, the European Materials Research Society, the European Space Agency etc.

The Postgraduate Studies Program "Advanced Functional Materials" is a re-establishment of the existing MSc Course "Physics and Technology of Materials" of the School of Physics of the Aristotle University of Thessaloniki and began its operation in the academic year 1995-1996. During its 28 years of operation, approximately 250 people have graduated. The graduate continuation to market and research so far is considered particularly satisfactory given the adverse economic situation in Greece, but also the general socio-economic problems of recent years on an international scale.

As an evolution of the previous MSc Course, Postgraduate Studies Program "Advanced Functional Materials" takes into account a) the accumulated experience of 28 years of operation, b) current research issues in advanced functional materials, c) the increased needs of the international community in specialized research / scientific staff, d) the views of its students, graduates, teachers, industrial stakeholders e) the profile of the Physics School and the research activities of its staff as well as the need to highlight It was considered appropriate to radically revise it and transform it into a new MSc with a different structure and additional targeting.

2. Purpose & Object of the MSc

The possibilities offered by the new MSc "Advanced Functional Materials" are expected to be the subject of cutting-edge basic and applied research both nationally, European, and globally for many years to come. Besides, the increasing scientific and technological challenges in the field of materials have led to an increasing demand for scientific knowledge, services and technologies on the study and treatment of open questions in modern materials on a national, European, and global scale.

The subject of the MSc Course includes the development, properties and technology of advanced functional materials which are materials designed and manufactured in an appropriate way to have the desired properties and appropriate/appropriate surface morphology. Advanced Functional Materials is an innovative research subject that Over the last twenty years, it has been developing rapidly, and/or covering all material categories such as inorganic, organic, hybrid and nanomaterial, soft matter, and interfaces with specific functions. In particular, the MSc focuses on the development, simulation & characterization of new materials with improved properties for the next generation of high-tech applications. In addition, emphasis is placed on the relationship between the method of development or processing, atomic structure, micro- or nanostructure, macroscopic properties as well as material performance.

The purpose of the MSc Course is to train specialized scientists with interdisciplinary education and high quality theoretical and experimental training on issues of new cutting-edge materials, which includes issues of development, properties, characterization, selection and optimization of materials, business skills, management, and transfer of know-how. Graduates of the MSc Course have a solid background of theoretical and experimental knowledge, necessary for understanding and formalism advanced principles in the development, properties, technology of materials and their applications, environmental and social impacts and sustainable development, and are able to meet the needs of research centers, universities and R&D departments of industry and production bodies both in Greece and in the European Union.

The number of students admitted to the MSc "Advanced Functional Materials" per year is set at a maximum of 16 postgraduate students. Candidates must hold first-cycle university degrees from departments or faculties in Greece or abroad, with a program of study related to the subject of the MSc, as it is specialized in the Government Gazette of the Postgraduate Program and/or in more detail in the annual invitation for the admission of students to the Postgraduate Program. Graduates of Departments or Faculties, whose subject matter is partially related to that of the MSc, are admitted under the condition of their successful examination in three undergraduate courses of the Department of Physics, as defined by the Assembly of the Department of Physics and mentioned in the annual invitation for the admission of students to the Postgraduate Program.

The duration of studies for the granting of the title lasts three (3) semesters. For the study of the MSc "Advanced Functional Materials" there is no tuition or registration fee.

All activities are adequately disseminated by all available academic means, e.g. through the websites of the School of Physics and the MSc, announcements and sending information notes to collaborators, graduates, and active students of the MSc, with the help of scientific social networks and media.

In the context of strengthening ties with the local community and productive bodies, the principle of "smart specialization" is also served, with the aim of strengthening cooperation with productive and research bodies at local and national level. This is achieved by carrying out study visits, diploma theses on issues of common interest and carrying out internships in the framework of the Erasmus+ program.

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The website of the MSc <http://pms.physics.auth.gr/materials2024> is bilingual (GR/EN) and contains useful information regarding the procedures followed both during admission process and during study period.

On the website, regular posts include detailed curriculum with descriptions, teachers, contact details and links of MODIP and the elearning service where teachers post the educational material and use it as a channel of communication with students (email, announcements).

The activities of the MSc are announced on the website of the MSc and on social media. In addition, teachers and students are informed about the activities via e-mail.

A record of alumni communication is maintained to be informed about the seminars and events that take place.

On the website of the MSc there are posted the regulations forming the operation framework such as

- *Internal Regulation*
- *Regulation of studies, internships, mobility, theses*
- *Regulation of student complaints and objections*
- *Regulation of academic advisor*
- *Ethics Regulation of AUTH's Research*

3. Academic calendar

1. The academic year starts on September 1 every year and ends on August 31 of the following year.
2. The educational work of every academic year is organized in two semesters, the fall semester, and the spring semester, each of which comprises 13 weeks of teaching and two or three weeks of exams.
3. Fall semester courses start in the last week of September and end in late January, followed by the first exam period of the fall semester.
 - a. Spring semester courses start in mid-February and end in June, followed by the first exam period of the spring semester.
 - b. Every semester has two exam periods:
 - c. Fall semester courses are examined during the exam period January-February and re-sit exams are held in September.
 - d. Spring semester courses are examined during the exam period of July and re-sit exams are held in September.
 - e. The exam periods usually last for three weeks.
4. Every semester, before the beginning of each exam period, students have the right and obligation to evaluate their courses and instructors, to improve the quality of their studies. More information is available at the website of the Quality Assurance Unit (MODIP-AUTH <http://qa.auth.gr/en>) and the website of their Faculty/School.
5. HOLIDAYS: Neither courses nor exams are held in August, the summer holidays. Holidays also include:
 - Christmas Holidays: December 24 to January 7.
 - Carnival Holidays: from Thursday before Lent to the day after Lent Monday.
 - Easter Holidays: from the Monday of Easter Week to the Sunday after Easter Sunday.
 - October 26: Saint Dimitrios Day – Feast of the city's Patron Saint. Liberation of Thessaloniki from the Ottoman occupation (National Holiday).
 - October 28: National celebration.
 - November 17: Students' uprising in the National Technical University of Athens against the junta in 1973.
 - January 30: The Three Patron Saints of Education Day.
 - March 25: National Anniversary of the revolution of 1821 against the Turkish rule.
 - May 1: Labour Day.
 - Holy Spirit Day: Monday (after Pentecost).

During the academic year, a series of seminars (in person or via teleconference) are held by distinguished scientists so that students are informed about modern developments in the field of materials, their applications and soft skills related to the research process. It is noted that the research conducted by the teachers of the MSc in materials issues has an interdisciplinary character and is considered competitive at European level.

The presentations of the diploma theses are organized, at the end of each examination period, are open to the public and are appropriately displayed. Finally, students and graduates of the MSc may present their research work in the form of a speech or poster in the context of a Workshop/Open Day organized on an annual basis where representatives of Industry and local government are invited. In addition, the presentation of diploma theses in national and international conferences is promoted/supported.

During the academic year, educational trips are conducted to industrial bodies related to Advanced Functional Materials.

4. Course curriculum

The curriculum of the MSc promotes the critical investigation of scientific thinking on materials issues, the methodology for the experimental and theoretical investigation of new materials, the valid analysis of research results, the evaluation of scientific hypotheses and the systematization of scientific proposals.

The curriculum is uniform and there are no specializations. The main language of instruction is Greek. Depending on the structure of the audience and/or the nationality of the teacher, teaching may be conducted in English. The dissertation can be written in English or Greek. The total number of credits (ECTS) required to obtain the Master's Degree (MSc) is 90.

The courses offered in the MSc "Advanced Functional Materials" for the acquisition of a Master's degree are semester and are divided into: a) Compulsory Courses and b) Elective Courses. The content of the Elective courses offered (2nd semester of studies) will be shaped according to modern developments in the field of advanced functional materials. In the 3rd semester of studies, the original diploma thesis is conducted.

The courses in the curriculum are divided into compulsory and selective. In compulsory courses (1st and 2nd semester) emphasis is placed on laboratory character, so that students become familiar not only with the theoretical background of development and characterization techniques but also with the corresponding experimental and/or computational laboratory procedures. The selective courses offered (2nd semester) have been designed to cover a wider range in the field of advanced functional materials, while their number and content will be shaped annually according to modern developments and the number of admissions. The 3rd semester includes the preparation of an original diploma thesis.

The examination of the individual courses or other educational activities takes place at the end of each semester with *written or oral examinations, preparation of assignments or a combination of the above*. The method of evaluation is defined by the instructor of each course at the beginning of the academic semester.

The grading scale for evaluating the performance of postgraduate students is defined from zero (0) to ten (10), as follows:

1. *Excellent (8.5 to 10)*
2. *Very Good (6.5 to 8.5 not included)*
3. *Good (6 to 6.5 not included)*
4. *Minimum passing grade is six (6) and above.*

The attendance of courses or any other educational activity is mandatory. A postgraduate student is considered to have attended a course (and therefore has the right to participate in the examinations) only if he has attended at least seventy-five (75) of the theoretical hours of the course and seventy-five (75) of the laboratory training in whichever courses it is provided. Otherwise, the postgraduate student is required to attend the course again in the next academic year.

The schedule of courses, examinations per semester and the detailed description of the courses can be found on the website of the MSc where there are also the corresponding links of the MODIP and the elearning service, which teachers use to post educational material but also as a means of communication with the students of the MSc.

INDICATIVE CURRICULUM

No	Course Title	Course type/ Semester	Distance learning	ECTS
1	Solid State Physics	O/1		3
2	Computational Methods and Simulations of Functional Materials	O/1		5
3	Growth of Functional Materials	O/1		7
4	Nanostructures, Heterostructures and Elastoplastic Behavior	O/1		5
5	Magnetic Properties of Materials and Technological Applications	O/1		5
6	Electron Microscopy and X-ray Diffraction in Materials Science	O/1		5
1st semester - Total		5		30
7	Electrical Properties of Semiconductors and Insulating Films – Devices for Novel Technologies	O/2		5
8	Optical Properties, Spectroscopy and Applications	O/2		5
9	Materials Selection & Processing	O/2		3
10	Research Methodology Training Practicals	O/2		3
11	Advanced Topics and Skills on Materials Innovation Development	O/2	50%	2
12-14	Selective Courses	S/2		12
2nd semester – Total		5O+3S		30
15	M.Sc. Thesis	O/3		30
3rd semester - Total		0		30

O: Obligatory course / S: Selective course

Selective Courses (students choose 3 courses from the following list)

No	Course Title	Course type/ Semester	Distance learning	ECTS
1	Synchrotron Radiation: Properties and Applications in Materials Characterization	S/2		4
2	Materials and Techniques in Modern Biomedicine	S/2	65%	4
3	Electronic Structure and Lattice Dynamics of Nanomaterials	S/2		4
4	Thermal and Thermoelectric properties of Materials, Nanostructures and Nanostructured Materials	S/2	50%	4
5	Functional Colloidal, Ceramic, and Polymeric Materials	S/2	30%	4
6	Optoelectronic and Microelectronic Devices	S/2		4
7	Internship ¹	S/2		4
8	Advanced Topics on Materials Characterization: Introduction to Archaeometry	S/2		4
9	Advanced Metallic Matrix Materials and Nanomaterials	S/2		4
10	Advanced Computational Methods for the Simulation of Functional Materials	S/2		4
11	Low-Dimensional Materials	S/2		4
12	Advanced Methods of Transmission Electron Microscopy & Nanoanalysis	S/2		4
13	Advanced Topics on Materials Growth, Synthesis & Processing	S/2		4

In the event of an obstacle to the conduct of a course, its reimbursement is foreseen at a date and time posted on the PSP website.

¹ *It is possible to travel and carry out an internship in an institution abroad in accordance with the Erasmus⁺ regulation.*

5. Student Provisions

On the website of the MSc Course <http://pms.physics.auth.gr/materials2024> there are specific links under the tab Links including practical information about provisions to Aristotle University Students categorized as follows.

Studies

- Academic Calendar
- AUTH Map
- European Credit Transfer System
- Department of European Educational Programmes
- Erasmus-School of Physics-AUTH
- Student Practice
- Scholarships

Services

- Student's Advocat (only in Greek)
- Centre for Foreign Language Teaching
- School of Modern Greek Language
- Accommodation
- University Student Dining
- Student Health Services
- University Gym
- Kalandra University Camp
- Career and Studies Office
- Central Library
- Information Technology Center
- Student Unions

AUTH

- Facilities
- Administrative Bodies
- Rectorate Authorities
- Brief History
- Faculties & Schools
- Undergraduate Studies
- Postgraduate Studies
- AUTH in the world

6. Administration & Instructors

The Assembly of School of Physics has the following responsibilities:

1. establishes Committees for the evaluation of the applications of prospective postgraduate students and approves their enrollment in the MSc,
2. assigns the teaching work to the teachers of the MSc,
3. recommends to the Senate the amendment of the decision establishing the Postgraduate Program, as well as the extension of the duration of the Postgraduate Program,
4. establishes examination committees for the examination of postgraduate students' dissertations and appoints the supervisor per thesis,
5. ascertains the successful completion of studies, in order to be awarded the title of MSc,
6. approves the report of the MSc, upon the recommendation of the Coordinating Committee (CC).

By decision of the Assembly of the Department, the responsibilities of per. a) and d) may be transferred to the Coordinating Committee of the MSc

The Steering Committee of the MSc which consists of the Director of the MSc and four (4) faculty members of the Department who have a related subject to that of the MSc and undertake teaching work in the MSc.

The Director of the MSc who comes from the faculty members of the Department as a priority rank of Professor or Associate Professor and is appointed by decision of the Assembly of the Department for a two-year term, renewable without limitation and is not entitled to additional remuneration for his administrative work.

The Secretarial Support of the MSc is provided by the Department of Physics. The Secretariat of the MSc is responsible for keeping records and grades of postgraduate students. It also informs postgraduate students on issues related to the organization and operation of the MSc Finally, it is responsible for the preparation of the topics they propose to the Assembly of the School or to the Curriculum Committee.

Director of the MSc	<i>M. Angelakeris, Professor, School of Physics</i>	<i>Tel. 2310998172 email:agelaker@auth.gr</i>
Secretarial Support	<i>C. Metaxa, EDIP, School of Physics</i>	<i>Tel. 2310998027 email:materials@physics.auth.gr</i>
Secretariat of School of Physics	<i>G. Kaimakamis, EDIP, School of Physics</i>	<i>Τηλ. 2310998140 email:agelaker@auth.gr</i>
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	<i>K. Efthimiadis, Professor, School of Physics</i>	<i>Tel. 2310998065 email:kge@auth.gr</i>

What follows is contact list of teaching instructors. Detailed information on affiliations and course appointment exists on MSc Course website

Contact Information

Name	Position	Telephone	e-mail
Angelakeris Makis	Professor	2310 998172	agelaker@auth.gr
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