University of Crete
Department of Physics
Guide to Graduate Studies

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PREFACE

The present document briefly describes the guide to graduate studies at the Department of Physics of the University of Crete.

The Department of Physics was the first one in Greece to offer in 1985 an organized graduate program in Physics. Since then, 352 students have obtained a degree of Masters of Science (MSc) in a specialized area of modern Physics, while 128 have been awarded the degree of Doctor of Philosophy (PhD) from the Department. The students, both Greek nationals and foreigners, have continued a successful career in academic institutions of Greece and abroad. More information on our graduates is available in the following web pages:

Masters' Graduates - http://www.physics.uoc.gr/en/masters
PhD Graduates - http://www.physics.uoc.gr/en/phd

The graduate program of the Department was modified in 2007-08, 2013-14 and 2017-18 becoming more compact and intensive. We believe that this new structure, which is presented in the following pages, is an improvement compared to the past program, it addresses the modern academic challenges and it will further help to maintain the tradition of excellence in the education and opportunities we provide to our graduate students

Heraklion, 1 June 2018

Iosif Papadakis, Professor
Chairman of the Department of Physics

SUMMARY

In the present document we briefly describe the two graduate programs of the Department of Physics of the University of Crete, which lead to a degree of Masters in Science (M.Sc.). The programs have a long-standing history and they were revised in 2007-2008, 2013-2014 and 2017-2018 in order to adhere to changes in Greek legislation. In the process they were updated in order to better prepare our graduates in the challenges they face in today's world. Currently the Department of Physics offers:

- Graduate Program in "Advanced Physics" - duration of 12 months
- Graduate Program in "Photonics-Nanoelectronics" - duration of 18 months

Graduates of the above programs, as well as individuals holding an MSc degree, have the opportunity to be admitted to the three (3) year PhD program of the Department and complete their dissertation in any field of modern physics. More information is available in the web page of the Department of Physics:

http://gradstudy.physics.uoc.gr

The Department of Physics also participates in an interdepartmental graduate program of the University of Crete entitled :

- "Brain and Mind" - see: http://brain-mind.med.uoc.gr

1. GRADUATE PROGRAM IN "ADVANCED PHYSICS"

1.1 AIM

The graduate program in "Advanced Physics" covers all modern areas of Theoretical and Experimental Physics. Its main goals are :

1. To provide high quality training and specialization of the students at the level of Masters, so that they can be competitive to work in the private and public sector, as specialized research personnel in Universities and research centers, or as educators with advanced qualification and abilities.
2. To train the students in order to be admitted in a PhD program so that upon completion of their PhD degree they can work as professors and/or researchers in Universities and research institutes.

1.2 PROGRAM DESCRIPTION AND ADMISSION REQUIREMENTS

The graduate program in "Advanced Physics" consists of two parts. The first is a program with a duration of 12 months and leads to a degree of Masters of Science (MSc) with specialization in the following directions: a) Astrophysics and Space Physics, b) Elementary Particles and Cosmology, c) Atomic and Molecular Physics, d) Condensed Matter Physics, d) Applied Physics. Graduates of the program may apply to a 3-year programs which leads to a degree of Doctor of Philosophy (PhD).

An individual can be admitted in the graduate program if he/she holds a degree of

Bachelors in Science (BSc) or Engineering from accredited Universities or Technological institutes.

In order to obtain the MSc, a student must successfully complete 60 ECTS, of which 30 ECTS originate from courses and 30 ECTS from completing a research project, which leads to a Masters thesis that is successfully defended in front of a graduate committee.

For the first semester the recommended program typically consists of two compulsory physics courses, each having a load of 6 ECTS, and one course of 5 ECTS in the area a student wishes to specialize. At the second semester the students follow one more compulsory course and one specialized course. This program may be modified but only under special circumstances and upon approval of the Graduate Program Committee. The Master thesis research has a typical duration of four (4) months; it is performed in parallel with the courses and starts in the beginning of the second semester. Attending the weekly Physics colloquium as well as specialized seminars may offer 2 additional ECTS to the students.

All graduate students have to participate in the research and educational activities of the Department and as part of their training as Teaching Assistants.

Under special circumstances and upon approval of the Department a graduate student may request to extend the duration of his/his studies by a maximum of 6 more months. If the student has not fulfilled all requirements towards the completion of the Masters degree within the period of 18 months, the MSc degree can no longer be awarded and the student cannot remain in the program.

In order to be admitted to a PhD program a student must already have obtained a Masters degree. Only under special circumstances and upon approval of the Department students with a BSc degree can be admitted to the PhD program. In order for the PhD degree to be awarded a student must be registered for a minimum of 3 years and must write a PhD dissertation, part of which has to be published in a well known international refereed journal.

1.3 Graduate Curriculum

The graduate program of "Advanced Physics" offers a number of courses in theoretical and experimental physics, which are described in the following paragraphs. The courses are grouped in a) compulsory courses which are offered on a regular basis, b) elective courses which are offered when there is demand based on the interests of the graduate student and c) reading courses, where a students does most of the study on his/her own with some guidance from a faculty member. The official language used in the lectures is English. In the case where only Greek speaking students attend the courses, the lectures can be in Greek.

The compulsory courses in category (a) have a load of 6 ECTS each, with typically 3 hours of lectures of and 2 hours of exercises per week. These courses are:

- Classical Mechanics II
- Classical Electrodynamics
- Advanced Quantum Mechanics
- Statistical Physics

- Mathematical Methods for Physics
- Special Topics in Physics

The compulsory course "Physics Seminar" corresponds to 2 ECTS, and requires the active participation of the students to the Physics Colloquia and specialized seminars, while the elective course "Research Presentation" has a load of 1 ECTS.

Depending on the interests of the graduate students and the availability of teaching personnel, the following specialized courses are offered. Each has a load of 5 ECTS, which corresponds to 2 hours of lecture and 2 hours of exercises per week.

(1) Astrophysics and Space Physics
- Stellar Evolution and Nucleosynthesis
- Astrophysics III
- High Energy Astrophysics
- Gas Dynamics
- Production and Transfer of Radiation
- Elements of Ionospheric Physics
- Physics of Galaxies
- Physics of the Interstellar Medium
- Special Topics in Astrophysics

(2) Elementary Particle Physics and Cosmology
- Relativistic Quantum Mechanics
- Quantum Field Theory
- Advanced Quantum Field Theory
- Symmetries and Group Theory
- Classical Field Theory and the Standard Model
- Theory of Gravity
- Cosmology
- Topics in Superstring Theory
- Advanced Topics in Modern Physics I
- Advanced Topics in Modern Physics II

(3) Atomic and Molecular Physics
- Atomic and Molecular Physics
- Laboratory of Optical Methods of Analysis of Complex Materials
- Quantum Electronics I: Theory of Lasers – Laser Technology Lab
- Quantum Electronics II: Non-linear optics
- Quantum Optics
- Quantum Optics and Quantum Information
- High Power Narrow Pulse Lasers
- Optics I: Classical Optics
- Optical Fibers
- Optics of Charged Particles
- Spectroscopic Techniques
- Special Topics in Atomic and Molecular Physics

(4) Condensed Matter Physics
- Basic Concepts in Condensed Matter Physics
- Quantum Many-Particle Systems
- Quantum Heterostructures
- Non-Linear Phenomena in Physics

- Mechanics of Continuum Media
- Experimental Techniques in Condensed Matter Physics
- Advanced Methods in Computational Physics
- Statistical Mechanics out of Equilibrium
- Physics of Soft Matter
- Physics of Novel Materials and Nanostructures
- Physics and Technology in low-dimentional Materials
- Spectroscopy in Condensed Matter Physics
- Special Topics in Condensed Matter Physics

(5) Applied Physics

- Analog Electronics
- Thin Films in Electronics
- Laboratory of Semiconductor Physics
- Microwave Semiconducting Devices
- Methods of Analysis of Electronic Materials
- Optoelectronic Semiconducting Devices
- Technology of Semiconducting Devices and Circuits
- Physics of Semiconducting Devices
- Physics of Semiconductors
- Special Topics in Applied Physics
- Artificial Neural Networks

1.4 LOGISTICS SUPPORT

The logistics support available to the graduate students of the Department of Physics includes:

- Two dedicated lecture rooms
- Office space (personal desks) and associated office supplies which are sufficient to cover the needs of the actual number of graduate students
- Dedicated computer rooms in order to access the computing facilities of the Department.
- Access to the Libraries of the University of Crete and the Foundation for Research and Technology (FORTH)
- Access to the computing facilities (clusters) of the Univ. of Crete and FORTH.
- Laboratories: The infrastructure of the following laboratories belongs to the Department of Physics or to the Institute of Electronic Structure and Laser, or to another associated Institute of FORTH.
    - Laboratory of Laser and Applications
    - Laboratory of Micro and Nanoelectronics
    - Laboratory of Nanostructures
    - Laboratory of Photonic and Electronic Materials
    - Laboratory of Superconducting and Magnetic Materials
    - Laboratory of Atomic Collisions and Electron Spectroscopy
    - Skinakas Observatory and the associated data analysis laboratory

2. Graduate Program in "Photonics & Nanoelectronics"

2.1 Aim

The graduate program in "Photonics and Nanoelectronics" has a subject the science and technology in the emerging areas of Nanoelectronics and Photonics. Its main goal is to provide a high quality training and specialization of the students at the level of Masters so that they can be competitive to work in the private and public sector, as specialized research personnel in Universities and research.

2.2 Program Description and Admission Requirements

The program leads to a degree of Masters of Science (MSc) with specialization in the following areas:

1. Matter-Radiation Interaction
2. Epitaxial growth of semiconductor heterostructures-nanostructures
3. Applications of Photonics in Biomedical Technology, Nanotechnology and Preservation of Cultural Heritage
4. Magnetic materials
5. High precision metrology
6. Micro/nano and opto-electronics of SiC, GaAs, GaN and other semiconductors
7. Optics (linear, wave, nonlinear and quantum)
8. Advanced optoelectronic semiconductor structures, transparent materials, quantum dot nanostructures
9. Imaging of nanostructures
10. Ultrafast phenomena – ultrashort pulses
11. Physical and bio-chemical sensors
12. Photonic/semiconductor materials/structure and Microelectronics
13. Cold matter – degenerate gases.

An individual can be admitted in the graduate program if he/she holds a degree of Bachelors in Science (BSc) or Engineering from accredited Universities or Technological institutes. A maximum of 15 students are admitted per year.

In order to obtain the MSc, a student must successfully complete a workload of 10 courses as well as to completing a research project, which leads to a Masters thesis that is successfully defended in front of the Graduate Committee. The courses "Physics of Semiconducting Devices", "Quantum Electronics I", and "Applied Quantum Physics" are compulsory. Upon approval from the Graduate Program Committee a student may follow up to 4 courses from another graduate program of the Department of Physics or up to 3 courses of other graduate programs of the University of Crete.

The program has duration of three (3) semesters. Under special circumstances and upon approval of the Department a student may request to extend the duration of his/her studies by one (1) semester. If a student has not fulfilled all requirements towards the completion of the Masters within the period of 24 months, the MSc degree can no longer be awarded and the student cannot remain in the program.

All graduate students have to participate in the research and educational activities of the Department and as part of their training as Teaching Assistants.

2.3 GRADUATE CURRICULUM

The graduate studies in the program of "Microelectronics-Optoelectronics" require the successful completion of a number of courses listed bellow, as well as the active participation in the weekly colloquia of the Department of Physics and specialized seminars. The completions of a Masters thesis of 30 ECTS is also compulsory. The official language used in the lectures is English. In the case where only Greek speaking students attend the courses, the lectures can be in Greek. All courses run for a full semester each. The list of available courses follows:

Compulsory Courses

- Quantum Electronics I: Theory of Lasers – Laser Technology Lab (6 ECTS)
- Applied Quantum Physics (6 ECTS)
- Physics of Semiconducting Devices (6 ECTS)
- Research Laboratory I (5 ECTS)
- Research Laboratory II (5 ECTS)
- Teaching Experimental Physics I (3 ECTS)
- Teaching Experimental Physics II (3 ECTS)

Elective Courses (all have a load of 5 ECTS)

- Condensed Matter Physics
- Structural and Chemical Analysis of Materials
- Physics of Semiconductors
- Methods of Analysis of Electronic Materials
- Magnetic Materials and Nanoelectronics
- Superconductivity and Spectroscopic Applications
- Analog Electronics I
- Special Topics in Micro/Nano-electronics
- Electronic Thin Film Science
- Microwave Electronic Devices I
- Laboratory of Semiconductor Physics
- Optics
- Quantum Optics
- Semiconducting Optoelectronic Devices
- Technology of Semiconducting Devices and Circuits
- Special Topics in Photonics
- Laboratory of Laser and Modern Optics II
- High Power Narrow Pulse Lasers
- Spectroscopic Techniques

2.4 LOGISTICS SUPPORT

The logistics support available to the graduate students of the Department of Physics includes:

- Two dedicated lecture rooms
- Office space (personal desks) and associated office supplies which are sufficient to cover the needs of the actual number of graduate students
- Dedicated computer rooms in order to access the computing facilities of the Department.
- Access to the Libraries of the University of Crete and the Foundation for Research and Technology (FORTH)
- Access to the computing facilities (clusters) of the Univ. of Crete and FORTH.
- Laboratories: The infrastructure of the following laboratories belongs to the Department of Physics or to the Institute of Electronic Structure and Laser, or to another associated Institute of FORTH.
    - Laboratory of Laser and Applications
    - Laboratory of Micro and Nanoelectronics
    - Laboratory of Nanostructures
    - Laboratory of Photonic and Electronic Materials
    - Laboratory of Superconducting and Magnetic Materials
    - Laboratory of Atomic Collisions and Electron Spectroscopy

2.6 COLLABORATION WITH FORTH

The graduate program in "Photonics - Nanoelectronics" of the Department of Physics has developed a close collaboration and synergy with the groups of Microelectronics and Laser of the Institute of Electronic Structure and Laser (IESL) of the Foundation of Research and Technology (FORTH). In particular, the Microelectronics group FORTH is housed in the Physics building, and it is jointly supported by FORTH and the University of Crete. This collaboration is materialized via the following general rules:

i) Research personnel of FORTH may teach graduate courses in the area of their specialty after approval from the Department of Physics and the Director of the corresponding FORTH Institute.
ii) Researchers of IESL/FORTH may be formal supervisors in Masters or PhD theses after an approval of the Department of Physics and the IESL Director.
iii) Upon approval by the Scientific Council of IESL/FORTH, graduate students of the Department of Physics may have access to the infrastructure of IESL, in order to complete their Masters and PhD research projects.
iv) The Department of Physics and IES/FORTH may jointly invite researchers and professors from other Universities and Research Institutes in order to give seminars, lectures, or offer complete graduate courses, as well as to collaborate with local faculty, researchers, and graduate students.
v) Upon request from the Graduate Program Committee of the Department of Physics, IESL/FORTH may offer a small number of fellowships to physics graduate students, as long as these adhere to the standard FORTH regulations.
vi) The Graduate Program Committee of may recognize graduate level courses offered by FORTH as part of the requirements towards the completion of the courses for the MSc in "Photonics - Nanoelectronics".
vii) Research equipment owned by IESL may be installed in the laboratories the Department of Physics and vice versa, following a common agreement between the two establishments.

3. PhD Studies

As mentioned in the previous sections, the Department of Physics of the University of Crete offers the possibility of graduate studies towards a degree of Doctor of Philosophy (PhD) in nearly all areas of modern physics.

In order for a student to be admitted in the PhD program he/she must have:

- A degree of Bachelors of Science (BSc) from an accredited University or Technical Institute.
- A Masters degree in Science (MSc) from an accredited University or Technical Institute.

Under special circumstances individuals with an outstanding record may be admitted to the PhD program of the Department of Physics without having an MSc degree. Note that PhD candidates, who have obtained their BSc and/or MSc degrees from universities outside Greece, must validate them (via Δ.Ο.Α.Τ.Α.Π.). In these cases the formal date of acceptance to the PhD program has to follow the date the degrees were officially validated.

Any individual interested in the PhD program may submit to the Graduate Student Secretary an application containing the following information:

- A Curriculum Vitae, as well transcripts of all undergraduate and graduate courses
- A letter in which the candidate may briefly present his/her research interests, as well as the reasons why he/she wishes to pursue a PhD degree at that Department of Physics.
- At least two (2) letters of recommendation from professors or researchers who can evaluate the academic qualities of the candidate.
- Possible GRE and TOEFL scores if available

The Graduate Program Committee may request additional information from the ones mentioned above as well as interview the candidate.

Applications are accepted and evaluated by the Graduate Program Committee throughout the year, but it is advised that they are submitted before the 1st of July for studies starting the next academic year.

Candidates who are admitted in the PhD program have immediate access to the infrastructure of the Department of Physics. There is a possibility of graduate fellowship to select candidates. Within a reasonable period of time the admitted PhD candidates must familiarize themselves on the research of the various groups in the department, identify the general area the wish to work on for their PhD thesis, and select a faculty member of the Department of Physics who wishes to act as their supervisor. The official date of the start of the PhD is when the three member advisory committee of the student is assigned. The PhD degree cannot be awarded unless three years have passed from this date. Extension of the PhD studies past the end of the fifth (5th) year requires the approval of the Department.

4. GRADUATE COURSES

In the following table we present the graduate courses that have been offered by the Department of Physics the past few years. We include the code of the course, its title, and the corresponding ECTS. We also indicate with "A" and "PN" whether the course is offered as part of the graduate program in "Advanced Physics" or "Microelectronics-Optoelectronics" respectively. The syllabus of each course is available online in the web page of the Department of Physics:

http://www.physics.uoc.gr/en/menu/course_list.php?show=All

Code	Course Title	Program	ECTS
Φ-501	Classical Mechanics II	A	6
Φ-503	Advanced Quantum Mechanics	A	6
Φ-505	Statistical Physics	A	6
Φ-509	Classical Electrodynamics	A	6
Φ-511	Mathematical Methods of Physics	A	6
Φ-523	Quantum Many-Particle Systems	A	5
Φ-528	Artificial Neural Networks	A	5
Φ-532	Production and Transfer of Radiation	A	5
Φ-533	Theory of Gravity	A	5
Φ-534	High Energy Astrophysics	A	5
Φ-561	Quantum Optics I	PN	5
Φ-563	High Power Narrow Pulse Lasers	PN	5
Φ-570	Structural and Chemical Analysis of Materials	PN	5
Φ-571	Analog Electronics	PN	5
Φ-572	Physics of Semiconductor Devices	PN	6
Φ-573	Laboratory of Semiconductor Physics	PN	5
Φ-574	Physics of Seminconductors	PN	5
Φ-575	Physics of 2D Semiconductor Devices	PN	5
Φ-604	Quantum Field Theory	A	5
Φ-606	Advanced Quantum Field Theory	A	5
Φ-631	Astrophysics III	A	5
Φ-660	Symmetries and Group Theory	A	5
Φ-661	Laboratory of Laser and Modern Optics II	PN	5
Φ-664	Techniques of Laser Spectroscopy	PN	5
Φ-665	Quantum Electronics I: Theory & Technology of Laser	PN	6
Φ-666	Quantum Electronics II – Non Linear Optics	PN	5
Φ-669	Advanced Methods of Computational Physics	A	5
Φ-675	Semiconducting Optoelectronic Devices	PN	5
Φ-676	Advanced Electronics Laboratory	PN	5
Φ-677	Electronic Thin Film and Nanostructure Science	PN	5
Φ-696	Modern Research Topics	PN	16
Φ-703	Applied Quantum Physics	PN	6
Φ-733	Physics of Galaxies	A	5
Φ-772	Magnetic Materials and Nanoelectronics	PN	5
Φ-800	Quantum Optics and Quantum Information	A	5
Φ-841	Special Topics in Condensed Matter Physics	A	5
Φ-881	Advanced Topics in Modern Physics II	A	5
Φ-965	Teaching Experimental Physics I	PN	3
Φ-966	Teaching Experimental Physics II	PN	3

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