



ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ

**Α . Δ Ι . Π .**

ΑΡΧΗ ΔΙΑΣΦΑΛΙΣΗΣ ΠΟΙΟΤΗΤΑΣ

ΑΝΩΤΑΤΗΣ ΕΚΠΑΙΔΕΥΣΗΣ

HELLENIC REPUBLIC

**H . Q . A . A .**

HELLENIC QUALITY ASSURANCE AGENCY

FOR HIGHER EDUCATION

## **EXTERNAL EVALUATION REPORT**

DEPARTMENT OF PHYSICS

UNIVERSITY OF PATRAS

DECEMBER 2013

### **External Evaluation Committee**

The Committee responsible for the External Evaluation of the Department of Physics of the University of Patras consisted of the following five (5) expert evaluators, drawn from the Registry constituted by the HQAA in accordance with Law 3374/2005:

1. Prof. Panos Razis, University of Cyprus, Cyprus (Coordinator)
2. Prof. Aris Christou, University of Maryland, USA
3. Prof. Christos Flytzanis, École Normale Supérieure, CNRS, France
4. Prof. Costas Kounnas, École Normale Supérieure, CNRS, France
5. Prof. Emmanuel Tsismelis, European Laboratory for Particle Physics, Switzerland and University of Oxford, United Kingdom

*The structure of the “Format” proposed for the External Evaluation Report is dictated by the requirements of Law 3374/2005 and corresponds generally to the structure of the Internal Evaluation Report submitted by the Department.*

*The length of text in each box is free. Moreover, the various questions may not be answered separately; they only provide a general idea about specific matters that should be addressed by the Committee when formulating its comments.*

## **Introduction**

The External Evaluation Committee (hereafter referred to as the “Committee”) met in Athens as well as in Patras, between the 16<sup>th</sup> and 21<sup>st</sup> of December 2013, to carry out the Evaluation of the Department of Physics (hereafter referred to as the “Department”) of the University of Patras (hereafter referred to as the “University”).

Unfortunately, two of the Members of the Committee, namely Prof. A. Christou and Prof. C. Flytzanis, could not attend the deliberations of the Committee, because of unforeseen circumstances arising in the last days before the scheduled meetings of the Committee. Due to this, there was insufficient time for their replacement by the Hellenic Quality Assurance Agency (HQAA). Therefore, the whole evaluation process had to proceed with the participation of three Members of the Committee. The External Evaluation Report is the result of the unanimous opinions/findings of the three Members of the Committee present during the whole process.

All three Members of the Committee signing this Report have attended an introductory presentation in the HQAA offices in Athens, providing general guidelines for the evaluation procedure. On the 16<sup>th</sup> of December 2013 they were transported from Athens to Patras.

During its visit to the University, from the 16<sup>th</sup> to 18<sup>th</sup> December, the Committee visited the Rectorate, the premises of the Department and various central facilities of the University. It had meetings with the Rector, the Deputy Rectors, the Dean of the Faculty of Natural Sciences, the Chairman of the Internal Evaluation Committee (OMEA) of the Department and the members of the quality assurance unit (MODIP) of the University. The Committee visited the Department and attended a series of presentations by the Chairman and its officers and by the Directors of all its Sections. In addition, the Members of the Committee attended short presentations by the academic staff of the Department and met with the technical, administrative and other staff of the Department and with its undergraduate and graduate students that were available at the designated time.

The Committee also had the opportunity to view the infrastructure of the Department and various central facilities of the University. More specifically:

- (a) In the afternoon of 16<sup>th</sup> December, the Members of the Committee first attended a meeting with the Deputy Rectors of the University,

Prof. Pantelis Kiprianos (Academic Affairs and Personnel) and Prof. Nikolaos Avouris (Research and Development). The Rectorate Authorities provided the Committee with general information regarding the University (annual budget, legislation, structure, faculties, departments, and the number of academic staff, administrative staff and students), as well as statistical data on its educational and research programmes, facilities provided to the University community, potential for further development, operational problems and sources of funding.

- (b) The Deputy Rector for Academic Affairs and Personnel, Prof. P. Kiprianos, Chairman of the Quality Assurance Unit (MODIP) of the University and acting as the Chairman of the meeting, presented the overall aims and practical measures taken for promoting quality assurance in the University's educational and research programmes, the sources and the level of financing the University and the time framework for completing the evaluation of all its Departments. He also presented the overall mission, organisation structure, budget, personnel numbers and future plans of the University.
- (c) The Dean of the Faculty of Natural Sciences, Prof. Ch. Kordoulis, welcomed the members of the Committee and presented the organisation structure of the Faculty and the history of the Department.
- (d) Prof. N. Karamanos, the Chairman of the Internal Evaluation Committee, presented to the Committee an introduction of the internal evaluation system of the University, including the objectives, procedures and milestones of the process, and a short historical overview of the University in general and the Department of Physics in particular.
- (e) The Members of the Committee then moved to the premises of the Department for a series of presentations by and deliberations with the Chairman and members of the Department:
- (f) The Chairman of the Department, Assoc. Prof. A. Argyriou, gave a detailed overview of the Department, its structure, its scientific areas organised in educational and research directions, its number of academic and administrative personnel and its number of research and technical staff. He also presented the number of students enrolled in the undergraduate and graduate programmes offered by the Department, as well as the structure of the undergraduate and graduate curricula. Moreover, he presented the statistical data on the students' graduation time, attendance, their average grades, overall performance etc.
- (g) The Chairman also provided general information on the number and funding sources of the research projects running in the Department, its current outreach activities, its scientific and public outcome in terms of publications, conferences, citations and promotion activities addressed to the society. Finally, he provided some information on student welfare, lodging, mobility and exchanges with other institutions within the country and abroad, the system of textbooks provided to the students and their access to the Library, the internet and other central facilities of the

University. The Graduate Studies Director, Prof. C. Krontiras followed, making a brief presentation on the structure of the graduate curriculum, its specialisation areas, the number of graduate students enrolled in each area, their evaluation system, their overall performance, and issues and challenges of the Department.

A number of questions were asked by the Committee Members for further clarification of various aspects of the above presentations. A major concern of the Committee was expressed on the rapid reduction of the number of academic, administrative and technical staff. Several questions were also raised on the future plans regarding staffing of the Department as a whole.

Prof. S. Fotopoulos, Director of the Interdisciplinary Graduate Studies Program presented the aims and functionality of the interdepartmental graduate programme offered in the area of Electronics and Information Processing, while Prof. G. Staikos, from the Department of Chemical Engineering, presented various development and scientific issues on the interdepartmental graduate programme on Polymer Science and Technology.

Late on Monday, 16<sup>th</sup> December, the Directors of the four Sections of the Department, namely:

- (a) Applied Physics Section (Prof. A. T. Georges)
- (b) Condensed Matter Physics Section (Assoc. Prof. A. Pomoni)
- (c) Electronics and Computers Section (Assoc. Prof. C. Psychalinos)
- (d) Theoretical & Mathematical Physics, Astronomy and Astrophysics Section (Prof. V. Geroyannis),

gave brief accounts on their respective scientific areas, providing information on their staff manpower, courses offered, teaching load, research projects and outcome, as well as funding based on national and international sources, national and international collaboration, scientific outcome in terms of publications and citations, outreach and services provided to the public and private sectors.

Assoc. Prof. A. Argyriou provided information on the measures taken by the Department on various safety and health issues.

On Tuesday, 17<sup>th</sup> December the deliberations continued with more detailed presentations on the laboratories and research activities of the faculty staff from the three out of the four Sections of the Department:

From the Section of Applied Physics:

- (a) Prof. S. Couris on laser, non-linear and quantum optics.
- (b) Prof. V. Tripanagnostopoulos on solar and renewable energy projects.
- (c) Assoc. Prof. A. Argyriou on Atmospheric Physics and Meteorology.

From the Section of Condensed Matter Physics:

- (a) Lecturer P. Karahaliou on Dielectric Spectroscopy.
- (b) Assist. Prof. D. Skarlatos on CMOS Front-End Technology.
- (c) Prof. Toprakcioglou on the Structure of Soft Matter and Nanoscale Materials.
- (d) Assist. Prof. L. Palilis on Organic/Polymer and Inorganic Semiconductors.
- (e) Prof. E. Vitoratos presented information on practical training and international activities undertaken by the Department in the framework of European physics networks, such as EUPEN, TUNING, STEPS and STEPS TWO and under the Erasmus exchange programme.

From the Section of Theoretical & Mathematical Physics, Astronomy & Astrophysics:

- (a) Prof. Emeritus D. Gkikas on Quantum Mechanics, Dynamical Systems & Quantum Information.
- (b) Prof. A. Zdetsis on Molecular Engineering.
- (c) Assist. Prof. V. Loukopoulos on Mechanics and Fluid Mechanics.
- (d) Prof. V. Geroyannis, Prof. C. Goudis and Assist. Prof. P. E. Christopoulou on Computational & Observational Astrophysics.
- (e) Prof. Emeritus K. Zioutas on the CAST Experiment at CERN.
- (f) Prof. S. Lola on Phenomenology and Cosmological Implications beyond the Standard Model.

The presentations were followed by discussion between the faculty staff and the Members of the Committee elaborating on operational issues and the plans for future follow-up in the corresponding scientific areas, including the education system structure of the undergraduate and graduate curricula, teaching methodology, laboratories, student numbers, funding sources and resources available to the students (library, textbooks, meals & board, recreation and sports activities, etc.).

Following the faculty presentations, the Committee visited some representative teaching laboratories and lecture halls of the Department, allowing the Committee Members to gain a more detailed picture on the infrastructure and the support facilities operating in the Department.

On Wednesday, 18<sup>th</sup> December, the Committee met with the technical and administrative personnel of the Department, including its secretariat, the technicians for the laboratories and the electronic information technology technical support. The Committee was provided with information regarding the number of employees, status and current concerns on their future employment.

Following the above, the Committee met separately, first with the available MSc and PhD students and afterwards with the available undergraduate students of the Department. During extensive discussions, the students raised a series of issues and challenges concerning the operational and funding aspects of their studies and research. The issues of establishing supporting funds through a national scholarships scheme and the big worry on their future potential employment, particularly during the severe economic crisis in the country and Europe in general, are the most difficult ones on the minds of most students, together with the major problem of the frequent disruption of the educational process in the Greek universities.

The Committee visited some representative central facilities on the University campus, the Sports Centres, the Student Residences and the Museum of Science and Technology. The Committee received information on the textbooks and on the Departmental and Central Library.

The Members of the Committee had a final meeting with the Rector, the Deputy Rectors and the Dean of the Faculty, the Head and the Deputy Heads of the Department, and the Members of the Internal Evaluation Committee. The Committee provided the authorities of the University a first summary of their findings.

Finally, closed Sessions of the Committee took place from the 18th-20th of December in Athens, for the Committee Members to consider all the information collected, to evaluate the Department and to write the External Evaluation Report.

For the evaluation, the Members of the Committee received and took into consideration the following electronic documents provided by the Department or HQAA:

- (a) The Internal Evaluation Report, including tables concerning the course programmes offered by the Department, corresponding teaching load of the faculty, student enrolment, information on the research programmes of the academic personnel of the Department, publications & citations for the period under evaluation 2007-2011, and some extra material from previous years and for the period 2012-2013.
- (b) The Web site for the undergraduate and graduate studies curricula.
- (c) The presentations provided by the Directors of the Department's Sections, the Chairman of the Department, the Chairman of the Internal Evaluation Committee, and the Graduate Studies Director.
- (d) The research activities and publications of the faculty staff.
- (e) Brief CVs of the academic staff.

## **A. Curriculum and Teaching**

### **A1.1 Curriculum: Undergraduate level**

#### **APPROACH**

The undergraduate physics curriculum is based on four years of study. The Bologna Process with 240 ECTS credit units required for the award of the undergraduate degree is adopted. The core undergraduate physics curriculum follows current international standards, while maintaining at the same time the long-term experience and traditions of the Department.

More specifically, the undergraduate physics curriculum consists of:

- (a) 32 theoretical and laboratory core courses, mandatory for all students (180 ECTS), and 12 mandatory or elective courses (60 ECTS) in the specialisation area selected by the student during the fourth year of study (which includes a non-mandatory diploma thesis equivalent to three courses). There are in total 31 elective courses offered, associated with the following specialisation areas:
- (b) Physics of Material Technology.
- (c) Energy and Environment.
- (d) Photonics.
- (e) Theoretical, Computational Physics and Astrophysics.
- (f) Electronics, Computers and Signal Processing.
- (g) General area.

In order to gain entrance into the above 6 specialisation areas, the student must have completed successfully courses from the first six semesters corresponding to at least 78 ECTS credit units.

The above courses include 5 general physics laboratory courses, 13 specialised laboratory courses and 2 computer laboratory courses.

A two-semester Diploma Thesis is offered in the fourth year of studies as a non-mandatory course.

The quality of the programme of study can be evaluated by taking into account the feedback from questionnaires filled by the students at the end of each semester, which can be used as a mechanism to further improve the quality of teaching.

The Committee considers that the core physics curriculum offered in the first 6 semesters is adequate. However, the Committee finds that certain specialised courses (*Introduction to Environmental Physics* and *Introduction to Astronomy and*

*Astrophysics*) during this period should be rescheduled for the 7<sup>th</sup> and 8<sup>th</sup> Semester. Their place should be taken by more basic physics courses (*Atomic and Molecular Physics, Nuclear and Particle Physics*), which are currently offered in some specialisation areas, and by a more extensive inclusion of courses or material in mathematics that should be taken by all students on a mandatory basis, in order to strengthen the students' knowledge and skills in these areas.

The undergraduate teaching laboratories are numerous and seem to cover the standard needs of an undergraduate programme. However, the instrumentation and equipment of the laboratories in general need to be renewed and upgraded.

Furthermore, the Committee notices an unacceptably long study period (average of 6.5 years) to complete the undergraduate degree. This could be to some extent due to the large number of students who prolonged their studies under the former education system.

The Committee was informed that the student attendance is very low. In spite of the recent measures taken by the Greek educational system (introduction of the 'n+2' rule), drastic measures have to be undertaken by the Department to change the situation as it is reflected in the accumulation of unreasonably high number of "inactive" students. These measures should include the mandatory use of the assigned Counselor Professor for each student throughout his/her studies and the introduction of a continuous assessment system (e.g. mid-term examinations or other evaluation measures).

### ***APPLICATION AND RESULTS***

Overall, the physics undergraduate curriculum is adequate and is compatible with international standards. The majority of the course content is of high quality. However, some minor restructuring is required with respect to a few courses being rescheduled to a more appropriate semester, so that the resulting structure will improve the coherence of the programme. The specialisation areas, which are offered in the 7<sup>th</sup> and 8<sup>th</sup> Semesters, are very well designed and are in accordance with international standards and practices.

The undergraduate teaching laboratories function adequately and are located in excellent building facilities. The Committee recommends that measures should be taken, with the required funds, for the regular upgrade, refurbishment and maintenance of the instrumentation and equipment. In addition, there is a serious lack of specialised technicians to support the laboratories in respect to hardware and software. The present situation, with only 3 people in the technical personnel and primarily unpaid graduate students covering the needs in the educational laboratories, is not acceptable.

With respect to the students registered in the undergraduate courses, the Committee notes that the total number of students in the Department is currently 1823 (952 are within the 'n+2' rule, implemented recently by the new higher institutions' legislation, i.e. they are counted as active students, while 871 physics students are currently

beyond the 'n+2' rule and are considered inactive).

The Committee also notes that the number of students in the specialised courses offered in the 7<sup>th</sup> and 8<sup>th</sup> semesters varies considerably and in many cases it is unacceptably low. This issue needs to be addressed by the Department.

The reduction of the academic staff leads to the situation where the number of lecturers in the Department is not sufficient to deliver even some of the core courses in specific areas, e.g. nuclear physics, particle physics, theoretical physics and mathematics.

### ***IMPROVEMENT***

The Committee recommends that excessive variations of the number of students in the specialised courses should be avoided, with no less than 5 enrolled students per course. Without increasing the number of academic staff, which should be the primary aim, this can be achieved by combining related courses.

The Committee recommends that the specialised courses *Introduction to Environmental Physics* and *Introduction to Astronomy and Astrophysics* should be rescheduled for the 7<sup>th</sup> and 8<sup>th</sup> Semester in the relevant specialised areas. The basic physics courses *Atomic and Molecular Physics* and *Nuclear and Particle Physics* should be offered to all students and rescheduled to the 5<sup>th</sup> or 6<sup>th</sup> Semesters. In addition, to strengthen the students' knowledge and capabilities, more extensive skills in mathematics should be acquired on a mandatory basis by all students.

The Committee considers that attention should be given to increasing the number of specialised technical personnel (by at least three additional positions), in order to guarantee the quality and continuous functioning of the laboratory courses. In addition, granting teaching assistantships to graduate students (preferentially PhD students) would strengthen the ability of the Department to conduct quality teaching and research.

The Committee recommends that the Diploma Thesis should be selected by as many students as possible, since this would introduce the students into research, develop their critical abilities and improve their presentation skills.

The Committee also recommends highly the following measures:

- (a) The continuous assessment of students throughout the curriculum.
- (b) The enforcement of the scheme of the Counsellor Professor for each student to supervise and guide the students throughout their studies, including their registration in each Semester.
- (c) The introduction of an orientation day to welcome and provide general information on the University and the Department for newcomer students.
- (d) The Department's Website should be updated to include each course's syllabus, lecture notes and past examination(s)

## **A. Curriculum and Teaching**

### **A1.2 Curriculum: Master and Doctoral level**

#### **APPROACH**

The Department offers a graduate programme in Physics (MSc. and PhD), in the following 5 scientific areas: **Electronics and Telecommunications; Energy and Environment; Materials Physics; Photonics; Theoretical Computational Physics and Astrophysics.**

In addition, the Department participates in the teaching of a number of interdisciplinary graduate programmes on:

- (a) Electronics and Information Processing;
- (b) Polymer Science and Technology;
- (c) Environmental Sciences;
- (d) Medical Physics;
- (e) Informatics of Life Sciences;
- (f) Signal and Telecommunications Processing Systems – Theory, Implementation and Applications,

all in collaboration with other University departments and schools.

All the master programmes are credited in ECTS units according to the Bologna Process, for a total of 90 credit units. Each programme spans three semesters, including the nominally two- semester master thesis.

The Committee notes that a significant number of the students entering the master programmes of the Department had also obtained their first degrees from the Department. The total number of MSc. students admitted per year in the Department is 25.

The admissions are handled by a Graduate Studies Coordination Committee and approved by the General Assembly of the Department. For applicants coming from accredited universities (AEI), the evaluation of each application goes through a specific quantitative algorithm based on the following criteria: the general grade of the applicant's undergraduate degree, his/her diploma thesis, any existing research activity and relevant professional experience, knowledge of a foreign language and recommendation letters. For a better certification of the above elements, an interview of the applicants is conducted.

For applicants coming from higher technological institutes (TEI), an examination is first conducted in accordance to the specialisation area chosen by each applicant, and upon success they are subject to the algorithm and interview process described above.

There are no scholarships available to support graduate students enrolled in the MSc. and doctoral programmes, except those funded by the Greek national fellowship foundation (IKY) and from various national research programmes, such as Thales and Heraclitus (which have now ended), and from a limited number of European framework programmes.

The courses attended by the students for the MSc. programmes are based on their scientific area of enrolment. They are of good quality, comparable to the level of MSc. programmes offered by other universities worldwide. Many of the specialisation topics are of applied nature, thus providing high-level knowledge and skills for improving the employment possibilities in the rather limited technological sector of the Greek society.

For each graduate student there is a Supervisor Professor and a 3-member Advising Committee reviewing his/her progress and writing the annual progress report. The MSc. students defend their thesis in front of a 3-member Examination Committee and the PhD students in front of a 7-member Examination Committee (with some participation of experts from other universities and research institutes in Greece) appointed by the Senate of the University.

The number of graduate students currently working for a MSc. degree directly offered by the Department is 83, for the interdisciplinary MSc. programme on Polymer Science and Technology 26 and for the interdisciplinary MSc. programme on Electronics and Information Processing 51. The maximum permitted duration of the MSc. studies is 3 years and on the average it takes 2 years to complete the degree.

The number of PhD students in the Department is 74, for the interdisciplinary PhD programme on Polymer Science and Technology is 13 and for the interdisciplinary PhD programme on Electronics and Information Processing is 5. There is currently no maximum time duration for acquiring the PhD degree, while the average duration for completing the PhD degree in the Department (beyond the MSc.), is  $5.0 \pm 0.7$  years.

In addition to the special research project performed by each student for his/her MSc. thesis, there are a large number of graduate courses offered in the areas of specialisation:

- (a) In the Electronics and Telecommunications area, the student must follow 10 mandatory courses and 2 out of 4 elective courses, all in the area of specialisation.
- (b) In the Energy and Environment area, the student must follow 2 mandatory courses (1 in core physics) and 5 out of 9 elective courses in the area of specialisation, plus 1 course from other specialisation areas.
- (c) In the Materials Physics area, the student must follow 5 mandatory courses (1 in core physics) and 2 out of 5 elective courses in the area of

specialisation, plus 1 course from other specialisation areas.

- (d) In the Photonics area, the student must follow 2 core physics courses and 5 out of 10 courses in the area of specialisation, plus 1 course from other specialisation areas.
- (e) In the Theoretical Computational Physics and Astrophysics Area, the student must follow 4 mandatory courses (3 in core physics) and 5 out of 21 elective courses in the area of specialisation.

### ***APPLICATION AND RESULTS***

The members of the Committee discussed extensively both the undergraduate and the graduate physics programme with the faculty members of the Department, in the presence of the Chairman and the Directors of the Sections.

Examining the graduate courses offered by the Department, the Committee notes the absence of mandatory graduate courses in core physics subjects in almost all areas of specialisation. Such subjects which are considered very important and beneficial for all graduate students (both at the MSc. and the PhD level), independently of their specialisation area, are Quantum Mechanics, Electromagnetism and Mathematical Physics.

It became also clear that there is no financial support for MSc. and PhD students apart from a few national and European research programmes running in the Department. The need for a national or university scholarship system is emphasised by the Committee. Due to this absence of financial support, several students seek outside work, effectively becoming part-time students, thus lengthening the duration of their studies. National scholarships for graduate students are formally established in most developed countries in the world.

### ***IMPROVEMENT***

The members of the Committee recommend highly the adoption of 3 core physics courses to all the specialisation areas of the graduate programme, covering quantum mechanics, electromagnetism and mathematical physics.

A major problem is the lack of a national or university scholarship scheme to support the students attending the graduate programmes offered by the Department. A structured scholarship scheme should be realised as quickly as possible. The implementation of teaching and research assistantships would serve the dual purpose of both providing financial support to graduate students during their studies and, at the same time, providing scientific assistance for the presently under-staffed laboratories in terms of the required technical support.

Another measure that will improve the situation would be to establish start-up funds for new faculty members in physics. Such funds are available to new faculty at major universities in the USA and Europe.

## ***A2.1 Teaching Undergraduate***

### ***APPROACH***

The teaching methodology adopted by the Department appears to be almost the same as that established internationally, apart from one element: It is mainly based on a series of lectures, only rarely complemented by problem-solving sessions, due to the very large number of students enrolled in the courses. In the case of physics laboratory courses, students perform the experiments on a rotational basis, except from one introductory laboratory where all students are trained simultaneously to acquire common experimental tools and skills. From a pedagogical point of view, the rotational system certainly presents a disadvantage, although the Committee understands that this is necessary in order to save the cost of acquiring multiple instrumentation infrastructure.

All courses offered by the Department are taught based on textbooks of international level, where each student receives for free one of the textbooks proposed by the Department. Most of these textbooks or their translated versions can be also found in the Central Library of the campus, in several copies. In addition, laboratory courses mostly use local textbooks or notes produced by the faculty, where several need to go through considerable revision, as they are outdated.

The teaching-staff-to-active-students ratio is approximately 1:27, given that there are 35 staff members for approximately 952 regular active students out of a total number of approximately 1823 students (ratio 1:52). The teaching-staff-to-active-student ratio is currently almost one third than that of the international standards, which is 1:10. However, in the near future, this number will even seriously deteriorate, due to the non-replacement of the faculty retired or moved elsewhere in other Greek universities. The Department must persuade the Greek State to implement an urgent recruitment policy for hiring additional personnel in the Department, or officially inviting distinguished faculty staff from other Greek universities (“μετακλήσεις”), in order to cope with this problem. A short-term solution would be to use temporarily the emeritus professors for meeting the urgent needs for the teaching.

The Committee visited some of the teaching laboratories of the Department which are situated on campus. They meet the present needs of the Department. However, considering the large number of students attending the laboratories, considerable additional technical assistance is needed. In addition, some upgrading of the hardware systems is needed, acquiring synchronous instrumentation with better specifications.

### **IMPLEMENTATION**

The academic staff of the Department is currently composed of 35 faculty members; i.e. 13 Professors, 9 Associate Professors, 10 Assistant Professors, 3 Lecturers, as well as 3 more Lecturers elected whose appointment is still pending. The Department has 1 technical staff member (ΕΤΕΠ), 1 technical/teaching staff member (ΕΕΔΙΠ) and 1 special scientist for computers upgrading and support. It also employs 2 centrally-assigned secretaries and another 3 secretaries assigned to the 3 out of the 4 Department Sections.

The number of faculty of the Department (35 members) is clearly insufficient to implement its educational programmes. This is due to the retirement of some faculty staff and the moving of a few members to other universities in Greece, mainly to universities in Athens.

The number of technicians is also currently not enough to support the teaching and research laboratories, the Webpages and the computer systems (both hardware and software) of the Department. Due to the large number of students enrolled, each laboratory course is divided into several sessions and their support is a very difficult task for the limited number of technical staff working in the Department.

*The Committee was satisfied from the room-space availability of the Departmental facilities within the very nice and large campus of the University, as well as with its laboratories' infrastructure.*

With respect to the study material, the textbooks provided are compatible to those used in the international literature. The laboratory notes (“εγχειρίδια”) constitute good material to cover the experimental exercises, although they need some considerable updating.

In addition, the Committee was informed that there is no satisfactory remote access (via Internet) to the content of all the courses offered by the Department and no representative sample of the examination level for each course.

A positive aspect of the undergraduate curriculum is the mobility of the students through their participation in the Erasmus programme. This allows them to continue their studies through registering for one semester or two in other universities abroad, thus gaining experience within the European Area of Higher Education.

The Department has introduced a collection of data for the evaluation of the teaching personnel (questionnaires), which enable the academic staff to draw useful conclusions about their overall performance and helps them to improve their teaching aspects.

In addition, the measure of a Counselor Professor per student, who follows his/her

progress and guides the student throughout his/her studies, providing valuable advises, should be reinforced and should become mandatory.

### **RESULTS AND IMPROVEMENT**

The intake of the Department is approximately 240 undergraduate students per year. According to the statistics provided by the Department, the total number of its undergraduate students currently enrolled is 1823, but only 952 (~52%) of them are considered as “active” students. A significant number of about 871 (~48%) are “inactive students” accumulated through the years («αιώνιοι φοιτητές»).

The number of students graduating per year is on the average about 90, which corresponds to about 37.5% of the entering students every year, but only to about 4.9% of all the enrolled students and to about 9.5% of the currently-active student body. Their average grade is 6.24 out of a maximum 10. There is an uneconomical and unnecessary long study period until graduation, which presently lies at the level of 6.5 years on the average. Only a very small fraction of the enrolled students succeed to graduate within the nominally expected time duration of 4 years.

The Committee proposes that the intake number of 240 students for the Department be drastically reduced to the level of 80-100 students per year. This can lead to better quality of teaching and better functionality of the laboratories which have a limited number capability. A further reason for this reduction is the significant shrinking of the Department in terms of the number of faculty and technical staff. At the level of the Greek State and for all the state universities operating in Greece, every effort should be made to complement the existing national entrance examination system with the proper measures to attract only students wanting to study the particular fields.

With respect to the guidance of students by the faculty members of the Department, the Committee proposes that the existing measure of the “Counselor Professor” for each student, who continuously monitors his/her progress and guides him/her throughout his/her studies should be reinforced and should become mandatory.

With respect to the students’ evaluation, the Department should utilise a combination of mid-term examinations, problem-solving sessions and written examinations and, in the case of laboratory courses, oral examinations and practical exercises.

The Committee noted that due to the prolonged strikes and occupation of the University buildings during the current semester, the courses textbooks have not been distributed timely to the students and the Central Library of the University was not available during the strike period. In addition, the only senior person in the Library of the Department is about to retire. The students worry that the access problem might

be prolonged for some time, unless some urgent solution is found by the Senate.

The Committee was also informed that only a limited amount of the educational material of the courses is posted on the Webpages of the Department to be accessed by the students. It is expected that the full implementation of the Digital Alma project (aimed towards the digitisation of all the University teaching and administrative documents) to all the departments of the University, including the Physics Department, in conjunction with the mandatory obligation of the lecturers, will resolve this problem.

There is clearly a need for more technicians in the laboratories. Due to the current economic crisis, an alternative solution would be to offer a sufficient number of teaching assistantships to graduate students. In addition, every effort should be made so that sufficient funds are secured by the Department for the maintenance and upgrade of the teaching and research equipment.

The faculty staff gives great importance to the promotion of physics to the local society and in particular to the secondary school students. On the University campus, the Museum of Science and Technology operates with more than 30000 visitors per year. It regularly receives groups of students from secondary schools. In view of this activity, the Committee encourages the faculty members, the graduate students and the University at large to take more actions towards advertising the Department's programmes.

## ***A2.2 Teaching Master and Doctoral studies***

### ***APPROACH***

The Department offers organised and well-structured graduate studies for a small number of areas in basic physics and a significantly bigger number of areas in applied physics.

The selection of students at the graduate level follows a well-defined procedure that includes an application letter for a specific area of specialisation, a curriculum vitae and a series of documents, including a first cycle degree, the analytic grading of the applicant, his/her diploma thesis, any existing research activity and relevant professional experience, foreign language knowledge and recommendation letters. For a better certification of the above elements, an interview of the applicants is conducted.

For applicants coming from higher technological institutes (TEI), an examination is first conducted, in accordance to the specialisation area chosen by the applicant, and upon success they are subject to the algorithm and the interview process described above.

The admissions are handled by a Graduate Studies Coordination Committee and approved by the General Assembly of the Department. For the enrollment to the PhD programme the award of a MSc. degree is a prerequisite.

There are a number of graduate courses offered by the Department, covering a few core subjects of basic physics, as well as a wide spectrum of courses selected in all specialised areas. The MSc. graduate programme comprises lecture courses, where the students' performance is evaluated via written examinations, oral examinations or written reports, and a mandatory research thesis. The nominal duration of the MSc. programme spans 3 semesters.

Following the completion of their courses, the students select their Research Supervisor and are integrated in the corresponding research group. The topics of their PhD thesis work and their annual progress is monitored by a 3-member Coordinating Committee.

Graduate students enjoy similar arrangements as undergraduate students concerning every aspect of their studies, student welfare and utilisation of the campus facilities.

### ***IMPLEMENTATION***

For each course of the MSc. programme there is a site where the registered students can find some general information on the syllabus of the course, the textbooks adopted and the structure of their chapters and various announcements for the course. Currently, there is very little information on the Internet about the material of each course (lecture slides and handouts, written examinations, sample exercises with solutions etc.). Under the Digital Alma project, currently undertaken by the University, such electronic material is expected to be completed in the near future.

For all graduate programmes (MSc. and PhD) there is a committee, consisting of 3 faculty members, who follow closely the selection of the specialisation topic for the corresponding student and his/her progress made on an annual basis. After the completion of the work for their master or PhD thesis, the students defend their thesis in an open seminar, in front of a 7-member examination committee. The doctoral theses are expected to lead to original publication(s) in international refereed journal(s).

### ***RESULTS AND IMPROVEMENT***

The graduate students complete their programmes on the average within 2 years for the MSc. degree and 5 years beyond that for the PhD degree. They are considered generally well-trained, bearing a good potential for further evolution in their academic, industrial or technology careers.

Some graduates of the Department managed to receive professional positions at various other universities and research centers in Greece and abroad. A fair number of graduates, however, preferred to stay at the University, something which is usually not desirable in the academia, where people are expected to spend a fair amount of time elsewhere, in order to broaden their career. This undesirable situation was taking place often in the past, but now seems to have changed for the last several appointments made by the Department.

In addition, as written on several pages in this Report, it is necessary to establish a scholarship scheme for all students at the PhD level and, if possible, also at the MSc. level. This can be realised through teaching and research assistantship posts, supported financially by the University, as well as through the submission of several research proposals in national and European funding agencies.

The Committee also recommends that the graduate research laboratories run by the experimental staff of the Department secure some minimal funds on an annual basis for the maintenance and upgrade of their infrastructure. Furthermore, the Department as a whole needs urgently to obtain 2-3 additional positions for technical support.

## **B. Research**

### ***APPROACH***

The Department aims for research outcome of international calibre, concentrating on a wide spectrum of applied areas and in a rather small spectrum of basic research areas.

Mostly due to historical reasons having to do with:

- (a) the higher education system in Greece;
- (b) the rather small size of the Department;
- (c) the research topics of the hired faculty members;
- (d) the limited number of faculty staff which diminishes rapidly due to retirement and with some faculty staff moving to other universities;

the Department concentrates its research in the areas covered by the existing 4 Departmental Sections:

- (a) Applied Physics Section (with 7 staff members and 1 on appointment pending),
- (b) Condensed Matter Physics Section (with 11 staff members and 1 on appointment pending),
- (c) Electronics and Computers Section (with 9 staff members),
- (d) Theoretical & Mathematical Physics, Astronomy and Astrophysics Section (with 8 staff members and 1 on appointment pending).

These areas of research cover a wide spectrum of theoretical and experimental physics spanning from astronomy and astrophysics, atmospheric physics and meteorology, renewable energy sources, electronics, theoretical and mathematical physics, lasers and applications, polymers, solids, liquid crystals and new materials. At the experimental level the research is currently performed at the 11 research laboratories hosted by the Department, or at other research laboratories in the country or abroad, collaborating officially with the Department or its individual members of the faculty staff.

The Department used to perform its research in the past by essentially appointing Greek scientists originating mostly from the vicinity counties, who happened to be exposed to international experience in research. Many of them had also their undergraduate or graduate studies at the same University, something which is not desirable in the academia, where people are expected to spend some time elsewhere, in other institutes in Greece or abroad before they might repatriate. The Committee notes that this undesirable situation seems to have changed for the last several appointments in the Department.

In order to strengthen the research collaboration of the faculty of the Department with the academic or other research personnel coming from collaborating institutes, the Department invites them from time to time, organising official seminars or workshops

where the results of research are presented to all the Department's members as well as to the general society.

Although currently there are little funds available for such purpose, the Committee believes that such seminars or workshops are very important for disseminating the research outcomes to the graduate students and researchers of the young generation.

### **IMPLEMENTATION**

The level of research conducted by the Department's faculty staff for the period 2007-2011 covered in the Internal Evaluation Report is good. This is reflected in the medium to large number of publications of the faculty accepted in international peer-reviewed journals (1.7 publications/staff member/year). The participation/member/year to local and international conferences is 1 and the number of citations per year is somewhat constant, at the level of 1500 per year for the whole Department. The situation seems to have improved in the last couple of years, with a noticeable increase in the number of publications (more than 2 publications/staff member/year).

The Department has signed official protocols of collaboration with CERN, the Greek National Research Center Democritus and Ecole Normale Supérieure in Paris, while its faculty collaborates in research with many foreign and Greek universities and research units. The Committee also noted that one of the members of the Department's faculty (now professor emeritus) is the spokesperson of a small international experiment at CERN, out of which an international workshop has been established, taking place on a rotational basis in several countries and bearing the name of Patras *honoris grata*.

With respect to the ability of the Department to attract competitive grants from European and national research funding agencies, the Committee notes that the national funding sources have diminished over the last years due to the continuing economic crisis. For example, medium size - but successful in terms of funding - national research schemes, like Thales or Heraclitus, have now expired without being replaced by other equivalent funding programmes. The Department has also so far attracted a satisfactory number of projects funded by the European Union Framework Programmes. The Committee marks down as an example of successful research venture the funding and setting-up of an important Astronomy infrastructure in the Mediterranean region, the telescope Aristarchos, which indicates that even under difficult conditions if there is vision and persistence, there is always a way to go forward.

The number of postdoctoral fellows is currently minimal, financed by limited national and European resources. Considering the important role that postdoctoral fellows play in research, this is damaging to the medium to long term research outcome and planning of the Department. The Committee also notes that only a very small number of graduate students are funded, due to the lack of a national teaching/research assistantship funding scheme.

In addition, the Committee registers that the number of technical staff currently supporting the smooth operation of the research laboratories (in addition to the support of the teaching laboratories) is clearly inadequate (only 3 people for all the Department). These matters must be urgently addressed by the Department. Due to the lack of new positions, a solution can be provided by introducing teaching and research assistantships for the graduate students.

### ***RESULTS***

From the official data made available to the Committee through the Internal Evaluation Report of the Department for the period 2007-2011, the following comments and conclusions can be drawn:

The Committee, considering the lack of new academic posts to replace retiring staff, due to the economic crisis in the country, shares the worries of the faculty staff concerning the future development of the Department. Nevertheless, it finds insufficient the strategic plan for the development of the Department, underlining the responsibility of the Department and the necessity for it to self-upgrade its programmes of studies, its administrative structures and its research directions. In the Department's development plan, recognition is made on some lack of coherence between the Sections of the Department and on corresponding disagreements among the faculty members. It is also giving credit to the faculty staff for struggling to achieve better collaboration with other institutes in order to attract funds, additional research personnel and students of high quality.

On the other hand, the report produced by the Department states that the success of the strategic plan rests on 2 elements of the Greek State: Funding and the hiring of new faculty members. It comes to the conclusion that the lack of funding and the considerable delay in hiring new personnel and in making decisions have led the Department to the situation where it cannot apply any strategic academic development.

On the matter of the lack of coherence between the Sections of the Department and the disagreements among the faculty members, the brief analysis made is based on the different views of the personnel (due to different professional and research experience) regarding the advertising of new positions, the upgrade of the programmes and administrating structures and the promotion of actions addressed to the general society.

The internal report finally comes to the conclusion that the efforts made by the Sections and the General Assembly of the Department are mutually incompatible with the lack of funding, the bureaucracy and the delays of the State, for which reason the strategic plan cannot be implemented.

The Committee notes that without a realistic and potentially successful strategic plan on an immediate or near future appointment policy, succession planning and new research

directions there will be serious problems in the Department considering that a number of staff members will retire soon and they might not be replaced by an adequate number of new appointments.

With respect to the scientific output of the Applied Physics Section, the Committee finds that its research activities on lasers, non-linear and quantum optics, solar and renewable energy sources and atmospheric physics and meteorology, although very dispersed in terms of topics, are very noticeable and important in industry, energy and everyday life, contributing to the professional integration of physicists through future employment. In addition, the research conducted by this Section attracts significant funding from public and private organisations.

With respect to the scientific output of the Condensed Matter Physics Section, the research activities of the Department on topics such as dielectric spectroscopy, CMOS technology, soft matter and nanoscale materials, organic/polymer and inorganic semiconductors are presenting a very rich spectrum of important applications and a considerable room for expanding knowledge and understanding matter in extreme scales and forms with new materials.

With respect to the Section on Electronics and Computers, the Committee notes that it allows the Department to maintain a strong interface with these important areas. As such, it provides know-how to the other Sections; it is involved in joint research projects and conducts a strong research programme of its own. It also contributes significantly to the teaching and training activities of the Department.

With respect to the Section of Theoretical & Mathematical Physics, Astronomy and Astrophysics, the Committee notes first of all that it contributes importantly to the successful implementation of the teaching programmes of the Department, by covering a large number of basic physics courses and mathematical tools. In addition, several areas of this Section, such as particle physics, astronomy and astrophysics contribute highly to the visibility and promotion of the Department, due to their important contributions to international high energy physics experiments. In view of the retirement/leaving of some members from this Section, an urgent provision should be made to recruit other people, either by acquiring new academic positions, or by calling for employment people from other universities.

### ***IMPROVEMENT***

The Committee identified as a serious concern the rapid diminishing of the number of faculty members of the Department, which happens unevenly across the various scientific areas of the Sections. The Department should take into strong consideration the expected limited amount of replacements/new appointments and develop a strategic plan of how to cope with the situation. On a short-term basis, the Department could take advantage of

the possible availability of its Emeritus members and integrate them into its teaching activities.

A measure that would improve the hiring situation would be to establish start-up funds for new faculty members in physics. Such funds are available to new faculty at major universities in the USA and Europe.

With respect to the different Sections the following measures are recommended: In view of the retirement or leaving of some members from key areas of recognised international status, such as particle physics, astronomy and astrophysics, provisions should be made to hire new people in these areas.

### ***C. All Other Services***

#### ***APPROACH***

The Department is located on the main University campus, which is one of the largest in Europe by area. The Committee considers that the Department's infrastructure facilities (offices, teaching rooms, laboratories, workshops, administrative services, and library), as well as central University facilities and services, such as the meals and lodging facilities, excellent sports and recreation facilities etc.), are all of very good quality. The Committee took note of the students' request that the meals and lodging facilities could be improved. The establishment of other secondary support facilities would contribute positively to the development of student and faculty clubs as well as cultural activities.

The secretariat staff is attributed both centrally for the Department (currently 5 persons) and individually for 3 out of the 4 Sections. Although this attribution of the administrative staff is desirable, the Committee noted that the expected reduction in administrative staff throughout the Greek university system causes serious operational problems in the functionality of the Department.

The technical support (currently 3 persons) for teaching, running and supervising exercises at the physics laboratories (including the maintenance and upgrade of the IT infrastructure) is evidently insufficient to cover the needs of the curriculum. This situation needs to be urgently corrected.

The Committee noted with pleasure the existence of central science and outreach facilities – the Museum of Science and Technology and the Aristarchus Observatory (at Mt. Helmos and managed jointly with the National Observatory of Greece).

### ***IMPLEMENTATION AND RESULTS***

The low number of administrative staff and the inadequate administrative infrastructure should be addressed in order to cover the needs of the Department in several aspects – particularly the digitalization of academic records and transcripts; the interface to the information handled by the University's accounting office; and the interaction with institutes abroad.

There is a pronounced inadequacy of the number of the technical personnel in the Department.

### ***IMPROVEMENTS***

One of the Department's priorities should be the recruitment of new administrative and technical personnel.

All secretarial and technical personnel should undergo thorough and continuous professional and vocational training on a regular basis. Through their training they should be able, among other things, to interact with foreign collaborating institutes, at least in English.

The central secretariat of the Department and the secretariat of each Section should be able to access the information handled by the University's accounting office.

The information technology system should be upgraded so that students should be able to access the library information remotely. Their academic records and transcripts should be digitalized in order to be readily available upon need.

The Department's Website should be updated to include the course syllabus, lecture notes and past examination(s).

### ***D. Strategic planning, perspectives for improvement and potential inhibiting factors***

Short, medium and long-term goals:

- (a) The curriculum is well-organised structurally, with a minor re-structuring needed for the undergraduate curriculum, as described in Part A.
- (b) The present administrative and technical personnel are clearly insufficient to cover the needs of the Department. In particular, technical personnel are required to support the teaching and research laboratories. Under the current circumstances, this insufficiency could be addressed through, for example, the introduction of a teaching/research assistantship programme for graduate students.
- (c) It is advised that the existing outreach facilities, e.g. the Museum of Science and Technology, that has more than 30,000 visitors annually, are continued and developed further to strengthen the links with the local schools and the community.
- (d) It is important that the Department strengthens its efforts to produce world-class research. This would require increasing the number of research staff and upgrading the infrastructure of the research laboratories.
- (e) The Department already exhibits a worrying reduction in its academic staff, resulting from retirements, departures and delays in the implementation of new appointments and transfers from other universities. The Department already faces a difficult situation and needs to implement its contingency plan. In particular, the areas of theoretical and particle physics require immediate attention.

The following inhibiting factors hold for all Greek universities:

- (a) The universities are restrained by the Law, which does not permit them to distribute some allocated funds and positions according to their needs. They do not have sufficient self-governance to redirect funds and positions according to their strategic planning. Each university should be given a budget and be allowed to set its priorities.
- (b) The Committee is seriously concerned by the student occupations (Καταλήψεις), with a high frequency of occurrence and with the resulting destructive fall-out and repercussions in the study and research activity of the Department. In particular, the Committee observes that this phenomenon contributes to the lengthening of the studies and to delaying the conferment of degrees. This situation is unacceptable as it also hinders the academic staff to carry out their research and to access their offices and laboratories.
- (c) More effort should be made by the relevant State authorities to ensure the continuity and non-interruption of the functioning of the University

throughout the academic year. This seems to be a general problem in Greece.

- (d) Like in most other universities in Greece, there continues to be a relatively high percentage of students admitted to the Department through the national examination system without the students necessarily wanting to become physicists. This problem holds for almost all scientific fields and has to be seriously addressed by the State, in close collaboration with the universities.

## ***E. Conclusions:***

Conclusions of the External Evaluation Committee and recommendations:

Most of the research in the Department compares well against international standings.

- (a) Since the establishment of the Department in 1966 (one of the first at the University) it is gradually increasing its role within the Hellenic scientific community by further developing connections with major international institutions.
- (b) Some of the faculty members of the Department are established physicists of the international scientific community in their areas of expertise.
- (c) The Department provides very good training in physics, developing, among others, well-trained applied physicists for careers in academia and industry areas. Moreover, many graduates are pursuing careers in several established universities and research centres in Greece and abroad.
- (d) The Committee noted scientific exchanges with other national agencies as well as with national and international research centres.
- (e) Some of the deficiencies in undergraduate studies are attributed to the high number of admitted students resulting from the peculiarities of the Greek higher-education admission system.
- (f) The Committee strongly recommends a minor revision of the students' course programme, as described in Part A of this Report. This should allow the students to make a better-informed choice of their specialisation area towards the end of their undergraduate studies and of their future professional development.

The Committee strongly believes in the necessity to implement a minimal acceptable system of scholarships for graduate students, both at the MSc. and at the PhD level. This can be realised through the implementation of teaching/ research scholarships and through the submission of applications for European and/or national research funding.

The Committee recommends that all laboratories require the continuing support of administrative and technical personnel. Graduate students with an appropriate teaching and/or research assistantship would successfully support the laboratories and help in the realisation of the teaching/research programmes.

The Department should develop a clear and coherent strategic plan within the framework of the higher education national legislation and follow a recruitment policy for new faculty members.

The number of undergraduate students admitted annually in the Department exceeds 220. The Committee believes that this number has to be significantly reduced to no more than 80-100 students annually, in order to achieve a much better functionality and quality of studies offered and to be compatible with the available infrastructure.

The current total number of undergraduate students exceeds 1820, of which only 952 are considered 'active' students. The Committee was informed that about 48% of all the students, and particularly those "under degree" (επί Πτυχίω), do not attend the courses offered and cannot be considered as active students (they simply attend only the examination periods).

The Committee strongly advises the wide and mandatory use of the Counselor Professor system, where each faculty member is assigned a reasonable number of students to continuously monitor their study progress. This should be included in the teaching load of the faculty staff.

It is also advised, where possible, that emeritus professors continue to be involved in teaching and research activities in order to provide at least a short-term solution to the academic staffing problems.

The scientific work of the Department is severely obstructed by several factors that occur in general in all Greek universities:

- The lack of the timely renewal of academic staff and the delay in completing the appointment process.
- The heavy administrative burden and bureaucracy involved in the Department processes, such as recruitment and budget allocation.
- Financing of participation in conferences/workshops/schools outside of Greece and within Greece is practically non-existent.
- Start-up funds and matching funds for new academic staff are non-existent.
- Delay in the approval and roll out of the research programmes supporting both students and academic staff.
- There is no structural position of postdoctoral fellowships.

The Members of the Committee

**UNIVERSITY OF PATRAS**  
**DEPARTMENT OF PHYSICS**

**Name and Surname**

**Signature**

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