



ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ

HELLENIC REPUBLIC

Α.ΔΙ.Π.

H.Q.A.A.

ΑΡΧΗ ΔΙΑΣΦΑΛΙΣΗΣ ΠΟΙΟΤΗΤΑΣ

HELLENIC QUALITY ASSURANCE AGENCY

ΑΝΩΤΑΤΗΣ ΕΚΠΑΙΔΕΥΣΗΣ

FOR HIGHER EDUCATION

EXTERNAL EVALUATION REPORT

DEPARTMENT of Chemistry, University of Crete

January, 2011

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External Evaluation Committee

The Committee responsible for the External Evaluation of the Department of Chemistry of University of Crete consisted of the following four (4) expert evaluators drawn from the Registry constituted by the HQAA in accordance with Law 3374/2005 :

1. Professor D. Coucouvanis, Chair
University of Michigan (USA)
2. Dr. S. Arseniyadis, Director
CNRS (France)
3. Professor C.A. Floudas
Princeton University (USA)
4. Professor A. Giannis
University of Leipsig (Germany)

Introduction

I. The External Evaluation Procedure

- Dates of the site visit

The visit was carried out from the 5 pm of the 24/1/2011 up to the 5 pm of 26/1/2011.

- Whom did the Committee meet ?

Academic staff:

Professors

At the beginning of the evaluation process, a general presentation of the research situation problems and future perspectives of the University of Crete (UoC) took place. The vice rector Prof. J. Papamatheakis outlined general aspects whereas the president of the Chemistry Department Prof. M. Orfanopoulos presented research and teaching activities of the University. Furthermore one professor of most divisions of the Chemistry department participated in the two meetings of the first day.

Although we urgently asked for a meeting with the Rector a meeting with him was not possible. However Prof. Papamatheakis (vice rector) met twice with the members of the external evaluation committee. Finally, Prof. I. Gerothanassis from the HQAA was present in all meetings.

Vice President of University of Crete

Prof. J. Papamatheakis

Director of Chemistry Department

Prof. M. Orfanopoulos

Professors

Spyros Anastasiadis

Associate Professors

Georgios Vassilikogiannakis

Pantelis Trikalitis

Spyros Pergantis

Georgios Froudakis

Summary: The Department of Chemistry managed to prepare a program that allowed meetings and discussions with ALL divisions of the department. In these meetings ALL members of the teaching staff were present. Furthermore we had the opportunity to speak to all laboratory instructors, to visit the laboratories, as well as the research laboratories of all divisions. We also discussed with representative of the students (undergraduate, masters and PhD students; a total of approx. 20 students). We visited the library and the facility for construction and repair of scientific glass instruments.

Day 1, Monday, January, 24, 2011: Meeting with the vice rector, the chairman of the department, and several colleagues of different divisions (see above).

Day 2- Tuesday, January, 25, 2011

General presentation by the Department Chairman (proedros tmimatos) about the history of the department, current research and teaching activities, infrastructure, facilities and financial situation including funding, and scientific publications and collaborations.

Professor Katerinopoulos and Professor Orfanopoulos presented the programs of undergraduate and graduate studies. Afterwards the research activities of the divisions of organic, inorganic, physical, environmental chemistry, and biochemistry were presented by the group leaders.

All presentations were detailed and informative, questions were asked and problems discussed. ALL the presentations were given to the members of the external evaluation committee in printed form and as a CD-ROM.

Day 3 –Wednesday, January, 25, 2011

During the last day we had the opportunity to visit the departmental laboratories as well as the laboratories (general chemistry, inorganic, organic, physical environmental chemistry,

and biochemistry) and the computational laboratories. During these visits we conversed with the corresponding laboratory instructors and students. We also met with the staff responsible for the University IT services. Finally we visited the library and talked with the librarian.

II. The Internal Evaluation Procedure

- *Appropriateness of sources and documentation used*

The documentation concerning the internal evaluation till 2008 was received by the members of the external evaluation committee prior to the evaluation process. Additional documents with detailed information concerning several research aspects and activities (see above) were received during the visit.

- *Quality and completeness of evidence reviewed and provided*

The furnished internal report reflects the current situation (i.e., number of students refers up to 2010; the actual number and list of current Departmental staff), clearly describes the structure, organisation, and duration of the entire degree.

- *To what extent have the objectives of the internal evaluation process been met by the Department?*

Overall the Internal Report met the objectives of the Evaluation Process.

A1. Undergraduate Curriculum

Goals and objectives of the Under-Graduate Curriculum (UGC)

The objective of the UGC is mainly excellence in both teaching the science by the faculty and learning the subjects by the students. The department generally has been successful in educating the undergraduate students who after completion of their education compare well with undergraduate students from excellent chemistry departments in Europe and the United States. Their training and success in post-graduate education is the major criterion of success. The lack of a national or international testing like the Graduate Record Examination, (GRE) makes it difficult to quantify their excellence and compare them to undergraduate students from other institutions.

- *What is the plan for achieving excellence?*

The structure of the curriculum is similar to the one used successfully in other internationally recognized excellent departments. The attendance of lectures is not mandatory and generally not satisfactory. The undergraduate laboratory training is mandatory and successful. The material used in the classrooms and the laboratories is updated regularly and consequently the curriculum is kept current and successful.

- *How were the objectives decided? Which factors were taken into account?*

The best description of the undergraduate instruction is transparency and the methods used in the classroom concerning teaching and testing are decided by the instructors. The professors that teach the undergraduate courses have been associated with Universities in countries outside the United States either as students or research associates. Consequently, the flexibility of the undergraduate program reflects their past experiences. The latter also are apparent in the European/American influence in the course study-guides.

The international distinction of the undergraduate students who matriculate under this departmental curriculum is demonstrated by the successful performance of a number of these students in post-graduate studies in Europe and the United States.

The undergraduate students are encouraged to participate in technical training in industry. This practice has been successful and should continue. It connects the younger chemists with the realistic association of their chosen science to society and also allows for their employers to evaluate their future potential employment.

IMPLEMENTATION

- *How effectively is the Department's goal implemented by the curriculum?*

The department has successfully designed programs in both graduate and undergraduate education and curricula that emulate those of the best universities in Europe and the U.S. As such the training of graduate and undergraduate students produces chemists who adequately meet the needs of Greek and International academic institutions and Chemical industry.

- *How does the curriculum compare with appropriate, universally accepted standards for the specific area of study?*

As stated previously, very well

- *Is the structure of the curriculum rational and clearly articulated?*

Yes as shown by the orderly operation of the classroom and laboratory instruction and

availability of study guides, based on syllabi.

- *Is the curriculum coherent and functional?*

Yes based on the above arguments

Is the material for each course appropriate and the time offered sufficient?

Yes.

- *Does the Department have the necessary resources and appropriately qualified and trained staff to implement the curriculum?*

The departmental facilities in a new building (completed in 2006) provide classrooms and laboratories of exceptional quality. The same is also true for modern instrumentation, library, and study halls. A group of exceptional instructors that supervise the laboratories have been in the department for many years, enjoy their duties and are very effective. This is apparent in their popularity to the students and faculty.

Emphasis must be placed in the need of research instrumentation. The available, excellent space should be filled with new "state of the art" instrumentation. In particular, the quality of the research of the organic chemists depends greatly on the availability of a high frequency NMR spectrometer. We strongly recommend that the administration makes certain that a 600 MHz NMR is purchased for routine use and a 800 MHz NMR for advanced research.

RESULTS

- *How well is the implementation achieving the Department's predefined goals and objectives?*

The new curriculum is in the first few months of application so making impossible any evaluation.

- *If not, why is it so? How is this problem dealt with?*

N/A

- *Does the Department understand why and how it achieved or failed to achieve these results?*

N/A

IMPROVEMENT

- *Does the Department know how the Curriculum should be improved?*

The new curriculum is in the first few months of application, so it is too early to evaluate the necessity of any improvements.

- *Which improvements does the Department plan to introduce?*

N/A

A2. Postgraduate Curriculum

Goals and objectives of the General Post-Graduate Program (GPP).

The GPP consists of two directions that may be followed sequentially (A and B) or in the case of A be a final destination.

- A) Post graduate Diploma of specialty (Masters with thesis)
- B) Ph.D Diploma

Both diplomas are driven by excellence in research. The impressive number of publications in high-impact international journals, attest to this drive. The masters (with thesis) diploma without continuation to a Ph.D diploma satisfy most needs of the Greek industry which in many cases does not need the sophistication of the Ph.D. degree. The latter is more appropriate for preparation for academic positions or post-Ph.D research positions. The success of both programs is evidenced by their effective continuation for nearly 23 years.

B. Teaching

APPROACH

The overarching principle in the teaching philosophy of the department is to provide basic knowledge of chemistry through core courses in the first three years to be followed with elective courses in the fourth year, and graduate courses in the masters program.

- *Teaching methods used, course updates, student participation, grades, and average duration for the undergraduate degree*

Teaching methods employ the traditional classroom lectures based on white board facilities and state of the art tools that include laptops with projection facilities, wireless internet, video recording of lectures and their use in webinars. The content of the courses was updated through a recent critical assessment of the teaching program with full faculty participation. Faculty members of the Chemistry Department have translated popular modern textbooks in several core areas, and these textbooks are widely used throughout all academic institutions in Greece. Course lectures, notes, homework assignments and solutions are also made available through the departmental website. The updates for elective and masters courses are performed annually. The undergraduate student participation in the exams varies between 70-85%, and the masters student participation approaches 100%. The average undergraduate degree is 7.0 out of 10 (based on a sample of 589) and the average duration for the completion of the undergraduate degree is approximately 5.2 years based on data reported at the oral presentation of the undergraduate program for the period 1987-2010 (typical percentages for graduation in 6 years are 10%, and in 7 years 1% as reported in the internal evaluation report for the period of 2001-2008). Oral presentations took place during the visit.

- *Teaching staff/ student ratio, interactions of faculty and students, and faculty teaching hours per week*

The teaching staff/student ratio for course work is quite favorable (1/12) approximately based on data provided at the oral presentation of the undergraduate program for the period of 2000-2010 during the visit. The teaching staff for course work consists of about 25 faculty members. The teaching staff/student ratio for laboratory work is very favorable (1/5) for a laboratory course with 20 positions. The teaching staff members for course work and laboratory work are available to the students not only through regularly scheduled office hours but also on demand at any requested time by the students. The faculty have on average 6 hrs /week for teaching duties which is an appropriate teaching assignment.

- *Teacher/student collaboration*

According to the interview with the students, this collaboration is highly satisfactory.

- *Adequacy of means and infrastructure resources*

The recently completed building of the Chemistry department has impressive facilities that are regarded as state of the art based on international standards. Both the classrooms and the teaching laboratories are properly equipped, are quite spacious, and can accommodate future faculty additions. Furthermore, a modern reading facility with wireless internet access is available on a 24 hour basis and can meet the demands of over 200 students.

- *Use of information technologies*

Use of Internet resources is widely spread, including online bibliographic databases, electronic books, wireless internet access, video recording, and webinars. A separate computational facility with about 25 personal computers in a local area network is available to the students. This departmental computational laboratory has room for improvement.

- *Examination system and assessment of course work by the students*

Multiple methods of assessing students are applied: assessing the performance of students in each class is carried out through written, or written plus interim exams at the discretion of the instructor. There is a student questionnaire for the assessment of the quality of each course. This is not required and its completion at desirable levels has room for improvement.

IMPLEMENTATION

- *Quality of teaching procedures*

The teaching methods are highly commended and this reflects, the experience and dedication

for excellence of the teaching staff. It was also pointed out unanimously during the interview with the undergraduate and master students. As a result, the quality of teaching is regarded as high.

- *Quality and adequacy of teaching materials and resources.*

The teaching material and resources are appropriate, updated frequently with international standards, and serve well the departmental mission for excellence.

- *Quality of course material. Is it brought up to date?*

The lectures in all courses are revisited and updated annually, and the quality of the course material is regarded as high.

- *Linking of research with teaching*

During the fourth year of undergraduate studies, the students are exposed to research through the dissertation. Also, during the industrial practical activity students are involved in applied research. It will be beneficial to a select number of students in their second and/or third year of studies, to have a formal option to join a research laboratory for research. One option is to introduce it in the curriculum as independent research with credit for a course. Another option is to provide modest stipends upon availability of funds.

- *Mobility of academic staff and students*

The department has numerous collaborations with academic and research institutions within Greece and abroad, and the programs SOCRATES/ERASMUS and SYNAPS had strong participation by faculty members and students. These efforts are encouraged to be maintained in the future.

- *Evaluation by the students of (a) the teaching and (b) the course content and study material/resources*

The evaluation of the students during the interview was very positive on both aspects. The formal evaluation process through a questionnaire presented to the students, in a hard copy form, at the end of each course could benefit from a more systematic process that will be done via access to a secure internet university site at which each student will provide his/her comments anonymously. It is also suggested that the undergraduate and masters students create awards for the best teaching staff members annually, where the nomination, assessment and selection process is student controlled exclusively.

RESULTS

- *Efficacy of teaching*

(see above in the APPROACH and IMPLEMENTATION sections)

- *Discrepancies in the success/failure percentage between courses and how they are justified.*

Based on Tables of the Internal Assessment Report, we consider that there are no major discrepancies.

- *Differences between students in (a) the time to graduation, and (b) final degree grades*

(see above in the APPROACH section)

- *Whether the Department understands the reasons of such positive or negative results?*

Based on extensive discussion with faculty members and instructors, they are fully aware of the strengths. They also are cognizant of the challenges that certain students face when they need to work so as to support their academic studies. The faculty accommodate the needs of such students and encourage them to complete their studies. This is a vital issue for a fraction of undergraduates and for the vast majority of students who pursue their masters degree without receiving any fellowship or teaching assistant stipend support.

IMPROVEMENT

- *Does the Department propose methods and ways for improvement?*

Even though the Chemistry department is in an excellent position in regard to the TEACHING component (see aforementioned discussion), the faculty members and teaching laboratory personnel are eager to introduce the most modern teaching methods and tools.

They also aim at maintaining the very good teaching staff/student ratios and at improving the interactions among faculty, undergraduate and graduate students.

- *What initiatives does it take in this direction?*

The department has introduced the faculty advisor system and each faculty member is assigned about 20 students who are guided throughout the duration of their studies. Also, each course introduces a web site that provides all relevant teaching material.

An improved computational laboratory will enhance the modelling and computational component of teaching which complements the experimental component.

Towards improving the quality and conditions of graduate studies at the masters level, the admitted students need to receive fellowships or teaching assistantships that will alleviate the financial issue and allow them to participate in both teaching and research. This is not a direction that the department can address in its totality, and requires the attention and consistent action of the ministry of education.

C. Research

APPROACH

- *What is the Department's policy and main objective in research?*

The research in the department is carried out currently by 25 Professors in five areas: Inorganic (4); Biochemistry (2); Organic (5); Environmental/Analytical(6); Physical Chemistry(8). The pre-doctoral program started in 1985 and until now has produced 289 masters and 126 Ph.D s'.

From the beginning the research was guided by a common desire among the faculty to achieve excellence. The hiring of the new faculty was not greatly influenced by politics or nepotism. The hiring of a number of excellent chemists at the same time based on high quality resulted in a group that subsequently worked together as a group to build a department that arguably is among the very best (if not the best) in the country.

The Department mainly carries out research related to the following fields: (1) Fullerenes, Photochemistry and photo-catalytic processes; (2) Natural products (isolation, structure determination, synthesis); (3) Synthesis of Fluorescence Indicators for detection of inorganic cations; (4) Medicinal Chemistry; (5) Heterogeneous catalysis; (6) Zeolites; (7) Biotransformations and chemoenzymatic processes; (8) Spiroketal lactones and chiral tetrahydrofurans; (9) Coordination chemistry; (10) Metallomacrocyclic chemistry; (11) Solid state chemistry; (12) Transmission electron microscopy; (13) Bioinorganic chemistry; (14) Inorganic colloids; (15) Biomineralization; (16) Corrosion control; (17) Biosilicification; (18) Functional open framework solids; (19) Atmospheric chemistry; (20) Mass Spectrometry; (21) Environmental organic and analytical chemistry; (22) NMR techniques; (23) Theoretical spectroscopy and nonlinear molecular dynamics; (24) Photochemistry and chemical kinetics; (25) Immunophysics; (26) Chemical dynamics; (27) Materials modelling and design; (28) Polymers and nanohybrid materials; (29) Applied spectroscopy; (30) Membrane protein biochemistry; and (31) Photosynthesis.

- *Has the Department set internal standards for assessing research?*

The department used the common international standards for assessing the published results of research (i.e., number of publications and citations; H index (ISI Web of Science); impact factor of journals); recognition of faculty via domestic and international awards.

IMPLEMENTATION

- *How does the Department promote and support research?*

The Department provides state of the art laboratory facilities for research and teaching and actively promotes research collaboration with other research institutes in related fields. The Department actively encourages and promotes the submission of applications to national and internationally funded projects by the academic staff.

- *Quality and adequacy of research infrastructure and support.*

The department has established first rate experimental laboratory facilities for both teaching and research purposes. Current and future research infrastructure needs dictate the urgent acquisition of a NMR-600 MHz and a NMR-800 MHz instrument complemented with appropriate technical support.

- *Scientific publications*

According to the Internal Assessment Report, during the period 2003-2007 the Academic Staff of the Department has published 470 papers in peer reviewed academic journals and had 10,952 citations. According to ISI Web of Science (as of December 15, 2010; unrestricted time period), the Professors of the department had an average H-Index of 20.8, the Associate Professors had an average H-Index of 18.9, and the Assistant Professors had an average of 18.

- *Research projects*

According to the funding record presented during the visit for the period 2003-2010, we can make a number of important observations: (a) support from the ministry of education lasted

for the period of 2003-2006 and no funding was provided for 2007-2010; (b) support from the General Secretariat of Research and Technology took place during 2005-2007 at a monotonically reduced rate, was terminated during 2008-2009, and re-activated in 2010 at a very low rate commensurate to 2006 and 2007 (i.e., the level of funding for 2006, 2007, 2008 was less than 200K Euros/yr); (c) support from industrial sources is a very low level during 2003-2006 and non-existing during 2007-2010; and (d) support from the European Union exhibited significant fluctuations ranging from 50K Euros in 2003 to about 1M Euros in 2004 to 700K Euros in 2005 and 2006 to 500K Euros in 2007 to 250K Euros in 2008 to 1.1M Euros in 2009 and 200K Euros in 2010. In sum, funding from the ministry of education and the General Secretariat of Research and Technology follows a very worrisome trend of significant reduction to a point of virtual elimination, while the competitive nature of funding from the European Union resulted in wide fluctuations, tremendous reduction in 2010, and introduces uncertainty for sustainable research funding.

- *Research collaborations*

The department apparently has had numerous research collaborations with domestic and international academic and research institutions. The internal evaluation report provides an extensive list of collaborating institutions and this list could benefit from specific information on the nature of each collaboration. The department is encouraged to enhance these collaborations through active participation in joint publications.

RESULTS

- *How successfully were the Department's research objectives implemented?*

The departmental objective of excellence in research is attained to a high degree.

- *Scientific publications*

(see comments in the IMPLEMENTATION section)

- *Research projects*

(see comments in the IMPLEMENTATION section)

- *Research collaborations*

(see comments in the IMPLEMENTATION section)

- *Efficacy of research work. Applied results and patents*

There is a limited number of patents resulting from the research work. An improvement of the patent office and the technology transfer office and their adequate financial support would benefit the results of research work and could lead into an increase of the patents and licenses.

- *Is the Department's research acknowledged and visible outside the Department? Rewards and awards.*

There are faculty members with international recognition reflected in awards and publications in high visibility journals. This is an area that could be improved.

IMPROVEMENT

- *Improvements in research proposed by the Department, if necessary.*

The Departmental suggestions for improving the research activities are:

- funding of fellowships and teaching assistantships for the masters program
- funding of fellowships for doctoral studies
- adequate funding of departmental operational expenses
- adequate funding for experimental and computational research infrastructure
- additional faculty positions (approximately 10 positions)
- funding for a 850 MHz NMR instrument

- *Initiatives in this direction undertaken by the Department*

The aforementioned improvements rely primarily upon the support by the ministry of education and the University of Crete, as well as funding from the European Union.

D. All Other Services

APPROACH

- *How does the Department view the various services provided to the members of the academic community (teaching staff, students).*

The distance between the Chemistry Department and the campus creates important financial problems to the students, most of them complaining for the higher ticket prices applied (1.10 € each way; 40 € monthly pass) compared to the main city universities (Thessaloniki, Athens).

The effectiveness of administrative and technical services is good to excellent. When compared to other countries (panel member's impressions) the current chemistry community in the department of chemistry at the University of Crete appears to have a larger proportion of happy staff members.

- Excellent coordination and communication between administration staff and their supervisor.

The academic staff of the Chemistry Department surveyed by the panel members contained a high proportion (by international standards) of people who had completed their masters and Ph.D.s in the same department or elsewhere, now acting as research instructors.

The library, when judged on international standards (European and US), is well equipped with books, electronic communication, access and highly skilled staff.

The panel members did not notice any understaffed technical service.

High-performance computing facilities, which are the most important infrastructural components for theory and computational chemistry, are adequate (though aging) and will benefit from major upgrades.

The unusual enthusiasm of technical staff is refreshing.

- *Does the Department have a policy to simplify administrative procedures? Are most procedures processed electronically?*

Yes they are. Moreover, things are working well according to the European standards while are continuously updated.

- *Does the Department have a policy to increase student presence on Campus?*

No information was available.

IMPLEMENTATION

- *Organization and infrastructure of the Department's administration (e.g. secretariat of the Department).*

The organization of Department's administrative staff meets the criteria for any leading institution. Undergraduate, post-graduate and economic affairs are pursued by a very friendly and efficient group of six individuals (five female and one male) sharing the work properly.

There are also two librarians and a glassware technician.

- *Form and function of academic services and infrastructure for students (e.g. library, PCs and free internet access, student counseling, athletic- cultural activity etc.).*

The student secretariats are quite efficient, the library is well organized but the cafeteria

(Kylikeion) is unavailable for apparently financial reasons.

Good sport facilities are available.

Free internet access is available in the library (online access to journals from home is made possible), in all labs and in the computer lab in the Department.

RESULTS

- *Are administrative and other services adequate and functional?*

Perfectly adequate and functional. A striking harmony is easily perceptible.

- *How does the Department view the particular results.*

The Department is aware of the problems concerning both the students and staff (exclusively financial, both cases).

IMPROVEMENTS

- *Has the Department identified ways and methods to improve the services provided?*

The consequences of national policies became especially obvious during the Committee's interview of undergraduate and graduate students. These were coherent, clever, ambitious young folks with a clear wish to do well and exploit their talents to the best advantage. Yet many of them stated that the Ph.D. degree from the University of Crete, though it is considered far better to those obtained by the main city universities (Athens and Thessaloniki), is no guarantee for opportunities beyond the master's degree, especially for those who see their future in industry, and that it might even be a dead-end option.

The committee supports the idea of a nationwide student rate for transportation, requested by the students. The government could participate by sponsoring part of the ticket cost, as is usually done in other European countries. Also, the Chemistry department support such a position.

Accommodation conditions for the students (most of them live in private houses) represent a high percentage. The question of a university subsidized housing facility was not highlighted by the students.

- *Initiatives undertaken in this direction*

No initiatives have been undertaken so far in these directions by the Department.

Collaboration with social, cultural and production organizations

The Department interacts with regional authorities by organizing seminars in high schools, lyceums, colleges or several government institutions to promote chemistry. Furthermore, the Department has in various ways contributed to the cultural activity of the city of Heraklion by organizing music concerts with open participation of the public.

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E. Strategic Planning, Perspectives for Improvement and Dealing with Potential Inhibiting Factors

- *Potential inhibiting factors at State, Institutional and Departmental level, and proposals on ways to overcome them*

The potential inhibiting factors at the state level are (a) the increased number of admitted students for undergraduate studies which is currently at the level of (100); (b) the lack of funding opportunities and support from the ministry of education during 2007-2010; (c) the almost non-existing funding and support from the General Secretariat of Research and Technology for 2007-2010; (d) the lack of fellowships and/or teaching assistantships for the masters program; and (e) the increased competitive level for external funding.

The potential inhibiting factors at the institutional level are (a) the reduced support of funds for the departmental operational expenses; (b) the lack of appropriate support for securing intellectual property rights through patents; (c) the non-introduction of transparent metrics for the distribution of funds from the institution principals to the departments which need (i) to reflect the quality of the research and teaching programs, (ii) to be distributed based on documented excellence and recognition, and (iii) to attain the goals of maintaining and enhancing the fine examples of excellence so as to compete with their respective departments at international level. A primary example of a critical need for the Chemistry department of the University of Crete is the institutional funding and support for the acquisition of a 600MHz NMR and a 800 MHz NMR instrument. These instruments can serve inter- and intra-departmental needs and are vital for a first rate Chemistry department.

A critical inhibiting factor at both the state and the institutional level is the lack of a meritocracy-based and documented excellence-based ranking systems. These should address the ranking for (a) the universities (i.e., institution wide), and (b) the departments (e.g., Chemistry departments).

The potential inhibiting factors at the departmental level are (a) the increased number of admitted undergraduate students; (b) the perceived reluctance of branching out and enhancing the area of chemical biology primarily and materials chemistry secondarily; (c) the long delays in the approval and hiring of new faculty; (d) the lack of start-up packages for new hires; (e) the lack of mechanisms for retention of high quality faculty; (f) the relatively low level of collaborative intra-departmental research proposals which could join forces across departmental divisions; and (g) the lack of recognition mechanisms (e.g., departmental awards) for exceptional contributions in teaching and research.

Specific suggestions to address the aforementioned inhibiting factors are:

1. Reduce the number of admitted undergraduate students to (50).

2. Acquire a 600 MHz and a 800 MHz NMR instrument for intra- and inter-departmental use.
3. Enhance the teaching and research frontiers in chemical biology and materials chemistry.
4. Introduce transparent metrics, based on documented departmental excellence, for the distribution of funds at the institutional and state level.
5. Institute fellowships and teaching assistantships at the masters and doctoral levels.
6. Initiate and sustain regular cycles of funding mechanisms from the ministry of education and the General Secretariat of Research and technology.
7. Establish and coordinate intra- and inter-departmental research proposals for competitive external funding opportunities so as to establish internationally recognized centers of excellence.
8. Introduce meritocracy and excellence-based ranking systems for the universities (i.e., university wide) and the departments (e.g., Chemistry).

The external evaluation committee is in agreement with the short-term, medium-term and long-term goals presented by the department of Chemistry.

F. Final Conclusions and recommendations of the EEC

Conclusions and recommendations of the EEC on:

- *the development of the Department to this date and its present situation, including explicit comments on good practices and weaknesses identified through the External Evaluation process and recommendations for improvement*

The external evaluation aims at enhancing the existing knowledge base that could be used for identifying future priorities for initiatives in research and teaching.

The Chemistry department of the University of Crete has established a high quality research and teaching program that is commensurate with international standards.

- All faculty members have active research programs.
- The group of young faculty members lead vibrant research initiatives.
- Most faculty members pursue creative and modern teaching initiatives.
- The best Ph.D. graduates are sought after for postdoctoral positions nationally and abroad, and some of them follow academic careers at domestic universities.
- The existing building facilities, experimental laboratories space for teaching and research, the classrooms, the office space, the library, the reading facility, the electronic, internet, and communications infrastructure are comparable or exceed corresponding facilities at internationally recognized departments.
- To maintain excellence in research and pursue scientific questions of high impact there is an urgent need for upgrade of the experimental infrastructure.

The external evaluation committee has the following recommendations:

- Pursue and establish a strong research activity primarily in the area of chemical biology and secondarily in the area of materials chemistry.
- Establish new faculty positions taking into account the relatively small size of the faculty in comparison to other Chemistry departments, new research directions in Chemistry, and forthcoming retirements.
- Pursue intra- and inter-departmental collaborative research efforts (e.g., Biology, Medicine, Materials) that follow the new directions.
- Acquire through institutional support and other funding sources cutting edge NMR instruments.
- Establish funding mechanisms at the institutional level that support start-up packages for new hires and retention of senior faculty.
- The state should establish funding sources for fellowships and teaching assistantships for masters and doctoral students.
- The state should reduce the number of admitted undergraduate students to a level of (50).
- Introduce transparent metrics, based on documented departmental excellence, for the distribution of funds at the institutional and state level.
- Introduce meritocracy and excellence-based ranking systems for the universities (i.e., university wide) and the departments (e.g., Chemistry).

- *the Department's readiness and capability to change/improve*

The external evaluation committee attests that the members of the Chemistry Department are aware of the current and future needs and have themselves proposed many of the aforementioned suggestions for improvement as evidenced in the internal evaluation report and during the site visit.

- *the Department's quality assurance*

The department's quality assurance depends on the continued excellence of the senior faculty and to a greater extent to the growth, recognition, and success of the younger faculty. The vibrant younger researchers represent the future of the department.

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The Members of the Committee

- | Name and Surname | Signature |
|---------------------------------------|-----------|
| 1. Professor Demetrios Coucouvanis | _____ |
| 2. Dr. Simeon Arseniyadis | _____ |
| 3. Professor Christodoulos A. Floudas | _____ |
| 4. Professor Athanassios Giannis | _____ |