Response Letter to External Evaluation Report

Institution:
University of Cyprus (UCY)
Department of Electrical and Computer Engineering (ECE)

Program of Study:
Master of Science in Intelligent Critical Infrastructure Systems

The ECE Department would like to thank the External Evaluation Committee for their invaluable time and constructive suggestions which have helped to improve the quality of the program. We have carefully addressed all the comments in the External Evaluation Report. The corresponding reply and any changes or refinements made are summarized in our response below (the committee's comments are given in *italics*).

FINDINGS

1.   EFFECTIVENESS OF TEACHING WORK – AVAILABLE RESOURCES

Use of platforms in teaching

Regarding practical training, the EEC has seen demonstrations of diverse and very impressive experimental and software platforms that can be used to support students in their learning during M.Sc. studies. It was, however, unclear how exactly these platforms will be integrated in the teaching. The EEC suggests to the program organizers to consider how this can be accomplished, not only through M.Sc. theses, but also possibly through the application-based courses.

Reply:

During the visit of the EEC at the KIOS facilities and laboratories, the following platforms/laboratories were demonstrated:

1. Laboratory for Power Systems and Renewable Energy
2. Simulation framework and architecture for PLCs security attacks
3. Demonstration on intelligent vehicle routing for congestion-free mobility
4. Smart Water Networks simulation platform
5. Drone platform for Monitoring and Control in Emergency Response
6. Platform for real-time simulation of Multiple Antenna Wireless Communications

As discussed during the visit, these demonstrations involved some indicative experimental and software platforms which can be used through M.Sc. theses but also can be integrated in

the teaching of some of the M.Sc. courses to support students in their learning. Based on the EEC's suggestion, we attach an updated version of the course descriptions which includes the integration of various of the above platforms in specific courses (see ECE 801 Monitoring and Estimation, ECE 803 Security for CIS, ECE 804 Industrial Control, ECE 807 CIS Applications I – Fundamentals, ECE 808 – CIS Applications II - Advanced). Moreover, we attach additional material on the KIOS Use Cases, which have been developed for the purposes of this Masters program and are integrated in the various courses (this material was also available to the EEC during the visit).

Flexible assessment

Regarding assessment, the EEC suggests to the organizers to consider flexible forms of assessment throughout the studies. This would facilitate the integration of students with diverse backgrounds into the program.

Reply:

We appreciate the comment and in-depth discussion during the visit with regard to flexible forms of assessment to facilitate the integration of students with diverse backgrounds and level of knowledge. Given the current rules and regulations set by the University of Cyprus, it is currently not possible to accommodate flexible assessment. However, we plan to examine this with the University in the future, as we agree with the EEC that such policies can better facilitate students with diverse backgrounds in the same program.

Innovative teaching methods

Even though a discussion of innovative teaching methods (such as flipped classroom or blended learning) did not take place during the site visit, the EEC feels that such an innovative program of study deserves the adoption of state of the art teaching methods. Moreover, the EEC is confident that the personnel involved will be able to integrate such methods as needed in the program.

Reply:

We appreciate the positive feedback from the committee. Innovative teaching methods have already been adopted by the instructors for their other courses and they constitute a good practice at the University of Cyprus and Imperial College London. For example, in some graduate level courses at UCY, students study independently and learn elements of the core curriculum which they later present in front of the whole class with the lecturer having the role of facilitator. The focus is to move from primarily lecture-based classroom sessions towards more interactive and student-centered teaching methods. It has been shown that this approach helps students acquire a deeper knowledge of the subject. In the future we will try to intensify and enhance these efforts and create more space for innovation in education.

Online courses

The ambition to make courses available on-line later in the implementation of the program were noted and positively commented on. This would be a benefit for the program (given that the teaching personnel comes from two different institutions) as well as the international community in this area.

<u>Reply:</u>

Throughout the development phase of the program we have carefully considered both the provision of on-line courses for a number of courses as well as the full implementation of the program as a distance learning program. Due to various practical constrains this would not have been possible for the first intake of students and therefore at this stage the program will be offered as a conventional program. Once the program matures and more experience is gained, this option will be re-considered and examined in more depth.

2.   PROGRAM OF STUDY AND HIGHER EDUCATION QUALIFICATIONS

Streamline of documentation

Overall the program of studies is of very high quality. The content and coverage of the individual courses and their integration into a coherent program is well thought out. The EEC suggests that the program organizers make an effort to streamline and unify the presentation of the different course outlines, in terms of pre-requisites, modes of assessment, etc. This is especially important as students from diverse backgrounds (not just electrical and computer engineering) are expected to attend the program.

Reply:

We would like to thank the committee for their positive feedback and for pointing out the discrepancies in the presentation of course descriptions. The documentation with regard to the course descriptions has been modified with the aim to streamline and unify the presentation of the different course outlines and adequately inform prospective students on the minimum requirements for each course. Please see the attached updated program prospectus (which also includes the updated course descriptions).

Elective courses

The EEC positively noted the extensive discussions that the program organizers already had regarding the introduction of elective courses. While this is not foreseen at this stage, it could be something to consider in the future, again with a view towards the diverse backgrounds and interests of the students.

Reply:

The possibility of having a small number of elective courses will be thoroughly examined in the future. The discussion on elective courses is planned to take place in the first internal evaluation of the program.

Seminars on social topics

The plans to include seminars on social topics (engineering ethics, social acceptance, etc.), research methodology and technical writing were also positively received. The program could benefit from setting a specific number of seminars dedicated to such topics.

Reply:

The committee's recommendation for setting a minimum number of seminars dedicated to social topics has been positively received. The description of the MSc Seminars & Workshop

course has been modified to reflect this. Students must attend at least 5 non-technical seminar presentations on social topics such as engineering ethics, social acceptance, etc.

Industry-related seminars

The international dimension is enhanced further by plans to include individual lectures from international experts as part of the envisioned seminar series. The program organizers can consider also inviting leaders from industry as part of this effort. This would also enhance further the emphasis that the program already places on entrepreneurial aspects and industrial relevance.

Reply:

The suggestion to invite leaders from industry as part of the seminars series has been positively noted. At the moment the focus of the program is to deliver courses by world-class expert academic faculty from UCY and Imperial with significant international research reputation on the topic of Intelligent CIS. However, both the program's courses and the seminars series can accommodate visiting guest lectures by industry leaders, both locally and internationally, in the field of Critical Infrastructures. The extensive network of industrial partners of the KIOS Innovation Hub will be utilized for these purposes.

IP rights

During the discussions the EEC brought up the issue of the ownership of intellectual property generated by the students during their M.Sc. studies. The EEC feels that a clear policy regarding IP rights and ownership should be communicated to the students. This is particularly important given the emphasis that the program places on research, entrepreneurship and industrial contacts.

Reply:

The University of Cyprus acknowledges the need for a clear policy regarding IP rights and ownership and thus has established the Intellectual Property Policy (https://www.ucy.ac.cy/research/documents/Research/patents/IPR_Policy_UCY.pdf). The policy is based on the principles that govern the ownership rights emanating from research of and/or materials produced by the University's members of staff, employees of affiliated institutions, centers and organizations as well as students of the University. The University provides support services to promote the creation of Intellectual Property (IP) whilst seeking to maximize the commercial exploitation of the resulting IPR. According to the policy, the University claims ownership of all intellectual property made or created by student members in the course of or incidentally to their studies. The policy will be properly communicated to the M.Sc. students during the orientation period and it is clearly stated in the updated program's prospectus. Students will also be encouraged to attend seminars on IP law or

related topics during their studies, organized by the Centre of Entrepreneurship at UCY and/or KIOS CoE.

3. RESEARCH WORK AND SYNERGIES WITH TEACHING

No comments

4. ADMINISTRATION SERVICES, STUDENT WELFARE AND SUPPORT OF TEACHING WORK

No comments

5. DISTANCE LEARNING PROGRAMS

N/A

6. DOCTORAL PROGRAMS OF STUDY

N/A

Further to our responses on the committee's comments included in the 'Findings' section of the External Evaluation Report, below we address any additional comments, suggestions and the indicator rating included in the 'Quality Standards and Indicators' section (the committee's comments and/or the relevant indicator are in *italics*).

1.1 Organization of teaching work

1.1.3.1 The implementation of a specific academic calendar and its timely publication

Reply:

The M.Sc. program will obey the general rules and regulations as set by the University of Cyprus. According with the policy of UCY, the academic calendar is published online well before the student registration begins, both at the website of the Academic Affairs and Student Welfare Service and the website of the Graduate School (http://www.ucy.ac.cy/graduateschool/en/postgraduate-studies/academic-calendar). A more detailed academic calendar including important dates specific to the M.Sc. program will be published in the program's webpage.

1.1.3.2 The disclosure of the program's curricula to the students, and their implementation by the teaching personnel

Reply:

The enrolled students as well as any prospective students will be able to access the program's curricula from the dedicated webpage of the program. It will be mandatory to maintain separate webpages per course, linked to the program's webpage. Each instructor must make his/her course syllabus available on the course's webpage and, furthermore, will provide the syllabus to the students on the 1st lecture of the course. The implementation of the curricula will be monitored by the Program Coordinator and possible issues will be discussed and resolved by the Program's Academic Board. Each student will have the opportunity to provide feedback when submitting the course evaluation, upon completion of the course.

1.1.3.4. The procedures for the fulfillment of undergraduate and postgraduate assignments / practical training

Reply:

Upon acceptance, each student will be provided with all necessary material with information procedures for the fulfillment of undergraduate and postgraduate assignments and/or practical training. Moreover, the necessary pre-requisite courses per student (if any) will be determined and discussed with the prospective student.

1.1.3.5 The procedures for the conduct and the format of the examinations and for student assessment

Reply:

The M.Sc. program will obey the general rules and procedures of the University of Cyprus. For information on procedures for the conduct and the format of the examinations and for student assessment please see sections '1. Studies – General' and '2. Grading System' included in the UCY's Postgraduate Studies Rules (Annex 8 of the application).

1.1.11 The program of study applies an effective policy for the prevention and detection of plagiarism

Reply:

The University's rules with regard to plagiarism are outlined in Section III (Disciplinary rules for students) of the UCY's Postgraduate Studies Rules (Annex 8 of the application). During the first week of teaching, the instructor gives to the students a written outline of the course (syllabus). This includes a section with rules and policies. The rules in place with regard to plagiarism are summarized in this section. Moreover, the orientation pack provided to students at the beginning of the program will include information regarding the University's rules on plagiarism.

Hardware-level topics

In this respect, the program can also clarify better how hardware-level topics such as SCADA, PLC, FPGA, communication busses, etc. will be covered in the program (for example, as part of the pre-requisites, the application courses, through the M.Sc. projects).

Reply:

We would like to thank the committee for pointing out the lack of clarification in documentation on how hardware-level topics will be covered in the program. Hardware-level topics will be covered in the context of two courses. In particular, in course ECE 804 – Industrial Control, a number of lectures has been included to illustrate the overall architecture and implementation issues relating to the automation hardware typically used (PLCs, FPGAs, SCADA). The syllabus of the course has been updated accordingly.

1.2 Teaching

1.2.4 The assessment system and criteria regarding student course performance, are clear, adequate, and known to the students.

Reply:

The documentation regarding the course descriptions has been updated (see attached file). The assessment system and criteria for student course performance have been harmonized across courses. Clear and adequate information on the above will be given to students during

the orientation period. This information would also be available in the course syllabus which each instructor must give to the students during the first week of the course.

1.2.5 Educational activities which encourage students' active participation in the learning process, are implemented.

Reply:

Innovative teaching methods have already been adopted by the instructors and constitute a good practice at the University of Cyprus. The focus is to move from a primarily lecture-based classroom sessions towards more interactive and student-centered teaching methods. In the future we will try to intensify and enhance these efforts and encourage more the students' active participation in the learning process.

1.2.7 Teaching materials (books, manuals, journals, databases, and teaching notes) meet the requirements set by the methodology of the program's individual courses and are updated regularly.

Reply:

The program is expected to start in September 2019. A plan for a timely and consistent development of all teaching materials is already in place and we are confident that they will meet the requirements set by the methodology of the program's individual courses.

2.2 Structure and Content of the Program of Study

2.2.1 The course curricula clearly define the expected learning outcomes, the content, the teaching and learning approaches and the method of assessing student performance.

Reply:

The documentation with regard to the course descriptions has been modified (see attached file) with the aim to streamline and unify the presentation of the different course outlines and adequately inform prospective students on the minimum requirements for each course.

2.2.3 The program of study is structured in a consistent manner and in sequence, so that concepts operating as preconditions precede the teaching of other, more complex and cognitively more demanding, concepts.

Reply:

In the updated course syllabi, we have included the prerequisite knowledge and skills for each course, so prospective and enrolled students are well informed on the background and knowledge needed to successfully complete the course. Pre-requisite and Co-requisite

courses have also been added with the aim to have concepts operating as preconditions precede the teaching of other, more complex and cognitively more demanding, concepts.

2.2.5 The program, in addition to the courses focusing on the specific discipline, includes an adequate number of general education courses.

Reply:

In addition to the focus of the program on the technical aspect of Intelligent CIS, the program aims to provide general transferable skills to students (for example communication, project management and entrepreneurship skills). The courses 'Innovation and Entrepreneurship' and 'MSc Seminars and Workshop' have been specially designed to fulfill this objective. All students of the University can also attend workshops and presentations organized by the UCY's Centre for Teaching and Learning, the Career Office and other entities of the University.

2.2.7 The number and the content of the program's courses are sufficient for the achievement of learning outcomes.

Reply:

We are confident that when graduating from the program, students will have acquired the required skills and knowledge to allow them to find employment in the CIS industry or continue their studies at the PhD level in the related field. A continuous evaluation plan is in place and updates will be carried out as necessary based on pre-specified criteria in order to ensure that the program achieves its goals and objectives.

2.4 Management of the Program of Study

While the committee was impressed with the platforms being demonstrated during the site visit, such research and educational platforms could benefit by being integrated with each other to investigate interdependencies among more complex infrastructures; for example, integrating simulated attacks on real PLCs and the effect this might have on the power systems platform that includes inverter connected solar panels. Another example may include drone data collected to enhance traffic management systems.

Reply:

The program organizers would like to thank the committee for their useful suggestions with regard to the integration of platforms to investigate interdependencies among more complex infrastructures and to note that we fully agree with the proposal. A key objective of the KIOS CIS Testbeds, which are currently under development, is to enable the examination of challenges related to interdependencies of CIS. Upon completion, this will be achieved by allowing the co-existence of software and hardware modules and the integration of various simulation environments from different application domains, through a flexible modular

architecture that allows for seamless, realistic operation, even when multiple inter-connected CIS infrastructures co-exist in the examined scenario.

3.1 Research – Teaching Synergies

KIOS is an outstanding center of excellence in this field, with an impressive track record in securing third party funding, fundamental and applied research contributions, and coupling these to education. The program can only benefit by including the latest research trends, for example in the area of data driven control, into the teaching curriculum.

Reply:

The M.Sc. is a research-oriented program and all taught courses include a significant research component to their curriculum. Latest research trends will be incorporated in the teaching of different components of the program depending on the area. The M.Sc. thesis constitutes a significant piece of research where students are expected to work on a comprehensive, individual project tackling the latest research challenges. Moreover, the M.Sc. seminars series is specially designed to deliver lectures in cutting-edge research areas among other topics.

4.3 Financial Resources

The organizers can also consider making the courses of the program available on an individual basis. This would allow additional local students to benefit from the new courses on offer and could also help attract additional participants (and income) from abroad (especially for the intensive "block" courses) and from industry (in the form of continuing education).

Reply:

Given the nature of the program which is self-funded, it is possible to offer some of the courses on an individual basis. Note that the courses are already available, at a fixed cost per course, to other postgraduate students at the University of Cyprus. In the future, and once the program and new courses mature and more experience is gained, we will consider the options of: (i) allowing external (non UCY students) participants to register in individual courses at a predefined cost, or even (ii) offer specific program courses exclusively to external participants at predefined cost. This will depend on the demand that will be observed during the first years of running the program. Any future decision of this issue will be in line with UCY rules and regulations.