Committee for the Evaluation of Electrical and Communication System Engineering

Study Programs

The Ben-Gurion University of the Negev Programs in Electrical and Communication System Engineering

Evaluation Report

November 2016

Contents

Chapter 1: Background

The Council for Higher Education (CHE) decided to evaluate study programs in the field of Electrical and Communication System Engineering during the academic year of 2016.

Following the decision of the CHE, the Minister of Education, who serves ex officio as Chairperson of the CHE, appointed a Committee consisting of:

- ***Prof. Alan Oppenheim***- Department of Electrical Engineering and Computer Science – MIT, USA -**Chair of the Committee**
- ***Prof. Susan Conry*** –Wallace H. Coulter School of Engineering Electrical & Computer Engineering - Clarkson University, USA
- ***Prof. Eby G. Friedman-*** Electrical and Computer Engineering, Department of Electrical and Computer Engineering- University of Rochester, USA
- ***Prof. Roch Guerin***- Department Chair and Professor of Computer Science and Engineering Department- Washington University in St. Louis, USA
- ***Prof. Ehud Heyman-*** School of Electrical Engineering - Department of Physical Electronics- Tel Aviv University, Israel
- ***Prof. Dr.-Ing. Walter Kellermann***- Chair of Multimedia Communications and Signal Processing- University Erlangen-Nuremberg, Germany
- ***Dr. Orly Yadid-Pecht****- iCORE/ AITF Chair of Integrated Sensors Intelligent Systems, Department of Electrical and Computer Engineering, University of Calgary - Canada
- ***Prof. Mathukumalli Vidyasagar*** - Chair in Systems Biology Science Erik Jonsson School of Engineering & Computer Science - The University of Texas at Dallas, USA

Prof. (Emeritus) Joseph Salzman- Department of Electrical Engineering, Technion, Israel Institute of Technology joined the committee for this visit as a consultant in Electro-optics.

Ms. Daniella Sandler and Ms. Inbal Haskell-Gordon served as the Coordinators of the Committee on behalf of the CHE.

Within the framework of its activity, the Committee was requested to:[1]

1. Examine the self-evaluation reports, submitted by the institutions that provide study programs in Electrical and Communication System Engineering, and to conduct on-site visits at those institutions.

2. Submit to the CHE an individual report on each of the evaluated academic units and study programs, including the Committee's findings and recommendations.

3. Submit to the CHE a general report regarding the examined field of study within the Israeli system of higher education including recommendations for standards in the evaluated field of study.

The entire process was conducted in accordance with the CHE's Guidelines for Self-Evaluation (of September 2013)

[1] The Committee's letter of appointment is attached as **Appendix 1**.
*Dr. Yadid-Pecht did not join the visit and did not participate in writing this report

Chapter 2: Committee Procedures

The Committee held its first meeting on January 6, 2016, during which it discussed fundamental issues concerning higher education in Israel, the quality assessment activity, as well as Electrical and Communication System Engineering Study programs in Israel.

In January 2016, the Committee held its visits of evaluation to 12 programs: Tel-Aviv University, the Technion, Bar-Ilan University, Ben-Gurion University, Shamoon College of Engineering, Ruppin Academic Center, Azrieli - College of Engineering Jerusalem, Lev Academic center, Ort Barude College, Holon Institute of Technology, Ariel University and Afeka College of Engineering. During the visits, the Committee met with various stakeholders at the institutions, including management, faculty, staff, and students.

This report deals with the programs of Electrical and Communication System Engineering Administration at the Ben-Gurion University of the Negev. The Committee's visit to the University took place on January 19, 2016.

The schedule of the visit is attached as **Appendix 2**.

The Committee thanks the management of the Ben-Gurion University of the Negev and the Department **Electrical and Communication System Engineering** for their self-evaluation report and for their hospitality towards the committee during its visit at the institution.

Chapter 3: Evaluation of Electrical and Electronic Engineering Study Programs at Ben Gurion University of the Negev

This Report relates to the situation current at the time of the visit to the institution, and does not take account of any subsequent changes. The Report records the conclusions reached by the Evaluation Committee based on the documentation provided by the institution, information gained through interviews, discussion and observation as well as other information available to the Committee.

1. Executive Summary

Observations and findings

At BGU, academic programs that in most universities worldwide are included under the unifying umbrella of Electrical Engineering (EE) are taught separately, although with a certain degree of overlap, by three different academic units: the Electrical and Computer Engineering (ECE) Department, the Communication System Engineering (CSE) Department and the Electro Optic Engineering (EOE) Unit. It has therefore been decided by the CHE that this Committee, whose role is to evaluate the EE education in Israel from a broad perspective, will evaluate the three units.

The committee feels that overall the study programs in BGU are of high quality and its graduates are included in the top cadre of Electrical Engineers in Israel. However, the committee found that the current three-department structure hampers the quality of the study programs, and it is actually a major stumbling block in the future development of the departments. The committee thinks that it is essential that the three units will be consolidated as a single unifying unit, to be referred to as a School. This recommendation actually reiterates the recommendation of the 2007 review committee, and it also aligns with the strategic plan of the ECE Department. It is expected that the new structure will lead to better utilization of the academic potential in research and in teaching, including: elimination of existing curriculum and course redundancies, and creation of a streamlined curriculum that projects a more coherent image to both students and industry; coordinated academic planning and hiring of new faculty; formation of comprehensive research groups with a broader scientific span and greater impact on the Industry; increased attractiveness of BGU to candidates for faculty positions. All these issues are demonstrated and discussed in the report.

The report addresses others issues, some of which are due to the current three-department structure. Others are not specific to BGU but pervasive across Israeli universities, and are therefore also commented on in a more general

sense in the General Report. One such significant issue is the current culture in which students in their 3rd and 4th year are often working 20 hours per week or more in industry. As discussed in the General Report, there are clear reasons why this culture has evolved and will likely continue. If structured appropriately as an educational partnership between the University and Industry, it has the potential to be beneficial for the study program, but alternatively has the potential of being detrimental and in many ways currently is. We specifically recommend that alternative models be explored and implemented to enable the students to engage with industry for both the financial and educational benefits they derive from it, but without compromising several important years of study and the quality of the education they receive.

2. Mission and Goals

Observations and findings

A) Background on the University, the Faculty and the Electrical Engineering programs

Ben Gurion University of the Negev (BGU) was established in 1970 and formally accredited by the CHE in 1973. The University comprises five faculties, operating in five campuses, three of which are in Be'er Sheva (Beersheba), the capital city of the Negev, one in Sde-Boker in the heart of the desert, and one in Eilat near the Red Sea. The self-evaluation report states that during the academic year 2013/14, there were approximately 18,900 students of whom 12,200 were studying toward a Bachelor degree, 2,400 were studying toward a Master without a thesis, 1,800 were studying toward a Master with thesis and 2,000 were studying toward a Ph.D. or an M.D.

The Faculty of Engineering Sciences was established in 1967 and operated at first under the academic supervision of the Technion. In 1971 the Faculty gained an independent status and was authorized to award B.Sc. and later M.Sc. degrees. The approval to grant Ph.D. degrees was obtained at the beginning of the eighties. The Faculty operates mainly in the main campus. It is now the second largest faculty with, according to the self-evaluation report, 4,550 B.Sc. students, 220 M.Sc. without thesis students, 520 M.Sc. with thesis students, and 280 Ph.D. students. The Faculty comprises twelve Departments and five additional Units that offer only graduate studies.

At BGU, academic programs that in most universities are operating under the unifying umbrella of Electrical Engineering[2], are provided separately by three different academic units, although with a certain degree of overlap: the Electrical and Computer Engineering (ECE) Department, the Communication System Engineering (CSE) Department and the Electro Optic Engineering (EOE) Unit. It has therefore been decided by the CHE that the Committee, whose role is to evaluate the EE discipline in all the academic institutes in Israel from a broad perspective, will assess the three programs.

The ECE Department was established in 1967, one of the six departments that later on became the Faculty of Engineering Sciences. The CSE Departments has been established in 1997 and the EOE Unit has been established in 1999. The number of students and graduating students in 2013 are summarized in the Table below.

Dept	B.SC	M.Sc. with thesis	M.Sc. with-out thesis	PhD
ECE total	904	72	13	53
ECE-graduating	204	30	8	17*
CSE Total	248	31	N/A	10
CSE-graduating	93	2	N/A	1
EOE Total	N/A	44	74	14
EOE-graduating	N/A	12	26	7*

* 4 year sum: 2010-2013

B) The mission of the Faculty

Recognizing the significant impact engineering has on improving the material wellbeing of society through developing and disseminating new

[2] Most EE Departments worldwide have Computer Engineering (CE) teaching and research tracks; hence the names of many of them are ECE while others retain the name EE even though they have CE tracks. In this report, we shall use the generic term EE unless we refer specifically to the existing ECE Department.

technologies, and through creating a prosperous industry, the Faculty set it goals on

(i) providing the best and most rigorous education possible in order to create a distinguished cadre of engineers leaders;

(ii) promoting cutting edge research for the benefit of Science and for developing the scientific and industrial infrastructure of Israel and of the Negev;

(iii) offering advanced programs to support the needs of the hi-tech Industry.

It should also be noted that BGU management is proactively promoting involvement and contribution to the community on campus and in the City. These activities which became one of the trademarks of BGU, are appreciated by the community and by the students and provide them with a sense of pride and identification.

C) Mission and goals of the academic units

The three units identify, of course, with the overall academic mission of the Faculty as stated above. Yet each adds its own perspective on the subject area.

(i) **The ECE Department** regards the world of EE from a broad perspective as a single discipline where it is sometime difficult to draw lines between sub-disciplines[3]. This is, in fact, how EE is perceived worldwide, as a wide discipline that spans all subjects from the physics of the Atom and Photon, to systems and information. The academic goal of the department is therefore to provide students with broad and rigorous knowledge in the fundamentals of EE in order to leave them with the freedom to choose, later on in the course of their studies or career, the specific sub-discipline they wish to specialize in, as well as to be able to work in collaborative teams that involve several sub-disciplines. This broad educational approach is also encouraged by offering teaching tracks toward combined degrees in ECE and Math, ECE and Physics and ECE and CS.

(ii) **The CSE Department** emphasizes research and education in the areas of networking and communication systems. Its academic goals and

[3] Consider, for example, the chain leading from algorithms, to VLSI, electronic devices, VLSI imagers and finally electro optics

curriculum are derived from this perspective emphasizing an interdisciplinary character based on Electrical Engineering and Computer Science. The goal is to produce graduates who are best equipped with the latest technologies and tools required in that area to meet the expectations of both students and high-tech industry.

(iii) **The EOE Unit** provides only graduate program (MSc with or without thesis and of course a PhD). The department regards optics as a multidisciplinary area, based mainly on EE and physics, but with applications in many other disciplines such as mechanical and material engineering, chemistry, nano-science, etc. As such, the department sees its unique role in admitting students from various backgrounds in engineering and natural sciences and educating them as EO engineers or scientists. In order to carry this mission, the department proposes to open an undergraduate program hoping that this will increase the number faculty staff, create teaching assistantships for graduate students and give a better background to undergraduate students in EO engineering.

The committee concludes that overall the departments adhere to their mission in the best possible way. Yet, having reviewed the programs' curricula and speaking with students and staff, the committee prefers the holistic approach that regards EE as a unifying umbrella for all the other disciplines. The committee thinks that this approach will better serve the overall mission stated by the faculty and should broadly lead to better education for the students both at the undergraduate and graduate levels, as well as better potential for career development. Eliminating the existing course redundancy, will also lead to a better, richer, and more effective curriculum. Finally, eliminating boundaries between departments will enable improved coordination in the planning of Faculty hiring and formation of larger and more comprehensive research groups. These issues are discussed in subsequent chapters. Overall, this will also contribute to enhancing the competitiveness of the department in hiring top-notch Faculty members.

<u>Recommendations</u>

Essential:

- The three academic units should be consolidated under a single umbrella of a School of EE[4], whose mission should be defined accordingly. This recommendation actually reiterates the recommendation of the 2007 review committee. It also aligns with the recommendation of the Ad Hoc Strategic Committee of the Faculty that operated between 2008 and 2010, and with the strategic plan of the ECE Department. In subsequent sections we shall examine this recommendation vis-a-vis our observations concerning the study programs, the students and the staff.

3. Organizational Structure

Observations and findings

A. Faculty structure

We focus mainly on the organizational structure of the Faculty of Engineering Sciences and of the reviewed units, as the organizational structure of the University is similar in all Israeli Universities.

The Faculty is headed by a Dean, who is elected by the Faculty Council, comprising all members of the Faculty, as well as representatives the other Faculties. The Council also approves new study programs and any policy change that leads to changes in the academic bylaws. The teaching bylaws of the departments are regulated by the BSc and MSc Teaching Committees, while hiring and promotion issues are dealt with by the Appointment Committee.

The Departments and Units of the Faculty maintain a similar internal structure with a Department Head, a Council, Teaching Committees and a Departmental Appointment Committee (DAC).

Open positions are usually defined at the department level. The DAC takes the lead in the internal review process and makes the academic inquiries. Next, a recruitment request is sent by the Department Head for approval

[4] Henceforth we shall use the term School, although some Institutes use the term Department or Faculty; the specific designation is a result of the overall structure of the Institute and does not necessarily reflect the function of the unit. Another reason for using this specific term in this report is to distinguish between this entity and the existing Departments and Units. It is up to the Institute and Faculty to decide whether the merged department will be defined as a School or a Department, and whether the name will be EE or ECE.

by the Dean, and then by the University Appointments Committee lead by the Rector.

This overall formal structure is reasonable as it provides the Departments with the freedom to conduct their academic life, i.e., initiating recruitment, promotion, as well as managing the research and teaching, while leaving more general regulation at the Dean's level. This structure becomes problematic, however, for small departments since it impose a substantial bureaucratic load, and also since special care must be exercised by the Dean to guarantee objectiveness and rigor in hiring and promotion. These difficulties become even bigger in the case of the EE area at BGU since there are three departments with partially overlapping areas.

B. The structure of the reviewed departments

The fact that the discipline is split between three departments with overlapping research areas, creates several difficulties and abnormalities. The key points are:

(i) Replication of bureaucracy at all levels, which mainly affects the smaller EOE and CSE Departments.

(ii) Redundancy in the curricula: Similar courses are offered in multiple departments at both the undergraduate and the graduate levels and differ only in the level at which they are being taught. Apart from the added cost, this phenomenon hampers the quality of the programs and the overall student satisfaction and appreciation of the program.

(iii) Uncoordinated academic planning: There are certain areas that are common to both the ECE and the CSE departments, and others that are common to both the ECE and the EOE departments. The desired situation is that hiring in these areas should be coordinated and planned to avoid duplication in research areas and instead create larger research groups with sufficient critical mass and with a broader span. This is, however, not the situation at BGU as the current structure does not encourage coordination.

(iv) Inefficient use of the teaching resources of the faculty: As described in the previous item, faculty members are engaged in teaching the same basic courses in different departments instead of being able to expand the spectrum of advanced courses.

(v) Difficulties in the hiring process: The lack of coordination also affects the hiring process when the departments have openings in the same area, which can result in large variance in the number of faculty members working in the same field. Furthermore, a rigorous and objective selection process is always a challenge in small departments, and it cannot be guaranteed over an extended period of time. These issues, combined with the fact that tension exists between departments, can detract good candidates from seeking positions at BGU.

(vi) The attractiveness of BGU to candidates for faculty positions: In the evaluation reports, the relative unattractiveness of the Beersheba area was pointed out as the main reason for the difficulty of hiring new faculty. The committee, however, felt that the above reasons, as well as dissatisfaction among the Faculty with the current situation are equally important.

There are other difficulties with the current structure, associated mainly with the quality and effectiveness of the study program, and with certain research areas. They will be discussed in subsequent chapters.

The current structure poses applicants to undergraduate studies with a tough if not confusing dilemma. They have to make a choice whether to study ECE or CSE or EOE. The committee thinks it is preferable for students to start studying the general science of EE before making this choice, and to defer this choice to a latter phase after they have acquired some basic knowledge on the discipline and their relative preferences for different sub-disciplines.

The current structure also sends a complicated message to the Industry as to who does what at BGU.

C. Recommended structure: A single unit

The best overall solution to the situation identified in the previous section is to unite the three departments in a single unit, to be defined as a Department or a School (henceforth we refer to it as a School of EE for reasons mentioned in footnote 3). This solution or similar ones have been discussed many times in the past and for some reasons have not materialized so far. Having discussed the situation with all the management and the faculty, the committee feels that there is now a consensus in all three departments that this is the best overall solution.

The only specific condition has been set by the EOE Unit, who requested that members of the ECE Department working in the area of EO will join them to form a unit within the School. The committee thinks that it will not be beneficial for the School if a particular research group, or groups, is formally defined as unit. The main reason is that this may create an unnecessary set of constraints on the School leadership in terms of a commitment to providing certain number of academic positions, or budget. The committee believes that allocation of such resources cannot be defined a priori to any particular area, and the School leadership, operating under the Council, should have full authority to decide on its policy regarding allocation of resources based on the overall needs of the School and changes in the EE area. Furthermore, such subdivision may create unnecessary scientific walls within the School and is not always possible (for example, several faculty members in the ECE department are working in areas associated with EO, such as fiber optics communication or light emitting micro-electronic devices, but may not define themselves as EO engineers).

Under the new School, all academic programs should be united, and all the degrees will be in EE (or ECE, as will be decided; see footnote 3). The School may continue operating the combined degree programs now operated jointly with Math, Physics and CS (see Section 2.C(ii)).

An important issue is the future of the graduate track in EOE. This track now admits many EE graduates from various academic institutes (universities as well as colleges), as well many non-EE graduates (see Section 2.C(iii)). In view of the important role that EO plays today in various disciplines and since this is a unique track in the Israeli University System, the committee recommends to continue operating and developing this track within the School. Yet, unlike the current situation, the courses in that track should be regular courses from the graduate curriculum of the School, except for a few preparatory course needed for students from non-EE background. Other details concerning this track are discussed in Chapter 4. The committee believes that it should be up to the School Council to decide whether they want to operate such a program.

<u>Recommendations</u>

Essential:

- The three departments should be merged into a single unit.

- The University and the Faculty should decide whether the merged department will be defined as a School or Department. This decision depends on the organizational structure of the University and the Faculty.
- The name of the unit should be one of the generic names used today. Both EE and ECE are appropriate in this case. More exotic names that retain the former departments' names are not recommended.
- Artificial subdivisions should be eliminated to ensure that faculty members working in similar areas don't end up being associated with different entities.
- Appointments, promotions, and allocation of resources (budget, manpower, lab space) should be handled by the School

4. Study Programs

Observations and findings

4A. The ECE Department

The department heads expressed the desire to develop a Power Electronics program because of the growing demand for expertise in electrical vehicles, solar energy, etc. This new program would call for hiring 3 to 4 new faculty in that area, and they expect there will be strong job opportunities for graduates in that area. The committee, however, felt that this was probably unrealistic and that because nearly every other university and college in Israel is contemplating starting or expanding such a program, this may not represent the most promising strategic initiative to consider.

Redundancy in course offerings (mostly introductory courses) across departments was mentioned as an issue that not only wastes resources but also makes it more difficult to coordinate the curriculum and ensure consistent background across students who may have taken different versions of a course. Differences in pre-requisites across programs are unavoidable, but can be managed more efficiently than is currently done, e.g., by redistributing course content across a common course sequence. Students were also affected by the current program structure and complained that there were too many tracks with not enough courses in each track.

In general, the ECE faculty felt that the existence of multiple small programs was problematic, and made projecting a coherent image to both students and industry difficult. They recommended closing the smaller areas and creating a common over-arching structure in the form of a School. This would also offer greater control on budget resources, and therefore facilitate the allocation of resources across programs in a more coherent fashion. One area where greater control on resource allocation is likely to help is that of support for teaching labs, which was identified as an area of weakness in the current programs. Another area in need of more resources is that of TAs and graders for courses. Because resources are insufficient, it is often the case that homework is not graded, which makes it harder for students to get a good sense for how well they are assimilating the material.

Faculty also expressed concerns that the fact that many/most 3rd and 4th year students work several days a week is interfering with course attendance and, therefore, the quality of their education, especially because many have jobs in other regions of Israel. In particular, most 3rd and 4th year students choose their elective courses not so much based on relevance to their studies, but on how well they fit to their work schedule.

The issue of increasing students' proficiency in English through adding courses taught in English was also discussed. The faculty is not opposed to it but is concerned that many students whose English level is poor, and there are many of them, may have difficulties. They appreciate the need for improving English proficiency, but this may have to be done progressively.

Another challenging area was the recruiting of students into the Ph.D. program. The vast majority of Ph.D. students are internally recruited, but the fact that most students start working and have, therefore, one leg already in an industry job by their 3rd or 4th year, makes it very difficult to convince them to stay for a Ph.D. At the same time and while they do lose a few students to Tel Aviv University or the Technion, they feel that they are holding their own when it comes to Ph.D. student quality, and the recruiting challenge they are facing is not unique to them, i.e., it is common to all Israeli universities.

Recommendations

Essential:

- The three programs should be consolidated into a single unit/School to facilitate coordination of courses and curriculum and project a more coherent image to both students and industry. Decisions regarding the internal restructuring of individual programs should then be made by the School, as should resource allocation decisions.

Advisable:

- Ensure adequate allocation of resources to support teaching labs and enough graders to ensure that homework can be graded.

Desirable:

- Improving English fluency of graduating students is desirable, but is likely best achieved through a progressive combination of approaches, some of which are already in place, e.g., having course material be in English, require all project reports to be written in English, etc. Increasing the prevalence of such solutions as well as introducing a few more elective courses taught in English could be effective in raising students' English fluency.

4B. The CSE Department

Observations and findings

The CSE department offers a B.Sc. program, a M.Sc. program, and a PhD. program in Communication Systems Engineering and as an additional option a Direct track PhD without granting a M.Sc. degree.

The curriculum of the B.Sc. program shows significant overlap with the B.Sc. program of ECE, but the actual courses are different from those of ECE, mostly of somewhat lower level as was acknowledged by both faculty and students. Some students expressed a clear preference for taking some of the ECE courses to obtain an even better knowledge base, e.g., in courses related to signal processing and the physical layer in communications. (According to the department head, students can take 10% of their curriculum from ECE courses.)
The CSE representatives emphasized their proximity to Computer Science and especially the Information Systems Engineering department. The students

appreciated their superior acquaintance with communication networks and the upper network layers relative to ECE students, and emphasized that the relevant hands-on experience provides them with an attractive qualification for employment.

In general, multidisciplinary is seen as a key and distinctive asset of the program. Distinguishing itself from the Information Systems Engineering (ISE) program is partly seen as a problem, especially as ISE attracts students by its strong emphasis on cyber security. In its evaluation report (p.35), CSE identifies nine areas (e.g., Big Data, Cyber Security, Internet of Things) as being important for the future development of its curriculum, which are essentially all claimed by ISE as well. Asked about this situation, the faculty noted that the two departments de facto still address different topics within this large area and students decide which program to choose based on their affinity to individual topics.

The B.Sc. programs in Computer Engineering (CE) offered by the ECE department and Software Engineering (SE) offered by the Software Engineering Unit are not seen as a competition by the CSE representatives, as they do not lead to a degree beyond the B.Sc.
The faculty members nevertheless stated that the low number of students at the graduate level (see Tables 2.5.1 and 4.1.3.2-3 of the self-evaluation) is a major challenge for the CSE program, which – seen from outside - also seems to support a merger with ECE. The open days of the department to attract potential students do not seem to be sufficient.

Students and faculty expressed in different forms that during undergraduate studies homework is often not checked by tutors especially in basic math and physics courses, which leaves students with frustration and insecurity. Moreover, B.Sc. students noted that in the third and fourth year, courses are often scheduled in a way to discourage working in industry, and students feel forced to take the courses which match their need to work rather than their interests. Finally, some students remarked that information on offers for final year projects is not well publicized.

<u>Recommendations</u>

Essential:

- The EE program should be consolidated such that the CSE becomes a study track in a more general ECE or EE program. If this recommendation is not implemented, the CSE program should be restructured to better avoid duplication of ECE courses on a lower level. With its proclaimed emphasis on a strong theoretical background, the CSE program should incorporate the ECE-level courses (e.g., in signal processing and communications).
- At the same time, the CSE program should use synergies with the ISE department to avoid redundancy and free resources for offering advanced courses in communication networks not only to the classical CSE clientele, but also to ISE and ECE students.
- The logistics of managing the final year projects, e.g., the information to the students on open projects, should be improved.

Advisable:

- Homework grading as feedback to undergraduate students is as important for CSE as it is for ECE. This is especially true for courses in math and physics.

Desirable:

- The scheduling of courses should acknowledge the need of some students to earn their living by working in parallel to their studies. The department may want to create an information platform which helps the students to find well-paid jobs in the CSE area, so that the external workload can be reduced and additional qualification is obtained.

4C. The EOE Unit

Observations and findings

EOE offers only graduate studies (MSc. and PhD.) It is the only unit in Israel (among Research Universities) granting graduate degrees specifically in Electro-Optics Engineering. The number of students in recent years was quite large as listed in the Table above: approximately 120-130 M.Sc. and 10-20 Ph.D. students. Some of the students are supervised by members of other departments in the university, yet these numbers imply an average of 25 students per faculty for guidance and other administrative responsibilities.

In order to provide uniformity in student backgrounds, non-EE B.Sc. graduates are requested to take a non-credit course on "Concepts in Electrical

Engineering" and a course in "Optics". In addition, two compulsory courses are: "Mathematical Principles in Electro-optics", and "Principles of Optical Imaging and Optical Components".

After successful completion of the non-credit courses, most of the graduate credit courses are open to all students according to their specific academic backgrounds and interests.

The M.Sc. program offers six possible areas of specialization: 1. Imaging systems and processing; 2. Optical communication; 3. Non-linear and quantum optics; 4. Optoelectronic devices and VLSI; 5. Optical signal processing and computing; and, 6. Biomedical optics. Students are requested to take at least one course in each area of specialization in order to get a broad background in EO. Laboratory courses include: 1. Electro-Optics lab; 2. Advanced Optics and Photonics lab; and 3. Optical Telecommunication lab (elective).

The study program exceeds the capability of the EOE Faculty members, and therefore, many EOE courses are given by academic staff from other departments and units, such as ECE, Physics, Biotechnology, Chemistry, Geography, Health Sciences, and the Desert Institute, and by adjunct teachers.

Since the EOE has no undergraduate program, the graduate students in EOE do not have the opportunity to get teaching assistantships. (Besides some exceptions, graduates students report on being blocked from teaching in ECE undergraduate courses). Thus, the vast majority of EOE graduate students work in industry, which limits their amount of time for research.

In order to address this problem, the strategic program of the EOE Unit proposes "…initiating a B.Sc program in electro-optics and photonics engineering..." with at least 30 new courses. The motivations stated are (i) "to enhance the number of internal staff; (ii) create teaching assistantships for our graduate students; and (iii) give a strong undergraduate background in photonics and EOE." For implementing this goal, the EOE strives to recruit 8 new Faculty members, and request a dedicated building for the department.

An in-depth discussion with the Head of the EOE Unit revealed that for implementing such a program, a market survey is required, addressing such issues as: the estimated number of student applications; the estimated number of high level scientists available, and willing to join BGU/EOE; the Industry needs for EO engineers. None of these studies have been done.

The committee raised serious concerns regarding opening such a program for the following reasons: (i) cost effectiveness, as many of the new courses proposed are taught with somewhat different slant in the B.Sc. in ECE program, others are specialized courses from the M.Sc. in EOE program; (ii) the proposers did not conduct a market survey regarding the estimated number of applications to this program. Actually, having talked with the students, we learned that many are working in the EE Industry. (iii) As noted in Chapter 2 (mission), the committee believes that the area of EOE might be too specialized for undergraduate students and actually a B.Sc. in ECE prepares them better for the Industry needs and provides them with a more flexible education that will help them in searching for jobs; (iv) Choosing EOE before even starting the undergraduate studies in too early: students should first have a basic education in engineering and only then have the freedom to make an educated choice whether to specialize in EOE in their Senior years; (vi) the department is too small to carry the load of such a program, and it will take years to build an academically good department that can manage such a program.

At the same time, the committee also discussed the future of the M.Sc. track in EOE, if the Unit is merged into the School. While, the committee thinks that there is no justification for keeping this unit as a separate entity, for the reasons stated earlier, is does recognize the unique role of the EOE track in educating graduate students from various backgrounds in engineering and natural sciences toward a career in the broad areas of EOE. EO is a multidisciplinary area, based mainly on EE and physics, but with new applications in many other disciplines such as mechanical and material engineering, chemistry, nano-science, etc. The EOE track has established itself as a successful hub of multidisciplinary graduate studies at BGU that attracts students and faculty from other departments. The committee therefore recommends continuing this graduate track within the School. The admission requirements and the mandatory courses in this track should be the same as those of the "regular" track for a M.Sc. in EE. Students without EE background will be able to be admitted provided that they study some non-credit preparatory courses. However, the decision whether to operate such a track within the School should be made by the School leadership.

<u>Recommendations</u>

Essential:

- The three programs should be consolidated into a single unit/School to facilitate coordination of courses and curriculum and project a more

coherent image to both students and industry. Duplication of courses, and redundancy in subjects across various courses should be eliminated in the new structure, and it is also anticipated that the current 25:1 ratio of graduate students to staff will be improved (reduced).

Desirable:

- Continue operating a special graduate track in EOE within the School as discussed above. The decision whether to operate such a track should be made by the School leadership.

5. Human Resources / Faculty

5A. The ECE Department

Observations and findings

There appears to be a well-established system in place to mentor new faculty when they arrive, and this is a positive point.

There was a general sentiment that even if the department faces challenges in hiring in some specific areas, *e.g.,* Computer Engineering, VLSI, and Power Electronics, recruiting was not a significant problem. The reference was made to a total of 11 applicants for one current opening, which was viewed as a reasonable pool (all 11 applicants are from Israel and have recently completed a post-doc). The committee felt though that this seemed to be a rather low number of applications, especially since candidates are likely to have also applied to all other universities in Israel.

The main concern raised by faculty relates to teaching load, which currently stands at 12 hours/year as opposed to 9 hours/year at other universities. They feel that this puts them at a significant disadvantage when it comes to their ability to be competitive on the research front. There appears to be mechanism in place to allow the top 25% of faculty, research-wise, to teach one less course, but there was considerable uncertainty among the faculty as to whether or not this program would continue, and little or no transparency in who was eligible.

Recommendations

Advisable:

- Ensure that faculty have a clear understanding of what is needed to qualify for a reduction in teaching load, and expand this program to the fullest extent possible.
- Develop outreach mechanisms to more proactively seek out Ph.D. students and post-docs in the US or Europe who may be interested in exploring possible faculty positions in Israel.

5B. The CSE Department

Observations and findings

The senior faculty of the CSE department left the impression of a dedicated and very cohesive group where mechanisms for mentoring young faculty and mutual support seemed to be well established. According to them, an upcoming opening for a new faculty of CSE should not again be filled with a representative of the physical layer, but rather by somebody researching future systems like 5G and with a strong theoretical interest. It was noted that the number of prospective candidates would be limited, as one does not expect anybody from outside Israel to apply, which implies that one must be flexible regarding the research area in order to ensure a high level of scientific qualification. The latter was emphasized as the main selection criterion for hiring, but it was also felt that the ideal candidate should fit well with the departments' current faculty.

The faculty did not complain too heavily about the teaching load, which was stated to be 6hrs per week, i.e., two courses per semester.

Recommendations

Essential:

- Incorporating topics such as Big Data, Cyber Security and Internet of Things in the CSE curriculum, as stated in the self-evaluation report, should be done **only if** the department has faculty in these areas. Given the strong activity of ISE in these areas, it is highly recommended to instead collaborate with ISE to avoid redundancy and inefficiency.

Advisable:

- In collaboration with ISE and ECE, the faculty should try to organize their teaching obligations more efficiently such that they can concentrate better on research and teaching in their special fields.
- Hiring of postdocs from abroad could enlarge the pool of potential candidates for filling future openings.

5C. The EOE Unit

Observations and findings

In 2016, there are 7 faculty members: one Emeritus Professor, one Full Professor, two Associate Professors, with the others being Senior Lecturers. Around 20 Faculty members from other departments support the M.Sc. programs in EOE.

The small size of the EOE Unit limits its overall scientific span, although some areas not covered by this unit are addressed by faculty members in other departments. Specifically, the EOE faculty members specialize in: Imaging systems, Image processing, Biomedical Optics, Optoelectronic Devices, Plasmonics and Metamaterials, and Millimeter-Wave Imaging. EOE areas that are addressed by members of other departments include: Lasers and Spectroscopy, Optical telecommunications, Remote Sensing, Atom Optics, Quantum Optics and Solar Cells.

Topics apparently not covered (or not emphasized) by the EOE team include: Quantum electrodynamics, Non-destructive Measurements, Semiconductor Laser Fabrication, Blue LED and Blue Semiconductor Laser technology, Photon entanglement, InP and Silicon photonics, VCSELs, Polaritons, etc. (There may be other topics, not mentioned here, while some of the mentioned topics are actually being dealt within EOE activities, but not perceived by this committee). A limited coverage of topics is a natural result of the small number of individuals that serve as Faculty members in EOE.

Overall, the EOE Faculty members constitute an undersized team, and highly dependent on the contribution of non-EOE members to fulfill its teaching, supervising and research goals. Due to team-size issues, the EOE is challenged in: 1. Teaching load; 2. Student supervision load; 3. Appointment and promotion procedures and internal administrative load; and 4. managing a broad teaching program where many of the courses are not covered by the department and are given in fact in collaboration with other departments or by adjunct professors.

Recommendations

Essential:

- In the new School structure, the EO group will be larger with a broader and more comprehensive scientific span. The new structure will also lead to better planning of faculty hiring.

Advisable:

- In the new School structure, teaching load and student supervision should be distributed uniformly within the School.
- The number of supervised graduate students should be a factor in moderating the teaching load.

6. Students

6A. The ECE Department

Observations and findings

Students appear generally happy with their choice of coming to BGU, which was often tied to BGU's reputation for offering a nicer community, *e.g.,* a "college town" type of setting, and a more balanced mix of social life and studies than other universities.

There was, however, a concern that students who do poorly are not provided with enough guidance and support. Students mentioned discussing this issue with friends at other universities and feeling that more support was available at those other institutions.

Master students expressed the desire to see a more proactive approach towards helping students identify scholarship opportunities. For example, identifying more scholarships for women, or providing greater access to scholarships that may be offered by industry. They felt that this was not approached as aggressively as it could.

Ph.D. students felt that they were in general well-prepared for jobs in industry, and had been well trained to be independent thinkers. One area of concern was that of grading load, with some students reporting having to do all the grading for a class of 80 students, which essentially prevented them from doing any research. There was also some uneasiness when it came to understanding publication requirements for graduation, with the feeling that there was significant disparity across areas, which could result in some unfairness in what students needed to accomplish before graduating.

Recommendations

Essential:

- Improve guidance and access to support for students who do poorly. This should start with close monitoring of students' performance to identify those who are struggling early on.

Desirable:

- Articulate consistent graduation criteria for Ph.D. across areas, and ensure that those are clearly communicated to students.

6B. The CSE Department

Observations and findings

The CSE students were in general very happy with their program and with student life in Beersheva in general. They feel that the level of their studies is not inferior to those at the three other big engineering schools in Israel, but student life is much more enjoyable at BGU. The main issue making their studies harder is – as apparently in most other engineering schools in Israel as well – the need to reconcile studies with the need to work for support oneself. The students complained and faculty confirmed that the CSE courses are scheduled across the entire week which discourages working off-premises. It was mentioned in various contexts that some students go to Tel Aviv or even further north for work to follow more attractive job offers and thus are on the campus only for three or four days per week, thereby skipping many lectures. Some students were convinced that the qualification obtained by working in the high-tech industry is even more important than the salary itself and the performance in such jobs is crucial for their future career.

Recommendations

Essential:

- Consider options to ease the reconciliation of studies and the need to work. Improve the scheduling of courses and provide more learning material for remote access (see also '4. Study Program, Section C').

6C. The EOE Unit

Observations and findings

There is a major emphasis at BGU to cater to students from various social and cultural backgrounds. The challenge is to offer an "equal opportunity" to less developed minority groups, while maintaining a high level of education that will enable the graduate an entry into an R&D position in Industry in the general area of EOE.

The admission requirements for M.Sc. candidates are: an average grade of above 80%, and a rank within the top 50% in his/her BSc. graduation year. The admission requirements for Ph.D. candidates are: an average of 85% in both, the M.Sc courses and the research thesis, as well as recommendations from three academics. After admitted, students from the various undergraduate programs (or from other universities) are requested to study non-credit courses for establishing a basic background. Students reported that in many cases, the choice of EOE is motivated by the fact that the non-credit requests in the EOE were less demanding than in other departments. They are expected to present their research results in an internal seminar series, and to publish it in professional scientific journals.

As noted earlier, the EOE department has no undergraduate program hence the graduate students do not have the opportunity to get teaching assistantships. (Apart from few exceptions, graduates students reported on being blocked from teaching in ECE undergraduate courses.) Thus, the vast majority of EOE graduate students work in industry, which limits their amount of time for research. Some full time students are supported through scholarships from the university or funded research.

The reported drop-out rate is in the 10% to 20% range. However, comparing the reported figures of the admitted and graduating students it seems that the rate is closer to 50%, which is understandable if one takes into account the fact that most students are working in the Industry.

Free conversation with both MSc. students and with PhD. students uncovered a limited awareness of topics not dealt with in the specific research of each student. In the balance between "focused" versus "broad coverage" the students reported that they were educated to prefer the focused approach. After graduation, they are mostly seeking a position in the local industry.

Students also complain that courses from the ECE and CSE departments are not always available to them, and the decision is not always based on missing prerequisites. Some courses with the same name are given in both the ECE and

CSE program, usually on two different levels, but they may choose only the lower level course.

Finally, students feel that Scholarships for EOE students and teaching assistantships are not on equal basis as these in Electrical Engineering.

Recommendations

Advisable:

- In the merged School, admission requirements should be uniform for all tracks; courses should be open equally to students having the proper prerequisites, regardless of their specialization track; scholarships and teaching assistantships should be distributed with uniform criteria.

7. Teaching and Learning Outcomes

7A. The ECE Department

Observations and findings

There are today only 35 out of 100 senior projects that are carried out in collaboration with industry. This relatively low number is the result of a conscious decision, as it was felt that many industry projects were not structured as the pedagogical tool they are supposed to be, and instead were mostly meant to gain access to free labor. While it is clearly important to ensure that students are not taken advantage of and are in a position to use their senior project as a learning experience, limiting collaborations with industry partners who can offer access to many interesting projects seems like a missed opportunity.

The department appears to be using a variety of teaching models, including experimenting with Moodle and offering a wealth of online material (a program is available that provides faculty with access to a tablet that can be used to record course material). Some of these initiatives have, however, been somewhat curtailed as they often resulted in students relying solely on the online material and stopping attending classes. This is by itself not an issue, except for the fact that students' final grades are strongly correlated with class attendance.

There was some dissatisfaction on the part of students with the quality of some courses, in particular Math and Computer Science, with the main complaint being little or no correlation between the course syllabus and the exams that

determine the final grade. In general, students felt that many courses fail to provide feedback on a student's performance until the final exam, by which time it is typically too late (some students mentioned not getting the result of their midterm until just before the final exam). There appears to be a general level of dissatisfaction with many undergraduate courses and what appears to be the limited effect that students feedback has on addressing the problem of bad teachers (students though said that they were very satisfied with the department's graduate courses). Students felt that this was in part caused by the fact that faculty are evaluated based on research rather than teaching, which devalues the importance of teaching and is in contradiction with the university's teaching mission. Students also expressed a need for better syllabus planning to help them navigate their way through their program.

On the positive front, Master students heaped praises on the departments seminars (they are required to attend 12, but most attend many more), which they felt played a major role in broadening their perspective.

Recommendations

Essential:

- There appears to be a need for a stronger emphasis on the importance of teaching quality; maybe by giving it more weight in promotion decisions. Additionally, there should be better transparency in how student feedback is used in dealing with poor teaching performance.

Advisable:

- Industry collaboration in senior projects needs to be better leveraged. It is obviously important to protect students from being exploited, but industry has much to offer when it comes to identifying interesting and relevant projects for students.
- Mechanisms also need to be put in place to ensure that students are provided regular and early feedback on their performance in a class. This likely correlates with the previously mentioned allocation of additional resources to ensure timely grading of homework.

Desirable:

- Faculty should be encouraged to explore new teaching models that can provide students with the benefits of easy access to online material, including videos of lectures, without jeopardizing class attendance. There is much activity in this area worldwide, with many institutions

facing the same challenges, and it is important to continue exploring this issue.

7B. The CSE Unit

Observations and findings

The CSE department implements quality assurance mechanisms such as anonymous student surveys on teaching quality, offering general counseling to students, supporting teachers to improve their teaching, giving teaching awards etc. Nonetheless, students complained about some teachers not being able to convey their messages in an understandable and motivating way, especially in undergraduate courses in math and physics. The dissatisfaction regarding these courses is aggravated by the fact that there seems to be no grading of homework so that students do not get any feedback on their performance before the final exams. Mid-terms that could provide some orientation are held at the discretion of the teachers and were said to be difficult and costly to organize by the faculty (second attempts must be offered, must be in written form), so that they are not common.

In general students, and also alumni found that good teachers should get more recognition, and staff should not only be evaluated based on research.

To address the need for fluency in English as the predominant language of science, it was stated that slides in lectures are typically offered in English and project reports are written in English, while the language in the classroom is Hebrew.

Regarding innovative teaching models, some faculty members are proactive and experiment with flipped classrooms, group competitions and Coursera, and appreciate the support available at the university level. Others emphasize the need for classroom attendance and point to significant correlation between classroom attendance and exam grades. The fact is that classroom attendance suffers from the students' need to work, but there is no uniform policy to support effective distance-learning: Some teachers offer recordings of their lectures, others distribute teaching material via Facebook.

Recommendations

Essential:

- The same essential recommendations as for ECE. For CSE, it seems also especially important to include math and physics teachers into such an effort to increase teaching quality.

Advisable:

- The same advisable recommendation as for ECE. Again, for CSE, it sees crucial that the math and physics course should be included in this effort and the feedback mechanisms, like homework grading and mid-terms, must be part of the effort.

Desirable:

- In any case, but especially if CSE does not change its policy of scheduling the courses over the entire week, it should provide sufficient options for distant learning for those who cannot attend all classes for financial/work reasons. Better distance learning materials should also reduce correlation between classroom attendance and exams grades, and the overall learning outcomes for BGUs students should be improved.

7C. The EOE Unit

Observations and findings

No special comment regarding "Learning outcomes"

8. Research

8A. The ECE Department

Observations and findings

The department appears to benefit from research activities that extend outside that of regular faculty and also include adjunct faculty. Even if this may be more an exception than the norm, it is illustrative of a healthy relationship between the department and its adjunct faculty.

The overall research quality and output appears high with several Ph.D. students displaying very strong publication records at a level comparable to that of top institutions worldwide.

8B. The CSE Department

With its multidisciplinary character, the research activities of the CSE department lie in both the EE and the CS domain, which is adequately reflected in the background of the mostly young researchers of the department. The publication record attests to the fact that world-wide recognition is earned in both communities. Given the relatively small size of the department and the correspondingly small number of PhD students and postdocs, it is unsurprising that the amount of external funding varies from year to year and does not grow continuously. The dominance of other sources (mostly industry) over competitive and public/governmental grants is much more pronounced than for engineering or the university as a whole. It was also noted that research activities of MSc and PhD students are strongly focused towards maximizing publication count.

Recommendations

Advisable:

- In the interest of long-term sustainability, it seems important to identify fundamental research areas where CSE researchers can collaborate among themselves and with ECE and ISE researchers and establish centers of excellence. This should naturally lead to more competitive grants and the desired publication count.

8C. The EOE Unit

Observations and findings

center of research in the fields of Electro Optics and Photonics. Research and teaching are considered the main missions of the department. A strong relationship between teaching and research exists, particularly due the fact that the department runs only a graduate students program, and research is a central part of the graduate student's qualification. Each M.Sc. Student in a thesis track is expected to publish at least one journal paper, and Ph.D. Students are expected to publish more than two.

Publication of research results in recognized, high rank scientific and technological journals is of very high rate. Also research contracts and grants are being pursued with high success-rate.

9. Infrastructure

9A. The ECE Department

Observations and findings

The main challenge seems to be in support for teaching labs, as the current budget does not appear to include adequate money for maintenance and replacement of end-of-life equipment or addition of new equipment needed to remain competitive. The primary mechanism that appears to be used to acquire new pieces of equipment is by leveraging research money. This is obviously not appropriate.

Recommendations

Essential:

- Budget needs to be allocated to ensure that the department can maintain its teaching labs equipped with the latest technologies.

9B. The CSE

Observations and findings

Students and faculty praise the high quality of the teaching labs and the according benefits for education. Given the fast development of the underlying technologies, staying current must be seen as a major challenge to financial and human resources.

Recommendations

Essential:

- As with ECE: Budget and human resources, i.e., lab support staff and faculty time, needs to be allocated to ensure that the department can maintain its teaching labs equipped with the latest technologies.

9C. The EOE Unit

Observations and findings

According to the "Self-evaluation report", the EOE unit staff and teaching labs are distributed between four buildings. Three of the teaching labs are located in

rooms which were originally offices and they lack the important infrastructure required for teaching labs. The secretary office is located in one building while four of the research staff members are located in another. The fifth and sixth staff members are in a completely different building. This scattered location is problematic and causes difficulty in the interaction between the EOE students, administration and staff. In addition, some additional student office space is required for some of the researchers.

Recommendations

Advisable:

- Within the School, the building, laboratory space and offices of the Faculty members from the EOE should be consolidated to enhance interaction between staff and graduate students.
- Laboratory space, technicians and support staff should be allocated to improve performance of the EOE experimental activities.

10. Self-Evaluation Process and implementation of previous recommendations

Observations and findings

The Faculty and the Departments have done a thorough job in providing an honest and extensive self-evaluation. Yet, the main recommendation of the previous evaluation committee, namely, to merge the three departments within a School of EE has not been implemented. Regardless of the reasons why this recommendation has not been implemented, having discussed the situation with all the management and the faculty, the committee feels that there is now a consensus in all three departments that this is the best overall solution.

The only specific condition has been set by the EOE Unit, which requested that members of the ECE Department working in the area of EO would join them to form a unit within the School. As discussed in Section 3 (Organizational Structure) the committee thinks that having a particular research group, or groups, be formally defined as a unit, would not be beneficial to the School. Instead, the committee would recommend the continuation of a graduate multi-disciplinary track in EOE operated within the School.

Chapter 4: Summary of Recommendations

4.A Recommendations Pertaining to the Structure

Essential Recommendations:

- The three academic units, the ECE Department, the CSE Department and the EOE Unit, should be consolidated into a single academic unit, to

facilitate coordination of academic planning and faculty hiring, courses and curricula, and a more coherent image to both students and industry.

- The University and the Faculty will decide whether the merged unit will be defined as a School or Department. This decision depends on the organizational structure of the University and the Faculty. Henceforth it is referred to as a School.
- The name of the School should be one of the generic names used today. Both EE and ECE are appropriate in this case.
- Artificial subdivisions should be eliminated to ensure that faculty members working in similar areas don't end up being associated with different entities.
- Appointments, promotions, and allocation of resources (budget, manpower, and lab space) should be handled by the School using uniform criteria.

Advisable Recommendations:

- Admission requirements to the M.Sc. program in the School should be uniform for all tracks; courses should be open equally to students having the proper prerequisites, regardless of their specialization track. Scholarships and teaching assistantships should be distributed with uniform criteria.
- Within the School, efforts should be made to consolidate laboratory space and offices of the Faculty and graduate students according to research areas in order to enhance interaction between staff and students, and for efficient utilization of technical staff and research equipment.

Desirable Recommendations:

- Once the School is established, it is recommended to continue operating the graduate track in EOE within the School. Some guidelines regarding this track are discussed in Section 4.C. The decision whether to operate this track should be made by the School leadership.

4.B General Recommendations:
Essential Recommendations:

- Given the present three department structure, the committee identified duplicated course across departments, often at different levels. This should be eliminated by coordinating the curricula of the various programs. Some specific examples are mentioned in the report.

- Improve guidance and access to support for students who do poorly. This should start with close monitoring of students' performance to identify those who are struggling early on.

Advisable Recommendations:

- Ensure adequate allocation of resources to keep updating the teaching labs with the latest technologies.
- Ensure adequate allocation of resources for homework grading, in particular in the two junior years (i.e., in math, physics and basic Engineering courses).
- Develop uniform academic requirements for the senior year projects, regardless whether they are performed in the Industry or in the faculty labs. Also improve the project logistics, e.g., an on-line bulletin board with information about open or on-going projects, etc.
- Industry collaboration in these projects needs to be better leveraged. Industry has much to offer when it comes to identifying interesting and relevant projects for students. It also prepares students to the job market and help in them in finding their first job in the Industry.
- Ensure that faculty members have a clear understanding of what is needed to qualify for a reduction in teaching load.
- Develop outreach mechanisms to more proactively seek out Ph.D. students and post-docs in the US or Europe who may be interested in exploring possible faculty positions in Israel.
- Incorporating topics such as Big Data, Cyber Security and Internet of Things in the School curriculum, as stated in the self-evaluation report of the CSE Department, should be done only if there are faculty member in these areas. Given the strong activity of ISE in these areas, it is highly recommended, instead, to collaborate with ISE to avoid redundancy.
- In the interest of long-term sustainability, it seems important to establish cross-departmental centers of excellence in certain common research areas.

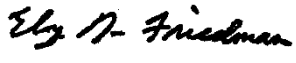
Desirable Recommendations:

- Improving English fluency of graduating students is desirable, but is likely best achieved through a progressive combination of approaches, some of which are already in place, *e.g.,* having course material be in English, require all project reports to be written in English, etc. Increasing the prevalence of such solutions as well as introducing a few more elective

courses taught in English could be effective in raising students' English fluency.

- Faculty should be encouraged to explore new teaching models that can provide students with the benefits of easy access to online material, including videos of lectures, without jeopardizing class attendance. There is much activity in this area worldwide, with many institutions facing the same challenges, and it is important to continue exploring this issue.
- Course scheduling should take into account the fact that most students need to earn their living. Different scheduling strategies should be used in the first two years when courses are mandatory, and in the last two years when most courses are elective and students are typically working in the Industry.
- The curriculum should encourage synergy with the ISE program.
- Articulate consistent graduation criteria for Ph.D. across areas, and ensure that those are clearly communicated to students.

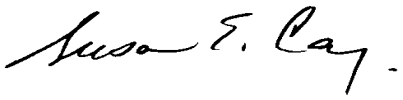
Signed by:



_____ _____

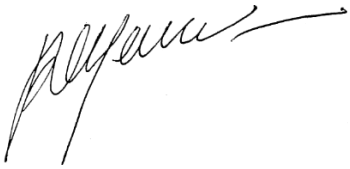
Prof. Alan Oppenheim - Chair

Prof. Eby G. Friedman



Prof. Dr.-Ing. Walter Kellermann

Prof. Susan Conry



Prof. Mathukumalli Vidyasagar

Prof. Roch Guerin

Prof. Ehud Heyman

Prof. (Emeritus) Joseph Salzman

<u>Appendix 1: Letter of Appointment</u>

December 2015

Prof. Alan Oppenheim
Department of Electrical Engineering and Computer Science
MIT
USA

Dear Professor, AL

The Israeli Council for Higher Education (CHE) strives to ensure the continuing excellence and quality of Israeli higher education through a systematic evaluation process. By engaging upon this mission, the CHE seeks: to enhance and ensure the quality of academic studies, to provide the public with information regarding the quality of study programs in institutions of higher education throughout Israel, and to ensure the continued integration of the Israeli system of higher education in the international academic arena.

As part of this important endeavor we reach out to world renowned academicians to help us meet the challenges that confront the Israeli higher education by accepting our invitation to participate in our international evaluation committees. This process establishes a structure for an ongoing consultative process around the globe on common academic dilemmas and prospects.

I therefore deeply appreciate your willingness to join us in this crucial enterprise.

It is with great pleasure that I hereby appoint you to serve as the Chair of the Council for Higher Education's Committee for the Evaluation of the study programs in **Electrical and Communication System Engineering.** In addition to yourself, the composition of the Committee will be as follows: Prof. Susan Conry, Prof. Roch Guerin, Prof. Ehud Heyman, Prof. Mathukumalli Vidyasagar, Dr. Orly Yadid-Pecht, Prof. Eby Gershon Friedman, Prof. Dr.-Ing Walter Kellermann.

Ms. Daniella Sandler and Ms. Inbal Haskell-Gordon will be the coordinators of the Committee.

Details regarding the operation of the committee and its mandate are provided in the enclosed appendix.

I wish you much success in your role as a member of this most important committee.

Sincerely,
Hagit Messer
Prof. Hagit Messer-Yaron
Vice Chair,
The Council for Higher Education (CHE)

Enclosures: Appendix to the Appointment Letter of Evaluation Committees

cc: Dr. Varda Ben-Shaul, Deputy Director-General for QA, CHE
Ms. Daniella Sandler, committee coordinator
Ms. Inbal Haskell-Gordon, committee coordinator

Appendix 2: Site Visit Schedule

Electro-Optics Engineering - schedule of site visit At Ben Gurion University
Building: 51 Room: 117

Tuesday 19/1/16

Time	Subject	Participants
9:15-9:45	Opening session with the heads of the institution and the senior staff member appointed to deal with quality assessment Location: Building 33 Room 102	Prof. Zvi Hacohen – Rector Prof. Gad Rabinowitz – Vice Rector Ms. Adi Zinger – Quality Assessment coordinator
9:45-10:30	Meeting with the Dean of the department of Engineering Location: Building 33 Room 102	Prof. Joseph Kost- Dean Prof. Stanley Rottman-Faculty Quality Assessment coordinator
Walk to EO MR 10:35-11:15	Meeting with the academic and administrative head of the department of **Electro-optics** Location: Building 51 Room 117	Prof. Adrian Stern- Head Ms. Martine Golan- Administrative Coordinator
11:15-12:00	Meeting with senior academic staff* **- Electro-Optics** Location: Building 51 Room 117	Prof. Ibrahim Abdulhalim (Chair) Prof. Yitzhak Yitzhaky Prof. Gabby Sarusi Dr. Yonatan Sivan Dr. Karabchevsky Alina Prof. Natan Kopeika (Emeritus)
12:00-12:30	Meeting with Scholars/ lecturers from Related Fields who collaborate with the **Electro-optics department** Location: Building 51 Room 117	Prof. Yuval Golan (Chair) Prof. Mario Feingold Prof. Yehuda B. Band Dr. Eugene Frumker
12:30-13:10	Meeting with PhD students / Junior academic staff *- **Electro-optics** Location: Building 51 Room 117	
Walk to EE MR 13:15-14:00	Lunch (in the same room) Location: Building 33 Room 102	Closed-door working meeting of the committee
Walk to EO MR 14:05-14:35	Meeting with MSc. students- **Electro-Optics** Location: Building 51 Room 117	

14:35-15:15	Final Project Presentation- **Electro-optics** Location: Building 51 Room 117	Ibraheem Watad Asi Solodar Idan Barak Daniel Rozban Itsic August (Chair)
15.15-15:55	Tour of campus (classes, library, offices of faculty members, computer labs etc.) Location: Building 51 Room 117	333 Liquid Crystal Devices, Nanophotonics 227 Nanophotonics 202 Imaging Sys. and Image processing 205 Computational Optical Sensing and Imaging 208 Bio-Medical Optics , Plasmonics 301 Optics and Photonics Teach. Lab 300A Opt. Communication Teach Lab
Walk to EE 16.00-16:40	Meeting with Alumni*- **Electro-optics only** Location: Building 51 Room 117	Dr. Gil Tidhar (Orbotech) -Chair Dr. Iftach Klapp (Agricultural Research Organization the Volcani) Dr. Dmitry Bykhovsky Mr. Avishai Marosn (Elop) Mr. Serge Karabchevsky (KAYA Instrument founder)
16:45-17:30	Meeting with adjunct lecturers- **all three programs** Location: Building 33 Room 102	N/A
17:30-17:40	Break Closed Door Meeting Location: Building 33 Room 102	
17:40-18:20	Summation meeting Location: Building 33 Room 102	Prof. Zvi Hacohen – Rector Prof. Gad Rabinowitz – Vice Rector Prof. Joseph Kost – Dean Prof. Stanley Rottman-Faculty Quality Assessment coordinator Prof. Wulich Dov, Head - Electrical & Computer Engineering Dr. Yhuda Ben- Shimol, Vice Head - Communication Systems Prof. Adrian Stern, Head - Electro-Optical Engineering Ms. Adi Zinger – Quality Assessment coordinator

18:20-18:50	Closed Door Meeting Location: Building 33 Room 102	

* The heads of the institution and academic unit or their representatives will not attend these meetings.

** The visit will be conducted in English with the exception of students who may speak in Hebrew and anyone else who feels unable to converse in English

Communication System Engineering- Tentative schedule of site visit
At Ben Gurion University

Building: 37 Room: 201

Tuesday 19/1/16

Time	Subject	Participants
9:00-9:45	Opening session with the heads of the institution and the senior staff member appointed to deal with quality assessment Location: Building 33 Room 102	Prof. Zvi Hacohen – Rector Prof. Gad Rabinowitz – Vice Rector Ms. Adi Zinger – Quality Assessment coordinator
9:45-10:30	Meeting with the Dean of the department of Engineering Location: Building 33 Room 102	Prof. Joseph Kost
10:30-11:15	Meeting with the academic and administrative heads of the department of **Communication System Engineering**	Dr. Yehuda Ben- Shimol,Vice Head Ms. Hana Dekalo-Administrative Coordinator Eng. Yedidia Bargad- Departmental Engineer
11:15-12:00	Meeting with senior academic staff* **- Communication System Engineering (201/37)**	Dr. Avin Chen Prof. Blauenstein Natan Dr. Gilboa Niv Dr. Gurewitz Omer Prof. Segal Michael Dr. Scalosub Gabriel Dr. Vilenchik Dan
12:00-12:45	Meeting with PhD students / Junior academic staff *- **Communication System Engineering (201/37)**	**PhD + Junior staff** Mr. Cohen Alejandro Mr. Cohen Itamar Mr. Kampeas Dor Joseph Mr. Shmuel Ori
12:45-13:15	Meeting with BA students- **Communication System Engineering (201/37)**	
13:15-14:00	Lunch (in the same room) Location: Building 33 Room 102	Closed-door working meeting of the committee
14:00-14:30	Meeting with MA students- **Communication System Engineering (201/37)**	**MSc + Junior staff** Mr. Danlchenko Kiril Ms. Levi Chen Mr. Meiry Ron Mr. Zohar Yehiel
14:30-15:15	Final Project Presentation – **Communication System Engineering (201/37)**	

15:15-16:00	Tour of campus (classes, library, offices of faculty members, computer labs etc.)	
16:00-16:45	Meeting with Alumni*- **all three programs** Location: Building 33 Room 102	Mr. Genadi Ziporkin Ms. Daniel Chen Mr. Imanilov Sasha Ms. Trabelsi Lee
16:45-17:30	Meeting with adjunct lecturers- **all three programs** Location: Building 33 Room 102	Mr. Siksik Zion Mr. Riezenberg Thomas Dr. Wagner Nathaniel
17:30-17:40	**Break**	
17:40-18:10	Closed Door Meeting Location: Building 33 Room 102	
18:10-18:30	Summation meeting Location: Building 33 Room 102	Prof. Zvi Hacohen – Rector Prof. Gad Rabinowitz – Vice Rector Prof. Joseph Kost - Dean Prof. Wulich Dov- Head, Electrical & Computer Engineering Dr. Yehuda Ben- Shimol, Vice Head, Communication Systems Engineering Prof. Adrian Stern- Head, Electro-Optical Engineering Ms. Adi Zinger – Quality Assessment coordinator

* The heads of the institution and academic unit or their representatives will not attend these meetings.
** The visit will be conducted in English with the exception of students who may speak in Hebrew and anyone else who feels unable to converse in English.

Electrical and Computer Engineering - schedule of site visit
At Ben Gurion University

Building: 33 Room: 102

Tuesday 19/1/16

Time	Subject	Participants
9:15-9:45	Opening session with the heads of the institution and the senior staff member appointed to deal with quality assessment	Prof. Zvi Hacohen – Rector Prof. Gad Rabinowitz – Vice Rector Ms. Adi Zinger – Quality Assessment coordinator
9:45-10:30	Meeting with the Dean of the department of Engineering	Prof. Joseph Kost – Dean Prof. Stanley Rottman - Faculty Quality Assessment coordinator
10:30-11:15	Meeting with the academic and administrative heads of the department of **Electrical and Computer Engineering**	Prof. Dov Wulich -Head Ms. Debbie Israel-Feinaro - Administrative Coordinator Engineering Dr. Alex Belenky - Departmental Engineer
11:15-12:00	Meeting with senior academic staff* **- Electrical and Computer Engineering**	Prof. Timor Melamed Prof. Haim Permuter Prof. Dan Sadot Prof. Joseph Rosen Prof. Hugo Guterman Dr. Shlomo Greenberg Dr. Ron Dabora Dr. Tammy Riklin-Raviv Dr. Stanislav Derevyanko Prof. Reuven Shavit
12:00-12:45	Meeting with PhD students / Junior academic staff *- **Electrical and Computer Engineering**	Mr. Alon Cervera Mr. Ziv Goldfeld Mr. Shahar Bar Mr. Avishay Shamir Mr. Iliya Iofedov
12:45-13:15	Meeting with B.Sc students- **Electrical and Computer Engineering**	
13:15-14:00	Lunch (in the same room)	Closed-door working meeting of the committee
14:00-14:30	Meeting with M.Sc students- **Electrical and Computer Engineering**	
14:30-15:15	Final Project Presentation	
15:15-16:00	Tour of campus (classes, library, offices of faculty members, computer labs etc.)	

16:00-16:45	Meeting with Alumni*- **Two programs** (without Electro-Optics)	**<u>Electrical and Computer Engineering</u>** Mr. Robert Giterman- Mr. Itamar Levi Dr. Igor Gutman Dr. Gill Tsouri Mr. Anton Kogan Mr. Agmon Morag **<u>Communication System Engineering</u>** Ms. Daniel Chen Mr. Sasha Imanilov Ms. Lee Trabelsi
16.45-17:30	Meeting with adjunct lecturers- **Two programs** (N/A for Electro-Optics)	**<u>Electrical and Computer Engineering</u>** Prof. Ilan Shallom Dr. Guy Tel-Zur Dr. Michael Belman **<u>Communication System Engineering</u>** Mr. Zion Siksik Mr. Thomas Riezenberg Dr. Nathaniel Wagner
17:30-17:40	**Break** + Closed Door Meeting	
17:40-18:20	Summation meeting	Prof. Zvi Hacohen – Rector Prof. Gad Rabinowitz – Vice Rector Prof. Joseph Kost – Dean Prof. Stanley Rottman - Faculty Quality Assessment coordinator Prof. Dov Wulich – Head, Electrical & Computer Engineering Dr. Yhuda Ben- Shimol -Vice Head, Communication Systems Prof. Adrian Stern – Head, Electro-Optical Engineering Ms. Adi Zinger – Quality Assessment coordinator
18:20-19:20	Closed Door Meeting	

* The heads of the institution and academic unit or their representatives will not attend these meetings.
** The visit will be conducted in English with the exception of students who may speak in Hebrew and anyone else who feels unable to converse in English.