



**Committee for the Evaluation of Electrical and Communication System  
Engineering Study Programs**

**The Bar-Ilan University  
Programs in Electrical Engineering  
Evaluation Report**

**November 2016**

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## **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

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:<sup>1</sup>

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).

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<sup>1</sup> The Committee's letter of appointment is attached as **Appendix 1**.

## **Chapter 2: Committee Procedures**

The Committee held its first meetings on January 6<sup>th</sup> 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.

Through January 2016, the Committee held its visits of evaluation, and visited the following institutions: The Technion, Tel Aviv University, Bar Ilan University, Ben Gurion University and Ariel University, Jerusalem College of Technology (Lev), Afeka College, SCE College, Ort Braude College, Rupin college, HIT and the Jerusalem College of Engineering (Azrieli). 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 Engineering Administration at the Bar Ilan University. The Committee's visit to the University took place on January 18<sup>th</sup>, 2016.

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

The Committee thanks the management of Bar Ilan University and the School of Electrical Engineering for their self-evaluation report and for their hospitality towards the committee during its visit at the institution.

## **Chapter 3: Evaluation of Electrical Engineering Study Program at Bar Ilan University**

*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**

The Faculty of Engineering at BIU has been established in 2011 and aims at research and teaching at the highest academic level. Based on the self-evaluation report and the on-site visit, the committee can confirm that these goals are indeed fully achieved. With 33 mostly young senior faculty, the Faculty serves currently about 500 students, with 350 of them belonging to the Electrical Engineering (EE) branch. The small size, the favorable student-to-faculty ratio, and the start-up situation determine the characteristics of the Faculty and provide benefits of many kinds: the family-like, enthusiastic and very supportive atmosphere is sensed at all levels. Teaching quality appears to be very high and typical problems inherent to the Israeli university system appear to be less pronounced, as efficient and often individualized support can be provided to students. Essential recommendations of the committee for EE as a whole include a revision of the IP policies to provide more incentives for EE staff, and a more intensive exploration of innovative teaching methods. Other important recommendations suggest the establishment of an alumni network and some improvements concerning specific teaching issues.

As an overarching theme, a need for further growth is stressed by the Faculty for reaching the goal of becoming another top level engineering school in Israel. While industry rates the Faculty and EE graduates already as first-class, it is felt that the reputation in the more general public and the attractivity to potential students should be improved by growth, e.g., in terms of student body and faculty size, more research areas and study tracks, more engineering

departments. The committee is not convinced that the arguments for promoting growth clearly outweigh the arguments for further optimizing the faculty with its current size and characteristics. If growth is seen as a must, then careful planning is recommended based on a more precise definition of the Faculty's mission and goals and its role within the University.

## **2. Mission and Goals**

### Observations and findings

Bar-Ilan University (BIU) defines its **mission** as being an *institution of higher learning which strives to combine cutting edge research with the finest standards of academic teaching*. As a distinctive feature it also includes *the promotion of Jewish Studies and research in this area, for which reason its students are required to enroll in courses centering on basic concepts in Judaism*. As part of this mission BIU emphasizes in its mission statement that it *strongly supports the strengthening of bonds between itself and the community, while aspiring to contribute to the narrowing of social gaps and the creation of a stronger and healthier Israeli society*.

During the visit the commitment to **cutting-edge research** as the primary goal was confirmed at all levels, while the importance of high-quality teaching was emphasized in parallel. It was repeatedly stressed that the profile of the university is changing from predominantly humanities and social studies towards a stronger emphasis of life sciences and exact sciences, which also led to the establishment of the School of Engineering in 2001, and its elevation to a Faculty of Engineering in 2011. While currently about 30% of the scientists work in the area of exact sciences and engineering, a share of 40% is targeted, but viewed as difficult due to the cost of attracting faculty, especially as scientific excellence of the successful candidate should not be compromised.

The structure of **Jewish studies** is said to change, with the amount of courses being reduced. It was emphasized by the Rector that the Jewish studies are

dedicated to scientific studies for gaining knowledge and should not be considered religious activity. At various levels across the institution it was however acknowledged that this component of the program supports the general perception of BIU as being a religious university and keeps many potential students from applying at BIU.

Regarding the **future development** of the School of Engineering, the Dean found it difficult to predict the status five or even ten years from now. In the near future, the Faculty should comprise three departments: (1) Data Science; (2) Computer Engineering; (3) Physical Systems. The relation to the Computer Science Department in the Faculty of Exact Sciences is also described as constructive, although points of contention are obvious, e.g., regarding Data Science. Beyond this, the emphasis is on growth of the Faculty of Engineering as a whole by additional areas that should be established with according study programs, e.g., in materials engineering, industrial engineering and software engineering. The strong link to physics and chemistry in the Faculty of Exact Sciences was mentioned as an opportunity for synergies by the former dean.

The need for growth was emphasized as the overall goal, both in terms of student numbers and faculty for existing areas, as well as in terms of the number of engineering areas to be covered. At the same time, it is consistently stated that the reputation of the School in the general public is still not at the desired level, which should be remedied by better marketing.

### Recommendations

#### **Essential:**

- Keep EE focused on cutting-edge research and high-quality education and do not compromise regarding scientific level.
- The proclaimed need for growth of the Faculty and EE calls for some strategic planning aligned to its mission:

- Clarify the desired dimensions for growth and the reasons for the need to grow. Assess the risks of growth and develop risk mitigation strategies.
- In the context of the planned growth of the Faculty of Engineering, Electrical Engineering should be proactive in defining complementary profiles for new departments to be added in the future. A diligent design of a cluster of symbiotic engineering fields could constitute a distinctive feature for the entire university.
- Clarify the position of the Faculty of Engineering regarding the public image of the University and design branding campaigns accordingly. It seems crucial to clearly define its position especially regarding the religious attributes of the University and its implications for the students and staff of the Faculty of Engineering. In this context, the claim to *strive for narrowing of social gaps and the creation of a stronger and healthier Israeli society*, requires some clarification to which extent non-Jewish parts of the Israeli society are addressed.

### **3. Organizational Structure**

#### Observations and findings

The Faculty of Engineering was established as one of eight independent faculties in 2011 after residing as a School of Engineering under the roof of the Faculty of Exact Sciences since 2001. Currently, the Faculty is structured in two branches that support according study programs, Computer Engineering (CE; 129 B.Sc. students in 2013/14) and Electrical Engineering (EE; with 239, 79, 45 students in B.Sc., M.Sc., Ph.D. programs, respectively, in 2013/14) and thus is a comparably small faculty with a very favorable student-to-faculty ratio of about 16.

Within the Faculty of Engineering, the EE branch collaborates with the CE branch on the level of the graduate M.Sc. programs and research, but offers a very different curriculum for undergraduate studies emphasizing the need for more physics in EE.

The different roles are seen as adequate and non-contentious, also in view of a different job market, and the interaction of EE with CE is perceived as constructive.

According to the Dean and the Faculty, the fact that engineering is relatively new at BIU and still relatively small is both an advantage and a disadvantage: It offers a large amount of flexibility regarding the definition of research areas and curricula and the ensuing small size of student and faculty body, together with a frequently mentioned extremely helpful administration (identified with a single person), foster close relations among students and faculty. This greatly benefits the study experience, and support enthusiasm and productivity in research. On the other hand, the small size implies limitations regarding the number of areas that can be covered both in research and teaching. At all levels, a unanimous commitment to growth was expressed, with the main obstacles being the difficulty in hiring new faculty and attracting more students.

Hiring new staff is dependent on the appointment committee of the university, where the Faculty of Engineering has a representative since 2015, which should improve the representation of interests of engineering in the hiring process. The committee was told that there is a scheme used for allocating funds for hiring faculty which predates the establishment of the Faculty of Engineering and thus puts the Faculty of Engineering at a disadvantage relative to the Faculty of Exact Sciences. According to the Rector, the university allocates extra funds to the Faculty of Engineering in order to compensate for a lack of funding and startup money from outside. (See also Section 5, 'Human Resources / Faculty').

The need for increasing the number of students is emphasized and various ideas and plans were mentioned during the visit across all levels of the organization (see also Sections 4 and 6). One major obstacle for growth of the student body is seen as a branding issue: BIU is not visible as a first-class engineering school and it is often perceived as a religious school to its disadvantage. From inside Electrical Engineering at BIU, this is seen primarily as a communication problem which should be addressed

by better marketing with more support from the top-level university administration. The fact that Engineering at BIU is not visible because it does not offer a wide spectrum of engineering programs supports the quest for growth.

In the overall organization of the Faculty, the adjunct faculty feels well supported in their needs to meet their teaching obligations, but largely disconnected from the core operational activities within the Faculty and its research activities. Some issues labeled as minor by the adjunct faculty are concerned with internal procedures: They felt that the process of exchanging grading information should be organized more efficiently and that the communication regarding student with difficulties could be improved.

### Recommendations

#### **Essential:**

- Make sure that the tangible benefits of being small are preserved when EE grows. This seems especially important for the family-like atmosphere, with all its positive implications that rely on individuals and their close interaction.
- Ensure that the Faculty of Engineering is properly represented in the governing structures of the University's and that rules and regulations that predate the establishment of the Faculty of Engineering are revised accordingly.
- Given the low student/faculty ratio, the increase of the student body seems to be most important for growth. The various avenues to this goal (for attracting, e.g., more Jewish religious students, more Arab students, and/or more international students) and the potential impact on the Faculty should be considered carefully. Resulting strategic decisions must form the basis of visibility efforts to address the branding issue.

#### **Desirable:**

- As noted by the adjuncts, some internal administrative processes may be reorganized to become more efficient.

## **4. Study Programs**

### Observations and findings

The branch of Electrical Engineering (EE) is currently offering a 4-year B.Sc. program in electrical engineering with five specialization tracks including a senior project starting in the fifth or sixth semester: Communications, Signal Processing, Nanoelectronics, Electrooptics, Bioengineering. It is seen as an advantage in terms of branding and for the students entering the job market that this B.Sc. program is different from the B.Sc. program in Computer Engineering (CE). Admission requires a psychometric test score of at least 650, similar to the other leading universities in Israel. The program is decidedly oriented towards graduate studies and not just to the training of practical engineers, which is reflected in the large number of theoretical courses. During the visit, the students agreed with the perception that the study program is challenging, but also showed pride in mastering it, and they felt well prepared for industry. Alumni, including an army recruitment official, confirmed that BIU graduates are considered by employers as being equally well-trained as graduates from other top universities in Israel. Some PhD students voiced an interest in more incentives for high-performing students to attract them to graduate studies and to foster excellence.

On the graduate level EE is offering a 2-years M.Sc. program (with and without thesis) that can be taught entirely in English if a student doesn't speak Hebrew, with tracks in Electrooptics, Nano- and Microelectronics, Data Science and Information Technology (Signal Processing, Communications, Computer Engineering), and Bioengineering. Admission to the M.Sc. program requires generally an average of at least 85 from an accredited B.Sc. program in engineering. Thereby, BIU competes with the leading universities in Israel for graduate students. For college graduates, reference letters do count as well. As there are not too many college graduates (from Lev, HIT, Afeka) entering, no statistics could be provided on these. For providing the courses of the M.Sc. program, the EE branch is collaborating closely with the CE branch. It was mentioned that, especially in the Bioengineering track, the choices of

electives are limited for some students. Moreover, it was mentioned that for the Bioengineering track also fundamental courses on biology that are matched to the needs of Bioengineering are missing. It was also mentioned by an alumnus that BIU should strengthen Quantum and Electromagnetic Theory.

Admission to the regular PhD program is tied to an average of at least 85 in the M.Sc. studies and is expected to take four years. In case of a M.Sc. degree without a thesis, publications count. Keeping the M.Sc. degree as a mandatory prerequisite for the PhD studies was unanimously seen as useful for maturing. A direct track for excellent B.Sc. students exists, which should take five years. The regular PhD program requires completion of eight mandatory courses, which should be reduced in the view of a former student. Otherwise, PhD students interviewed during the visit unanimously appreciated independence and academic freedom during the PhD program, in some cases, however, feeling a lack of guidance. The EE faculty at BIU is also perceived as being more flexible than other Israeli universities regarding parallel employment in industry during the PhD program.

In line with the mission of the university, the B.Sc. degree also requires a minimum of seven courses in Jewish studies (eight according to the self-documentation p.35) which should be reduced to five in the near future according to the Rector. Students joining BIU at graduate level need to complete two such courses.

The detailed design of study programs is the responsibility the Curriculum and Teaching Committee (CTC) and the Graduate Studies Committee (GSC) which also act upon input from the teaching staff including adjunct faculty. In some cases, elective courses are kept as they are considered important, although their popularity decreased over time.

The feedback from alumni and graduate students regarding the electrical engineering study programs at BIU was consistently emphasizing that the quality of the education is on a par with that of the best universities in Israel, and that this is recognized for

several years now by those who know BIU graduates, including employers. Alumni and students see a difference to other top universities in that the programs are implemented in a much 'warmer' atmosphere at BIU.

The numbers of enrolled and graduated students have been relatively stable over recent years, not indicating any significant growth. Regarding options for promoting further growth, several directions regarding study programs are considered and partly already implemented at BIU:

- The university reaches out to high schools for attracting students to their engineering programs, offers grants to excellent students and scholarships to students that have to support families. Other initiatives aim at establishing closer relations to the military, e.g., by attending Army fairs, and to industry.
- An international program should be launched soon according to the dean. This should help to attract students from outside Israel. Along these lines, funding for an international summer school has been obtained which should attract PhD candidates and postdocs.
- Allowing the students to start their studies in the spring semester, it is hoped to increase the student body by 20%.
- Using the flexibility of the young Faculty of Engineering it is suggested to add new tracks within EE to the existing portfolio and thereby attract more students. From alumni a strong desire towards establishing a Systems Engineering track was expressed in order to meet needs of the military and the according industry.
- The suggestion to establish a joint program with Lev in Jerusalem to serve the Jewish orthodox community, was seen with skepticism, as it might emphasize the religious image and have negative effects on branding and on the hiring process of faculty.
- Some PhD students expressed an interest in more double-degree programs at undergraduate level, such as 'Mathematics and EE'.

## Recommendations

### **Essential:**

- After a clarification of the strategy for growth (see Sections 2 and 3) invest in marketing the profiles of your study programs to fuel growth of the student body. This includes communicating the role and character of the Jewish study courses to potential students. The EE website, social media, newsletters and other media which are typically used for decision-making by the targeted clientele should be used for communication.
- Complement the bio-engineering track with additional courses that meet the expectations of the students.

### **Advisable:**

- Keep the academic level of the programs high to maintain the recognition among those who know BIU graduates already. Establish firm links with the increasing number of alumni and industry to improve the reputation in the general public.
- Review and consider complementing the EE programs with additional attractive courses on the graduate level to satisfy the interests of excellent students.

### **Desirable:**

- Consider more options for fast-track programs and dual degrees to attract the brightest minds.

## **5. Human Resources / Faculty**

### Observations and findings

The School of Engineering lists 33 senior faculty, 25 of which are associated to Electrical Engineering, more than 80 employed junior faculty, 10 senior adjunct and 13 junior adjunct faculty leading to a student-to-faculty ratio of 16. Among senior faculty, five are female. Faculty considers itself diverse, with mostly non-orthodox cultural backgrounds.

Regarding the **hiring process for senior faculty**, the Rector emphasized that only faculty with an excellent research track record from leading research universities will be hired. Inbreeding is prevented so that most faculty comes from outside and has completed a postdoc abroad. Even in case of urgent needs this principle is not compromised. Diversity is said to be promoted, but scientific qualification takes precedence over everything else. At the university administration level, a list of priorities exists and start-up money for hiring senior faculty is provided according to the list and opportunities, i.e., attractive candidates as pointed out by the dean. The start-up money is often decisive when competing with other universities, and Engineering was said to be in a weaker position in securing such funds relative to Life Sciences and Exact Sciences, as it had apparently not been part in the initial definition of the start-up funds distribution policy. It remained unclear to the reviewing committee when and how this policy will be adapted to the needs of Engineering.

Asked about what attracted them to join BIU, faculty unanimously referred to the dynamic, enthusiastic and visionary environment, which offered individualized support to grow and carry out cutting-edge research.

For the **promotion of senior faculty**, research criteria clearly outweigh teaching and service to the organization. Evaluation of research is mainly considering publications and is supported by a web-tool requiring each faculty to update its CV every six months. A certain paper-based impact is necessary in any case, even an impactful textbook would not make up for this for promotion to full professor, while it might suffice to reach tenure. Patents are now accepted as papers, but patenting takes long and is not recommended when promotion is desired soon. Letters of recommendation are important, especially if publications fall below a certain threshold. Applied research and the translation of research as service to the society are highly valued as well. It is assumed that this will usually be reflected in grants and industrial funding. As an example, the center of Nano-electronics was cited which was predominantly funded by industry. Teaching

performance is included in the promotion dossier and documented by teaching surveys. It is used as a criterion in borderline cases, i.e., it may delay promotion until the candidate has participated in a remedial teaching workshop. The number of supervised students counts as well. For tenure, service to the organization and collaborative efforts are also considered as a promotion criterion. Professional development is continually monitored and if someone falls behind expectations he or she will be asked to leave. A handful of such cases had no difficulty in finding another adequate job.

Having a representative of Engineering at the University's appointments committee is seen as a great advantage in explaining the merits of candidates from Engineering to the committee, e.g., with regard to the value of patents or conference publications and the calibration of impact factors in different fields.

The **tenure process** is seen as fair and transparent, although a bit long, by both the young and the senior faculty. The expectations are clearly communicated: Competitive grants, impactful publications in first-rate journals, supervision of students, good teaching are decisive, but service to the organization and collaborative efforts will count also. At least two major papers per year are expected which is the major point of stress for the candidates, although there is no absolute metric for the quality of the papers. It is expected that every faculty supervises on the order of three to five students with experimental groups being somewhat larger than theoretical groups. Out of about 70 students in total in EE, more than 40 are internal. The students are recruited by personal contact. The candidates for tenure feel well supported by their environment and typically a senior, but still young faculty member acts as mentor. Some have their own lab facilities.

For **tenured staff**, providing funding for their research group and reaching the next level are the main challenges complemented by the need to attract good

students. Reportedly, despite limited resources, the cooperative atmosphere among faculty members is not impaired by competition in this domain.

Compared to other universities in Israel, the **adjunct faculty** forms a relatively small group at BIU's EE branch. They are recruited via personal contact and most of them teach only a few hours, mostly undergraduate courses, so that they do not spend much time at the Faculty. Most of them also teach at other schools and refer to the joy of teaching as their main motivation. Some individuals use the connection to the Faculty for their own research projects or for recruiting staff for their own company. In general, they feel respected as part of the system and usually sufficiently informed about the matters concerning their teaching, although somewhat disconnected from the daily life of the Faculty. They state that their needs are fully satisfied, e.g., shared offices, teaching assistants. They engage in mentoring of students, feel free in changing the syllabus of their courses and see opportunities to contribute to the design of the curriculum. Overall, no complaints were voiced except for isolated ones on some inefficient processes in handling paperwork and on the exchange of information regarding students with difficulties.

The EE branch currently hosts 16 **Postdocs**. They are not supported by the university, but are paid by the labs directly or from outside grants, such as the Marie Curie program of the European Commission. They come because of personal relations and do not teach. Many of them do not speak Hebrew.

### Recommendations

#### **Essential:**

- Develop measures to preserve the cooperative start-up spirit and the family atmosphere among the faculty members beyond the period of initial growth.

- The allotment of start-up funds for hiring new faculty in the various faculties needs to be reconsidered to appropriately support the desired growth of engineering within BIU.

**Advisable:**

- The University should exploit its scientific excellence in engineering and more proactively attract international faculty for supporting both research and teaching, and to increase international visibility. This can be expected to also contribute to the reputation in Israel and thus help to increase student enrollment. An attractive program for foreign postdocs could be a first, low-risk and low-cost initiative, and could support recruiting senior staff in the long run.

## **6. Students**

### Observations and findings

The **general situation of EE students** is characterized by the comparatively low student/faculty ratio of 16. This allows faculty to pay personalized attention to each student from the very beginning of their studies. Moreover, the Faculty's administration is also strongly engaged in supporting all students with their individual needs, e.g., by procuring scholarships even beyond students' expectations. The head of the administrations seems to epitomize the caring efforts for students. Alumni stress that this caring atmosphere makes the main difference between BIU and the other top universities in Israel. Complementing the support by faculty and administration, tutoring by senior students is also common, although cross-year mentoring is not formally built into the system. Students enjoy the family-like and supportive atmosphere among themselves and the close contact to the mostly young and very approachable faculty. They feel that the studies are hard, but they value this as a quality feature as they see themselves in strong demand of industrial employers. ('We have only good things to say.') Faculty is very satisfied with the academic performance of the students, both on undergraduate and on graduate level.

The **number of students** is considered too low by the University's and the Faculty's administration and a student/faculty ratio of 20 is seen as more appropriate. It was stated that the number of students should increase at least in proportion with the planned increase of the number of faculty. Various initiatives to increase the student body as a whole were discussed in Section 4. Considering special student groups, high schools have been contacted to attract females, which currently represent 30% of the undergraduate students. Regarding the religious attributes of the university, these are seen by most of the current students as a handicap for convincing their secular peers to enroll with BIU. Current non-religious students did however not complain about the religious attributes of BIU. On the other hand, some religious students explicitly appreciated the way of observing the Jewish holidays at BIU, and according to a survey, BIU attracts religious students. Repeatedly, the Ultraorthodox and the Arab population were mentioned as potential sources of students that are generally underrepresented at universities in Israel and should be attracted. Lowering the threshold for accepting students is however not considered as an option.

For the M.Sc. program, students are recruited mostly from the best students of their own B.Sc. programs, but also from outside. Publications, but also summer camps in India and China were cited as options to increase enrollment. Competition with industry was also mentioned as a challenge when trying to attract the best students. Students are mentored by their project advisors which they choose themselves, once they start graduate studies.

As it is very common throughout Israel, many **students work** in parallel to their studies. At BIU, especially students with a religious background often have to support families. The university tries to counter the need for work outside the university by offering fellowships for 10 to 15% of the students or by offering research positions in the School's labs early, and to convince the students to start working in industry only later. If they do work, it is said to be relatively easy to schedule work around classes, although at one point it was suggested that later hours should be considered for teaching graduate courses, for the benefit of graduate students who work part-time.

In general, the overall perception by most students and faculty is that reconciling studies and the financial needs is manageable.

The **PhD students** share the same positive perception as the other students regarding the family-like and very supportive atmosphere and feel embedded in a first-class research environment that cares for their individual interests. The students are invited to attend - in some cases mandatory - colloquia and regular seminars both on the EE level as well as across departments. For optional events, attendance varies between students. There is no systematic inter-disciplinary interaction.

As a matter of concern, the PhD students pointed at the uncertainty regarding their professional future if they wanted to stay in academia: While industry is an attractive alternative, for the academic track, the future income level is hard to predict. During the PhD the basic scholarship as a PhD student is seen by some as insufficient and not fully predictable, and the complementary income as a teaching assistant is also not always assured although it seems to be a necessary source for many. Most PhD students perceive teaching as a very valuable experience regardless of the payment, but some would not teach if they didn't need the additional income.

Aiming at an academic career, the income after the PhD studies can also not be predicted, so that one cannot take proper loans. It is commonly understood that for an academic career, a postdoctoral experience abroad is required, which is not attractive for everybody.

When looking back, **alumni** also had only positive comments on their experience at BIU. While the close relations among students provide an informal alumni network to, e.g., help in job search, there is no alumni network established by EE.

## Recommendations

### **Essential:**

- The students feel almost like in paradise. To preserve this perception, one should think in advance about structures and processes that can assure the same amount of individual support and preserve family spirit and enthusiasm among students when their number grows. A cross-year mentoring mechanism could contribute to this.
- As part of the overall strategy for growth, develop a clear-cut profile for the public perception of the School in order to better attract the targeted student groups.

### **Advisable:**

- Build up an alumni network. This should strengthen the ties of the School to potential donors and funding sources and connect its students to potential employers. It should also contribute to increase visibility of the School and thus attract more students in the long-term.

### **Desirable:**

- Provide more certainty for the PhD students regarding extra options for additional income, e.g., by long-term contracts as teaching assistants.

## **7. Teaching and Learning Outcomes**

### Observations and findings

For evaluating the **teaching quality**, the School of Engineering uses a university-wide computerized teaching survey which is accessible to all students and carried out under the auspices of the University's Center for Advancement of Teaching with assistance of the Student Union. In addition, the lecturers receive feedback from the teaching assistants and student representatives and, if desired, other senior faculty. The teaching surveys form the main quantitative assessment and are considered as a criterion in the promotion process (see Section 'Human resources / Faculty') but also in planning the assignment of courses to lecturers. The students view this as an

effective, although not perfect, means for quality control, which is taken seriously by faculty. Students expressed during the visit a high degree of satisfaction with the overall teaching quality both for regular and adjunct faculty, but suggested that some lecturers should organize their syllabus a bit better. Suboptimum teaching was seen as a handicap for further studies.

Courses for the enhancement of teaching are offered to faculty by the University's Center for Advancement of Teaching and made mandatory if it is felt necessary. On the other hand, outstanding teaching is rewarded by nomination to the University's Excellent Teachers Award, which was awarded to EE faculty members four times between 2009 and 2014.

Regarding **innovative teaching methods**, the School uses a university-wide 'Moodle' platform, which provides a website for each course that is accessible to the students and teachers of the course. Supporting online material, homework assignments etc. for the course are also distributed via websites. At the visit it was mentioned that online courses for internal use are available (also a few 'MOOCs') which are developed with support from the university unit for online teaching. Some students expressed that they would appreciate more online material including video lectures, especially for the hard courses. In some cases, homework can be graded automatically. Students remarked that many different platforms are used for computer-based homework, which is sometimes confusing.

The majority of the lecture courses are taught in traditional ways in the classroom. The attendance in class is said to be very high, and although 'official' videos are recorded for some courses, a strong positive correlation between grades and attendance has been measured. In some courses attendance is mandatory.

Undergraduate classes are taught in Hebrew, at graduate level English is used as language for instruction if somebody does not speak Hebrew. The relative weighting

of various components within a course (exam, homework, intermediate quizzes, etc.) varies between courses. Often the final exam is felt to have too much weight.

Project work is always supervised by faculty, industry is rarely involved. If so, then mainly for experimental projects. The students are not requesting to change this. Junior faculty may interact with the student on a daily basis, while the senior faculty as official advisor only checks milestones and reviews the draft of the final report. The work is presented to senior faculty in the field and to third-year students. While most students enjoy the learning experience, some students are not entirely happy with their projects for various reasons. These include:

- Depending on their supervisor students may miss structure, e.g., a project plan including a binding timeline, milestones, and expectations for the outcome (e.g., publication).
- The actual efforts for completing the project vary widely (from two weeks to one year with ten weekly hours), while the grades do not.
- Graduate students are not paid for supervision of undergraduate projects. Faculty is said to be obliged to supervise three B.Sc. projects, but there is little incentive for faculty to invest a lot of effort.
- Some students would like to publish their work, but were not supported to do so.

### Recommendations

#### **Essential:**

- The mechanisms for assuring high teaching quality seem to be effective which is also reflected by high classroom attendance. This status should be continually monitored to maintain the high-quality teaching level.
- The small size and the favorable student/faculty ratio offers opportunities to explore innovative forms of teaching exploiting the close student-faculty relations and novel technologies. The Faculty of Engineering could develop this to a unique selling point when competing for students.

**Advisable:**

- Provide structured guidance for the fourth-year B.Sc. project. This could include the requirement to design a project plan including a Gantt chart for work packages, milestones, risk analysis, etc. For design and implementation projects, project documentation according to ISO or IEEE standards could be considered.

**Desirable:**

- The request for more online material should be considered. Software platforms for homework could possibly be harmonized.
- The relative weight of various components of a course should be reconsidered and possibly be equalized across courses.

## **8. Research**

### Observations and findings

The Faculty of Engineering views its mission regarding research as targeting 'applied research' as opposed to fundamental research. The strategy during the recent development of the school was to form centers of excellence in five areas of EE, which are considered to be crucial for Israel's industry and defense: Signal processing, communications and information theory, bio-engineering, microelectronics and nanotechnology, and electro-optics. These areas are also represented by according tracks of undergraduate studies and are supported by about the same number of faculty each. For assessing research performance and rewarding individuals and units, a database is used which requires every faculty member to update his/her CV every six months. According to the self-evaluation report, faculty members of each area are visible on the highest level in their respective fields. The Rector emphasized that not only publications in top journals, but also more applied or translational research that is of great value to the nation and the society, essentially reflected by grants, will be considered for promotion of faculty. It is recognized that most of the

external funding in engineering comes from industry or industrially-oriented sources.

Patents are recognized on the same level of papers after recent policy changes, although they would not fully compensate for a lack of top-level publications. Young faculty would rather aim at grants and papers, so that their promotion is not depending on the unpredictable delays in the patenting process. The University's policies regarding securing and marketing intellectual property (IP) are said to be under revision after, in the past, many faculty members marketed IP via organizations outside the University, because they were not satisfied with the University's own company.

In summary, quality and quantity of publications and grants show that research in Electrical Engineering at the School of Engineering fulfills its mission of first-class applied research in all five areas. The internal performance assessment mechanisms seem to assure that applied research receives proper recognition. IP policies have been identified as a weakness that needs reconsideration.

### Recommendations

#### **Essential:**

- The University should provide a set of policies for rewarding the creation of IP and for its marketing, which is attractive for the members of the School of Engineering. Some recognition for filing patent applications might be considered, but certainly ease of handling the process and reasonably short response times seem to be important criteria.

#### **Advisable:**

- Continue to monitor criteria for the assessment of publications and of outcomes of applied research in order to find the desired balance for the performance assessment of faculty.

## **9. Infrastructure**

### Observations and findings

During the visit some lab facilities were inspected which left the impression that the EE branch of the Faculty of Engineering is well equipped with up-to-date research facilities. The audio signal processing lab is known to be among the best ones in the world. The research infrastructure is also made available to some of the adjunct faculty which is highly appreciated and keeps their motivation high. On the other hand there were some complaints that in some of the labs space for students is scarce.

### Recommendations

#### **Advisable:**

- Assign enough space to those groups where lab space is scarce, ideally by providing extra office space for PhD students and MSc students close to the lab.

## **10. Self-Evaluation Process and implementation of previous recommendations**

### Observations and findings

The self-evaluation report has been very carefully written and provides detailed information regarding all aspects under evaluation.

The report of the 2007 CHE examining committee included a number of recommendations. Some of the problems underlying these recommendations were related to the then small size of the school and the fact that it was part of the Faculty of Exact Sciences.

- The School has been elevated to a Faculty of Engineering in 2011, which now allows to represent the interests of engineering independently of the Faculty of Exact Sciences.

- The recommendation to merge the B.Sc. programs of EE and CE has not been implemented, as it was felt that the two programs are sufficiently different regarding the subjects taught. It is argued that a merger would have constrained the development of the programs towards different profiles as they are welcomed by the job market.
- The recommendation to obtain an accredited M.Sc. program has been implemented, and BIU was authorized to grant a M.Sc. degree in Electrical Engineering in 2009.
- The number of staff increased significantly since 2007, both regarding faculty and lab personnel.
- The recommendation to reduce incentives for students to work outside the university has been addressed and fellowships are granted to 10-15% of the students.

## **Chapter 4: Summary of Recommendations**

Many of the recommendations resulting from the observations in the various subsections, complement each other and are therefore merged in the following summary.

### **Essential Recommendations:**

- Keep EE focused on cutting-edge research and high-quality education and do not compromise regarding scientific level.
- The proclaimed need for growth of the Faculty and EE calls for some strategic planning aligned to its mission:
  - Clarify the desired dimensions for growth (number of students, number of faculty number, research budget,...) and the reasons for the need to grow. Assess the risks of growth (regarding, e.g., teaching quality, research quality, students' satisfaction) and develop risk mitigation strategies.
  - Given that the planned growth of the Faculty of Engineering into other engineering areas seems to be only vaguely specified so far, Electrical Engineering should be proactive in defining complementary profiles for new departments to be added in the future. A diligent design of a cluster of symbiotic engineering fields which leads to a unique competence in a broader engineering area could constitute a distinctive feature for the entire university. Given the competition among universities in Israel and world-wide, strategic decisions are necessary on which areas to choose to stimulate growth and to excel.
- Clarify the position of the Faculty of Engineering regarding the public image of the University. It seems crucial to clearly define its position especially regarding the religious attributes of the University and its implications for the students and staff of the Faculty of Engineering. In this context, the claim to *strive for narrowing of social gaps and the creation of a stronger and healthier Israeli society*, requires some clarification to which extent non-Jewish parts of the Israeli society are addressed.

- After a clarification of the strategy for growth and the development of a clear-cut profile for the public perception of the Faculty of Engineering, the Faculty should invest in marketing the profiles of its study programs to fuel growth of the student body. Thereby, in addition to all the advantages that current students enjoy, EE should also communicate the role and character of the Jewish study courses. The EE website, social media, newsletters and other media which are typically used for decision-making by the targeted clientele should be used for communication.
- Make sure that the tangible benefits of being small are preserved when EE grows. This seems especially important for cooperative start-up spirit and the family-like atmosphere among faculty, students and administration, with all its positive implications that rely on individuals and their close interaction. One should think in advance about structures and processes that can assure the same amount of individual support. A cross-year mentoring mechanism could contribute to this.
- Ensure that the Faculty of Engineering is properly represented in the governing structures of the University's and that rules and regulations that predate the establishment of the Faculty of Engineering are revised accordingly. The allotment of start-up funds for hiring new faculty in the various faculties needs to be reconsidered to appropriately support the desired growth of engineering within BIU.
- Given the low student/faculty ratio, the increase of the student body seems to be most important for growth. The various avenues to this goal (for attracting, e.g., more Jewish religious students, more Arabic students, and/or more international students) and the potential impact on the Faculty should be considered carefully. Resulting strategic decisions must form the basis of visibility efforts to address the branding issue.
- Complement the bio-engineering track with additional courses that meet the expectations of the students.
- The mechanisms for assuring high teaching quality seem to be effective and the students are very happy with the teaching quality in general. This status should be continually monitored to maintain the high-quality teaching level.

- The small size and the favorable student/faculty ratio offers opportunities to explore innovative forms of teaching exploiting the close relations between student and faculty and novel technologies. The Faculty of Engineering could develop this to a unique selling point when competing for students.
- The University should review its policies for rewarding the creation of IP and for its marketing, and render IP creation more attractive for the members of the School of Engineering. Some recognition for filing patent applications might be considered, but certainly ease of handling the process and reasonably short response times seem to be important criteria.

**Advisable Recommendations:**

- Keep the academic level of the programs high to maintain the recognition among those who know BIU graduates already. Establish firm links with the increasing number of alumni and industry to improve the reputation in the general public.
- Review and consider complementing the EE programs with additional attractive courses on the graduate level to satisfy the interests of excellent students.
- The University should exploit its scientific excellence in engineering and more proactively attract international faculty for supporting both research and teaching, and to increase international visibility. This can be expected to also contribute to the reputation in Israel and thus help to increase student enrollment. An attractive program for foreign postdocs could be a first, low-risk and low-cost initiative, and could support recruiting senior staff in the long run.
- Build up an alumni network. This should strengthen the ties of the School to potential donors and funding sources and connect its students to potential employers. It should also contribute to increase visibility of the School and thus attract more students in the long-term.
- Provide structured guidance for the fourth-year B.Sc. project. This could include a project plan based on professional standards.

- Continue to monitor criteria for the assessment of publications and of outcomes of applied research in order to find the desired balance for the performance assessment of faculty.
- Assign enough space to those groups where lab space is scarce.

**Desirable Recommendations:**

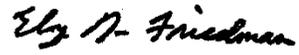
- As noted by the adjuncts, some internal administrative processes may be reorganized to become more efficient.
- Consider more options for fast-track programs and dual degrees to attract the brightest minds.
- Provide more certainty for the PhD students regarding extra options for additional income, e.g., by long-term contracts as teaching assistants.
- The request for more online material should be considered. Software platforms for homework could possibly be harmonized.
- The relative weight of various components of a course should be reconsidered and possibly be equalized across courses.

**Signed by:**



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Prof. Alan Oppenheim - Chair



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Prof. Eby G. Friedman



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Prof. Ehud Heyman



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Dr. Orly Yadid-Pecht



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Prof. Mathukumalli Vidyasagar



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Prof. Susan Conry



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Prof. Roch Guerin



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Prof. Dr.-Ing. Walter Kellermann

## Appendix 1: Letter of Appointment



December 2015

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

Dear Professor,

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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,

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**

**Electrical Engineering – Schedule of site visit**

**Monday, January 18, 2016, ח' שבט תשע"ו**

**Location:** Building no. 1104, Room no. 329

<b>Time</b>	<b>Subject</b>	<b>Participants</b>
8:30 – 9:00	Arriving to Bar-Ilan University	
9:09:00-9:09:45	Opening session with the heads of the institution	Prof. Miriam Faust , Rector Prof. Amnon Albeck, Vice-Rector
09:45-10:15	Meeting with the Dean of the Faculty of Engineering	Prof. Ephraim Zehavi, Dean of the Faculty of Engineering
10:15-10:30	Meeting with the Dean and former Dean of the Faculty of Engineering	Prof. Ephraim Zehavi, Dean Prof. George Moschytz Former Dean
10:30-11:15	Meeting with the academic and administrative heads of the department of <b>Electrical Engineering</b>	Vice-Dean & (EO) electro-optics - Prof. Zeev Zalevsky (GSC) & (SP) signal processing - Prof. Sharon Gannot (NE) nano-electronics - Prof. Alexander Fish (Bio) bio-engineering - Prof. Rachela Popovtzer (Comm) communications - Prof. Amir Leshem (CTC) Prof. Avinoam Zadok
11:15-12:00	Meeting with senior academic staff*	Prof. Orit Shefi ,Bio-engineering Dr. Dror Fixler , Electro-Optics Dr. Yair Noam , Signal Processing Dr. Doron Naveh , Nano-electronics Dr. Adam Teman, Nano-electronics Dr. Itshak Bergel, Communications
12:00-12:45	Meeting with PhD students / Junior academic staff *	
12:45-13:30	Lunch (in the same room)	Closed-door working meeting of the committee
13:30-14:15	Meeting with adjunct lecturers	Dr. Yehuda Elmaliah Dr. Abraham Saad Dr. Yoav Weizman
14:15-15:15	Meeting with B.Sc and M.Sc students	

<b>Time</b>	<b>Subject</b>	<b>Participants</b>
15:15-16:00	Meeting with Alumni**	
16.00-16:15	Closed Door Meeting	
16.15-17:00	Final Project Presentation of B.Sc. Alumni, by Dr. Itshak Bergel	
17:00-17:30	Tour of campus (classes, library, offices of faculty members, computer labs etc.)	
17:30-18:00	Summation meeting	Prof. Miriam Faust , Rector Prof. Amnon Albeck, Vice-Rector Prof. Ephraim Zehavi, Dean of the Faculty of Engineering
18:00-18.30	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.