



Committee for the Evaluation of Mechanical Engineering Study Programs

**Technion-Israel Institute of Technology
Faculty of Mechanical Engineering**

August 2008

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Chapter 1-Background

The Council for Higher Education (CHE) decided to evaluate study programs in the field of Mechanical Engineering during the academic year 2007-2008.

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

- Prof. William J. Wepfer – School of Mechanical Engineering, Georgia Institute of Technology, USA, Committee Chairman
- Prof. Alexander Solan – Department of Mechanical Engineering (Emeritus), Technion – Israel Institute of Technology
- Prof. Steven Dubowsky – Mechanical Engineering Department, Massachusetts Institute of Technology, USA
- Prof. Mordechai Perl – Mechanical Engineering Department, Ben-Gurion University
- Dr. Joseph Sussman – Vice President, North America Information Technology, Bayer Corporate and Business Services, and President-Elect, ABET, Inc., USA

Mr. Moty Bar and Ms. Annie-Clair Pilo served as coordinators of the committee on behalf of the Council for Higher Education.

Within the framework of its activity, the committee was requested to:

1. Examine the self-evaluation reports, which were submitted by the institutions that provide study programs in Mechanical Engineering, and conduct on-site visits at those institutions.
2. Present CHE with final reports for the evaluated units and study programs - a separate report for each institution, including the committee's findings and recommendations, together with the response of the institutions to the reports.
3. To submit to the CHE a report regarding its opinion of the examined field of study within the Israeli system of higher education. The committee will submit a separate report to the CHE in this matter.
4. To recommend standards for the evaluated field of study.

The committee's Terms of Reference document is attached as Appendix 1.

The first stage of the quality assessment process consisted of self-evaluation by the institutions. This process was conducted in accordance with CHE Guidelines for Self-Evaluation (December 2006).

Chapter 2-Committee Procedures

The Committee held its first meeting on January 25, 2008 during which it discussed fundamental issues concerning mechanical engineering study programs in Israel and the quality assessment activity of the CHE.

The committee members received the self-evaluation reports in January 2008 and the committee conducted two-day visits to each of the institutions offering study programs in the field under examination in March and May 2008. During the visits, the committee met with the relevant officials within the organizational structure of each institution as well as faculty and students.

In order to prevent the appearance of a conflict of interest, committee members did not participate in visits to institutions in which they were faculty members (active or retired). Because Professor Alexander Solan is a retired faculty member at Technion, he did not participate in this visit.

In accordance with the committee's request, the institution publicized in advance the agenda of the committee's upcoming visit and it invited academic staff members, administrative staff and students to meet with the committee in order to assess their opinions of the mechanical engineering study program offered at each of the institutions. This report deals with the Faculty of Mechanical Engineering at the Technion-Israel Institute of Technology. The committee's visit took place on May 25-26, 2008. The schedule of the visit, including a listing of participants representing the institution, is attached as Appendix 2.

The committee thanks the management of the institution and the Faculty of Mechanical Engineering for their self-evaluation report and for their hospitality towards the committee during its visit.

Chapter 3 - Evaluation of the Faculty of Mechanical Engineering at the Technion

Background

The Technion opened in 1924. The first class was comprised of sixteen students who specialized in construction, road building, and architecture. In the 1930's eleven laboratories and a Nautical School were established. In 1934 the Faculty of Industrial Technology was established. A few years later, the faculties of Electrical Engineering, Mechanical Engineering, and Chemical Engineering emerged from this Faculty. In 1962 the Technion was recognized by the Council for Higher Education together with Hebrew University and the Weizmann Institute of Science. Technion graduates have paved the way for Israel to become a high-technology "power house" in the world economy. During the 2004-05 academic year the Technion student population was nearly 13,000 of which roughly 9,000 were at the undergraduate level and nearly 4000 at the graduate level. In 2006-07 the Faculty of Mechanical Engineering enrolled 898 undergraduate students, 157 master's level students, and 53 doctoral students. In 2006-07, 139 students earned B.Sc. degrees, 33 master's level degrees, and 7 Ph.D. degrees.

Mission of the Program

The mission of the Faculty of Mechanical Engineering as stated by the Technion is to educate students, and to conduct research, at the highest level of the scientific and engineering disciplines that constitute the area known as mechanical engineering. This mission translates into the following more specific goals:

- *To equip the graduates with strong theoretical and practical tools for analysis and design of advanced engineering systems.*
- *To educate in the graduate programs, in particular the Ph.D., the new generation of researchers who will lead academia and industry in the country and in the future.*
- *To conduct research at the level of the best universities in the field worldwide.*
- *To be at the forefront of the rapidly expanding boundaries of mechanical engineering such as MEMS, Nano, and Biological systems.*

The committee finds that the mission statement of the Faculty of Mechanical Engineering is consistent with Technion's mission statement and is appropriate for a research university for both undergraduate and graduate mechanical engineering programs. The committee also observed that the Faculty of Mechanical Engineering lacks a strategic plan for attaining its stated mission and goals. The committee encourages the Dean to work closely with the senior faculty to develop such a strategic plan.

Study Program

The undergraduate mechanical engineering study program provides students with four major tracks of specialization to include Energy, Revadim (Robotics, Control, and Mechatronics), Mechanics, and Design. The committee noted that mechanical engineering has advocated and proposed a new track in biomedical engineering. The committee encourages the academic authorities to expedite the implementation of this interdisciplinary track. In addition, an “honors-like” program called Brackim prepares selected students for R&D positions with the Israeli Defense Force. The program also offers the Reamim program which enables qualified undergraduate students expedited entry into their graduate programs. The program provides several options to enable a variety of students with various backgrounds to pursue the master’s degree. The committee observed that the study programs at both the undergraduate and graduate levels are of very high quality.

The committee observed that students must declare and enroll in an engineering major during their first year. This lack of flexibility means that a “change of major” is usually a prohibitive barrier. The committee encourages Technion to consider a more flexible approach that would allow students to declare an engineering major after their first year without undue penalty in terms of make-up courses.

The rigor of the program appears to foster and develop a sense of self-study within the undergraduate student population. Technion was the only Israeli mechanical engineering program that demonstrated this outcome.

Some Technion students expressed a desire that a few of their technical courses be taught in English to acclimate them to the use of the published literature within the field of mechanical engineering.

Some of the laboratory equipment appears dated and should be renewed to provide greater opportunity for relevant, “hands-on” experiential learning and to provide for independent and creative work. The final projects are well designed thereby providing the students with an outstanding experience.

Enrollment in the doctoral program is lower than desirable for sustaining a competitive world-class research program and supporting mechanical engineering’s faculty. The Faculty is encouraged to explore approaches to growing the doctoral program. Special attention should be given to increasing the financial support provided to Ph.D. students.

Faculty

The mechanical engineering senior staff appears to be of very high quality. Faculty members earned their doctorates or performed post-docs at internationally renowned institutions. The senior staff maintains their expertise primarily through research. The committee observes that the collegiality among the faculty is very strong. The committee was impressed by the quality of the junior faculty. Technion has been able to provide

globally-competitive start-up packages to these new faculty members. However, it appears that Technion has been handicapped by limited operating budgets which threaten the progress of such junior faculty members once the start-up equipment becomes obsolete. Technion's ability to recruit elite junior-faculty is threatened by a low salary structure relative to Israeli industry and foreign universities. The committee believes that it is critical that the mechanical engineering program place a high priority on the recruitment of women faculty.

Over the past few years budget cuts have reduced the size of the full-time faculty from 48 to 36. One result of these cuts is that the external faculty now teach nearly 50% of the mechanical engineering course offerings. The committee observes that, if allowed to continue, this heavy reliance on external faculty may have a long-term detrimental impact on the quality and consistency of the student's educational experience.

While recognizing funding constraints, the committee believes that the senior staff must take full responsibility for the future of the mechanical engineering program and work closely with the Dean in making the case for additional resources with the Technion administration.

Teaching and Learning

Technion students appear to demonstrate an ability for self-learning due to the rigorous nature of the study program. The committee believes that self-education is an important goal of engineering education, considering the need of practicing engineers to keep pace with the continuous advances in science, technology, and engineering practice. The committee encourages the faculty to continue to nurture this important intellectual facility among Technion mechanical engineering students.

The Faculty recognizes that while the admission scores of mechanical engineering students are below that of electrical engineering students, they have been able to raise the performance of mechanical engineering students to a high and competitive level. The exemplary performance of mechanical engineering students in the IDF provides such proof.

The Dean is caught in a terrible dilemma. Low stipends for external faculty and teaching assistants make it extremely difficult to attract such individuals to teach courses. In addition budget cuts have led to a significant reduction in the grading of student homework assignments.

Students

The committee met with undergraduate and graduate students. The undergraduate students conveyed a deep sense of appreciation for the mechanical engineering faculty and staff. They felt that despite the stereotype that Technion is not student friendly, the mechanical engineering faculty and staff go out of their way to support the students. The

students demonstrated great optimism about their future and their prospects for positions in Israeli industry or graduate programs.

The graduate students expressed similar feelings. However, doctoral students indicated that there was not consistent mentoring of students to pursue academic careers. Some felt that this was due to the over-constrained and limited faculty hiring within Israel, competitive offers from Israeli industry, and the attraction of faculty positions in the US and Europe.

Research

The committee judges the mechanical engineering faculty's research to be outstanding. The faculty publishes in high-quality journals and does an excellent job of educating its doctoral students. Technion is to be commended for investing in start-up packages for new faculty. However, the committee observed that once these initial investments have been made, the low amount of competitive research funding available to faculty makes it difficult to maintain their edge. In addition, the program would benefit from a larger number of doctoral students. Doctoral students expressed frustration that much of their time was spent serving as teaching assistants. The committee encourages the program to explore alternative methods of funding graduate students so that more of their time could be devoted to research.

Infrastructure

During its visit, the committee was informed of a major gift that will expand the Lady Davis facility and provide much needed additional space. The committee also notes that while Technion is able to fund major capital projects, the department is severely handicapped by the lack of operating budget to pay for external teachers and upgrade to its instructional laboratories.

The undergraduate laboratories provide an appropriate environment for learning. However some of the laboratories appear to be somewhat dated and could use a major upgrading.

The committee noted that the department's computer clusters included very old systems and lacked the server-centric site-license access to modern engineering software that global peer institutions routinely provide their students.

The committee also observed that the department maintained its own library. The committee noted that the students used the library for studying and working in groups and that the operating hours did not accommodate student needs. More critically, the committee questions the efficacy of operating numerous satellite libraries in a resource constrained environment. The committee encourages the Technion administration to address this issue.

Self-Evaluation

The committee notes that Technion has had a long-term self evaluation process independent of CHE. In fact, the Faculty of Mechanical Engineering's external visiting committee convened in January of 2007. This committee acknowledges Technion's frustration with seemingly multiple and overlapping evaluation processes.

The self-study was prepared by a senior faculty member appointed by the Dean with input from some of the senior faculty. It appeared to the committee that the Dean did not place much value in the self-study process. The self-study was prepared in a manner that emphasized quantitative metrics and provided an accurate snap-shot of the department.

The committee found that the self-study did not reflect the department's vision and strategy for attaining its mission and goals. Furthermore the self-study did not provide in-depth introspection in terms of where it is and where it wants to go.

The committee understands that the Dean has experienced very difficult and limited budgets and he has essentially shielded the senior faculty from these problems. The committee encourages the Dean and the senior faculty to develop a strategic plan that will enable the department to manage this difficult situation.

Summary

The graduates at all degree levels of the Faculty of Mechanical Engineering are well prepared to enter the profession of mechanical engineering, and have a high expectation of success.

Within the next year the Dean needs to work closely with the senior faculty to develop a strategic plan for attaining its stated mission and goals.

The undergraduate program provides students with four major tracks of specialization. The committee noted that mechanical engineering has advocated and proposed a new track in biomedical engineering. The committee encourages the academic authorities to expedite the implementation of this interdisciplinary track. The committee encourages mechanical engineering to expand its undergraduate curricular offerings through collaborations with other Technion departments.

The rigor of the program appears to foster and develop a sense of self-study within the undergraduate student population. Technion was the only Israeli mechanical engineering program that demonstrated this outcome.

Enrollment in the doctoral program is lower than desirable for sustaining a competitive world-class research program and supporting mechanical engineering's faculty. The Faculty is encouraged to explore approaches to growing the doctoral program. Special attention should be given to increasing the financial support provided to Ph.D. students.

The mechanical engineering senior staff appears to be of very high quality. The committee observes that the collegiality among the faculty is very strong. The committee was impressed by the quality of the junior faculty. Technion's ability to recruit elite junior-faculty is threatened by a low salary structure relative to Israeli industry and foreign universities. The committee believes that it is critical that the mechanical engineering program place a high priority on the recruitment of women faculty.

Over the past few years budget cuts have reduced the size of the full-time faculty from 48 to 36. One result of these cuts is that the external staff teach nearly 50% of the mechanical engineering course offerings. The committee observes that, if allowed to continue, this heavy reliance on external faculty may have a long-term detrimental impact on the quality and consistency of the student's educational experience. The committee recommends that the faculty size be increased to at least 40 in the next two years simply to maintain Technion's international reputation.

The committee judges the mechanical engineering faculty's research to be outstanding. The faculty publishes in high-quality journals and does an excellent job of educating its doctoral students.

The committee also notes that while Technion is able to fund major capital projects, the department is severely handicapped by the lack of operating budget to pay for external teachers and upgrade its instructional laboratories. Within the next two years, the Technion administration is encouraged to develop operating budgets that will provide adequate support for the department.

The committee encourages the Technion management to address the duplication of services such as the satellite libraries among several major departments.

The Committee is aware that all study programs operate under external constraints, in particular budget limitations. Nevertheless, it is the Committee's opinion that many of its recommendations can be implemented within the external constraints, by appropriate action of the authorities of the University and the Faculty.

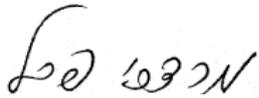
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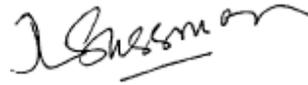
Prof. William J. Wepfer
Chairperson



Prof. Steven Dubowsky



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