



General Report of the Committee for the Evaluation of Mechanical Engineering Studies

Mechanical Engineering Studies
Within the Israeli System of Higher Education

September 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

Ms. Annie-Claire Pilo and Mr. Moty Bar 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 hold on-site visits to 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. This document summarizes the committee's overall findings regarding mechanical engineering studies within Israel.***
4. ***In a separate document the committee also provided suggestions to CHE concerning process improvements for the evaluation process and observations on the current standards and criteria 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).

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 CHE.

The committee members received the self-evaluation reports in January 2008 and the committee conducted two-day visits to each of the six institutions offering study programs in mechanical engineering in March and May 2008. Not all the of the committee members participated in all of the reviews due to scheduling constraints and/or the issue of potential conflict of interest, as discussed below. During the visits, the committee met with the relevant officials within the organizational structure of each institution as well as senior and junior academic staff as well as 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).

Within Israel, the following universities and colleges are authorized by CHE to offer mechanical engineering study programs:

The Academic College of Judea and Samaria

Department of Mechanical Engineering-Mechatronics

Afeka Tel-Aviv Academic College of Engineering

Department of Mechanical and Systems Engineering

Ben Gurion University

Department of Mechanical Engineering

ORT Braude College

Department of Mechanical Engineering

Tel Aviv University

School of Mechanical Engineering

Technion-The Israel Institute of Technology

Faculty of Mechanical Engineering

The committee expresses its appreciation to each of the six institutions for their assistance during the evaluation process and their hospitality during the visit. The committee wishes to acknowledge the efforts of the CHE coordinators for helping the work of the committee do smoothly and efficiently.

Chapter 2 - Observations and Recommendations Concerning Mechanical Engineering Studies

Introduction. The committee believes that the six mechanical engineering programs in Israel, as a whole, provide Israeli industry and the nation with well-prepared mechanical engineering graduates with an appropriate mix of skills and interests. The faculty members are well-qualified and do a good job of educating their students. The committee also observed several trends which need to be addressed, if these six programs and the Israeli CHE and PBC are to sustain the critical base of mechanical engineering graduates. These issues are delineated below and include: (1). the alignment of mission, vision, and program aspirations; (2). the number of mechanical engineering programs within Israel; (3). the financial support of the programs and low faculty salaries; (4). the need to increase research opportunities for faculty members at research universities; (5). the need for open-ended problem-solving and life-long learning; and (6). the critical requirement for interdisciplinary education.

Mission, Vision, and Aspirations of the Programs. The committee found that the mission and vision for the three research universities were clearly stated and that the aspirations and expectations of the faculty, students, and administration were in alignment and agreement. The committee found that the mission and vision of the mechanical engineering programs in the three colleges emphasized undergraduate education as reflected in the study programs. However, the committee also found that the faculties at each of the three colleges perceive that the requirement for promotion is not aligned with the college mission and vision statements. The college faculties believe that successful research is a critical element for advancement. The committee encourages the CHE to develop and promulgate an alternative path for faculty promotion based on professional achievement and demonstrated professional engineering and teaching competence. It should be made clear, that given each college's mission, continuous professional development activities by the staff are no less important than research and should be rewarded.

Number of Mechanical Engineering Study Programs. The six mechanical engineering programs represent a nice mix that appears to satisfy the needs of Israeli industry and academia. Undergraduate enrollments seem to be stable and the graduates of these programs appear to be employable and successful in industry. In the aggregate, the supply and demand for bachelors level graduates seem to be in balance and thus the committee does not believe that additional mechanical engineering programs are needed at this time. It appears to the committee that the current B.Sc. programs should be improved and have their enrollments optimized before adding additional undergraduate programs.

Given the committee's limited knowledge of the job market for M.Sc. and Ph.D. level graduates, it appears that the three research universities have sufficient capacity to meet the needs of Israeli industry. Furthermore, only the research universities have the depth and breadth of faculty as well as the infrastructure to provide the type of high "value-added" graduates at the M.Sc. and Ph.D. levels required by Israeli industry and academia.

The committee believes that the current B.Sc. programs at the colleges without advanced level degrees need to be deepened and broadened before thinking about adding additional advanced degree programs.

Financial Support. The committee recognizes that within Israel, faculty salary levels are the result of negotiated agreements between the government and the faculty unions. The committee also notes the contrast between Israel's highly successful and globally-competitive high-tech industry with its ability to pay competitive salaries with that of the Israeli academic enterprise which provides minimal flexibility to pay faculty globally-competitive salaries.

The committee notes that operating budgets have been reduced over the past five years. This has resulted in higher student-to-faculty ratios, an increased reliance on the use of lower-paid external faculty, and increased class sizes. In some cases external faculty are teaching a large percentage of the required core courses.

While many external faculty members are excellent teachers and bring to the classroom important practical views of engineering to their classes, their college and university work is not central to their professional lives. The committee believes that it is not possible to build a world-class educational program, in the college or research university context, based on a faculty with a high percentage of part-time, and transitional (untentured) teachers.

Furthermore, faculty salaries are significantly lower than those in Israeli industry or those in US and European universities. The salary disparity is such that it is even difficult for some programs to find external faculty to teach. A common finding across the six program visits leads to the recommendation to CHE to provide additional funding to allow for the hiring of additional faculty---especially at the junior level---at salaries that are more competitive with the global marketplace. The committee also found funding for laboratory and infrastructure needs was inadequate for the education of mechanical engineering students. Although it appears that the six programs are doing a good job graduating students for Israeli industry, the faculty is extremely stressed and fragile and, if this issue is not addressed, the quality of mechanical engineering graduates has the potential to rapidly deteriorate in the very near future. In the long run Israeli mechanical engineering programs cannot sustain their quality and the industrial base without significantly increased investments. This issue must be addressed by Israeli society.

Limited Research Opportunities. Quality research universities, offering MS and Ph.D. degrees, are built on the advanced state of knowledge. Research is the critical key to such advanced knowledge. Globally-competitive research requires the significant investment of financial resources. The committee observes that research funding opportunities for faculty in the three mechanical engineering research-intensive programs are limited and insufficient to support their activities. Israeli society must address the critical need to support research as a means maintaining the country's intellectual and economic vitality as well as its defense requirements.

Innovation and Life-Long Learning. The committee recognizes that the six programs included a variety of open-ended problems within their curricula in varying degrees. The committee believes that each of the six programs must modify their curricula to put an even greater emphasis open-ended learning experiences. Such intellectual agility is absolutely critical to maintaining, and building, Israel's competitive advantage. Self-education must continue to be 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. Engineering requires life-long self-education. Within the next two years, the committee encourages all six programs to enhance and emphasize self-study and open-ended problems to nurture the students' creative skills.

Students at more than one of the six programs expressed a desire that a few of their technical courses be taught in English to acclimate them to the use of the published literature and latest advances within the field of mechanical engineering. The committee supports the concept that some courses be taught in English to better prepare Israeli mechanical engineering graduates for the globally-competitive world.

Interdisciplinary Education. The committee noted that the six mechanical engineering programs have a tendency to isolate themselves from their sister engineering units as well as the basic science departments. The committee strongly encourages the mechanical engineering programs to collaborate with their sister departments in order to adapt their curricula to enhance student abilities to perform engineering that bridges multiple disciplines and helps the students to frame and solve the technological problems of the future.

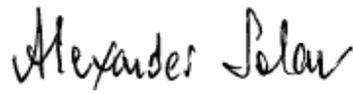
Summary. The committee strongly suggests that immediate steps and investments be made to address the following challenges:

1. Develop alternative criteria for the promotion of college faculty
2. Improve the current programs and provide them with sufficient financial resources before adding additional undergraduate and graduate mechanical engineering programs.
3. Solve the problem of low faculty salaries and investments in Israeli higher education.
4. Provide additional investments and opportunities for engineering research at the research universities.
5. Insist upon a greater emphasis on open-ended problem framing and solving as well as life-long learning.
6. Require programs to promote interdisciplinary curricula.

Respectfully submitted,



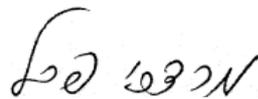
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