



Committee for the Evaluation of Material Science and Engineering Study Programs

General Evaluation Report

October 2014

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Chapter 1- Background

The Council for Higher Education (CHE) decided to evaluate the study programs in the field of Material Engineering during the academic year of 2014.

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. Enrique J. Lavernia – College of Engineering, University of California, Davis, California, USA: Committee Chair
- Prof. David N. Seidman – Materials Science and Engineering, Northwestern University, , Illinois USA
- Prof. Dr. Reiner Kirchheim – institute für Materialphysik, Gottingen University, Germany
- Prof. Ronald Gibala – Materials Science and Engineering, University of Michigan, Michigan, USA
- Prof. Doron Aurbach – Department of Chemistry, Bar-Ilan University, Israel

Ms. Daniella Sandler- Coordinator of the Committee on behalf of the CHE.

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

1. Examine the self-evaluation reports, submitted by the institutions that provide study programs in Material 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 July 2012.

¹ The Committee's letter of appointment is attached as **Appendix 1**.

Chapter 2-Committee Procedures

The Committee held its first meetings on 25, 4, 2014, during which it discussed fundamental issues concerning higher education in Israel, the quality assessment activity, as well as Material Engineering Study programs in Israel.

During April-May 2014 committee members conducted site visits to Ben Gurion University, The Technion and Azrieli College of Engineering.

This report refers to the General State of Material Science Engineering Programs in Israel.

Chapter 3: The State of Material Science and Engineering Study Programs in Israel

Introduction:

The field of Materials Science and Engineering continues to increase in stature and importance from its origins in ferrous metallurgy to encompass modern economically important areas, such as information technology, medicine, defense, transportation and energy. The Evaluation Committee is pleased to report its views on the state of research and education in Materials Science and Engineering (MSE) in Israel. The committee believes that the three MSE programs in Israel provide it with graduates in materials that can apply fundamental concepts to mathematics, chemistry and physics to solve important engineering problems under the broad rubric ‘materials.’ The committee acknowledges that one of the departments reviewed, The Technion, has changed its name from Materials Engineering to Materials Science and Engineering; however, in this report, we will use the term Materials Engineering to encompass all three departments. The combination of one college and two universities providing materials engineering degrees provides a framework that can simultaneously meet the need to graduate engineers that will and can support growth in the high technology industry as well as training future top-notch academic researchers. Moreover, future growth in materials engineering departments can be used as a vehicle to attract diverse populations, including students living in settlements, students from low-income families and students from Arab communities, which will ultimately contribute to social wellbeing and economic stability in Israel.

Additionally, a Department of Materials Science and Engineering was launched at Tel Aviv University with a new undergraduate program that requires joint degrees in materials science and engineering and Chemistry; the first class of students will commence studying October 2014. On Wednesday, April 30th, 2014 the Evaluation Committee met with Prof. Noam Eliaz, founding chair, and Prof. Ehud Heyman, Dean of Engineering. They presented to us the structure and student body of the Faculty of Engineering, the historical development of the materials area at TAU since 1994, the mission of the DMS&E, the research profiles and achievements of both the core and affiliated faculty, its distinguished international advisory board, the relevant institutional centers, and the B.Sc., M.Sc. and PhD programs. Having a new undergraduate materials program in the geographic center of Israel is important for Israel. This new MS&E program has a good balance between the exact sciences and engineering. It takes advantage of existing multi-disciplinary materials research at TAU by including affiliated faculty from engineering, the exact sciences and the life sciences, in addition to having a distinguished international advisory board, and core faculty members whose number is

anticipated to increase in the coming years, to improve its chances of success and visibility worldwide. This new program should be evaluated in great depth by the Israel Council of Higher Education within seven years.

The committee also made a series of observations that need to be addressed, not only to ensure the success of the current three departments, but also to take advantage of emerging trends in science and technology and meet national needs. These issues are discussed in detail below and include: (1) The need to maintain a balance between the engineering and science aspects of Materials Engineering; (2) The need to develop robust outreach programs that can help educate high school students about Materials Engineering; (3) The benefits of introducing a set of “core” courses required of all Ph.D. students in Materials Engineering. (4) The need to develop appropriate criteria to evaluate faculty at universities and colleges, which are consistent with the different missions of teaching and research; (5) The formulation and implementation of financial strategies to ensure the sustainability of the research infrastructure required for Materials Engineering research; (6) The need to engage active alumni. These are discussed in detail below.

1. Maintain balance between engineering and science aspects of Materials Engineering:

The science of Materials Engineering has evolved rapidly in recent years, particularly with the advent of novel fields, such as nanoscience, nanotechnology, computational materials and highly sophisticated advanced analytical techniques for study. To prepare students properly to perform in these new fields it is imperative to develop study programs that require in-depth mathematics, physics and chemistry courses that go beyond introductory level concepts. This requirement, however, must be balanced by the need to teach and train students who understand how to design and work with a very broad range of engineering materials. Faculty appointments must be made such that both science and engineering aspects of materials are satisfactorily addressed in each department’s curricula. It is clear that Israel’s high technology industries will need graduates who understand both science and engineering aspects of a very broad range of materials.

2. Develop robust and coordinated outreach programs:

The Evaluation Committee notes the need to better educate high school students about the opportunities in the field of Materials Engineering available to them at the college and university level. It is often the case that high school students are aware of careers in electrical engineering, mechanical engineering, etc., but not about opportunities in Materials Engineering. Moreover, an effective strategy will require all three Materials Engineering Departments to develop well-coordinated outreach programs with a highly

consistent message.

3. Introducing a set of required M.S. and Ph.D. “core” courses:

The Evaluation Committee recommends that Materials Engineering Departments in Israel develop and implement a set of “core” courses that are required of both M.Sc. and Ph.D. students. Such courses may include, for example: Thermodynamics and Statistical Mechanics; Kinetics of Materials; Electrical, Magnetic and Optical Properties; and Mechanical Properties of Materials. This requirement will ensure that all MSc. and Ph.D. students are provided with the same fundamental knowledge that will ultimately help them succeed in any career they elect to pursue. Moreover, such a requirement is consistent with most international M.Sc. and Ph.D. programs in Materials Engineering.

4. Criteria/metrics to evaluate faculty and infrastructure at universities and colleges:

There is a need to formulate and implement quantitative criteria and metrics to evaluate faculty and infrastructure in Materials Engineering Departments, which are both consistent and completely transparent. Such criteria should be consistent with the different expectations for the balance between research and teaching that exist at colleges and universities. Moreover, appropriate metrics must be established to evaluate faculty excellence in both research and teaching. The Evaluation Committee notes that the requirements for promotion were not always aligned with the mission and vision statements of the Materials Engineering Departments. From a resource standpoint it is also important to establish minimum requirements (e.g., space, teaching assistants, and graduate assistantships for the appropriate operation of each Materials Engineering Department in Israel. The departments should also develop a system of metrics to evaluate the supply and demand of materials engineers in Israel and to maintain a detailed data base that is readily accessible.

5. Sustainable financial infrastructure:

The Evaluation Committee observed that budgets have been reduced over the past few years and that this has resulted in higher student-to-faculty ratios, an increased dependence on the use of external adjunct lecturers, and increased class enrollments. In terms of research, the Materials Engineering field requires the purchase and maintenance of expensive equipment and the support of well-trained staff. It is imperative that universities and colleges develop and implement strategies to provide Materials Engineering Departments with the ability to obtain and maintain state-of-the-art instrumentation and support new research areas with the appropriate equipment to be competitive on an international level.

6. The need to engage alumni:

As a general observation, there appears to be very limited engagement of alumni with Materials Engineering Departments in Israel. Alumni engagement can not only result in the accrual valuable financial benefits to a department, but can also provide valuable input on strategic departmental issues, such as curriculum development and research areas that are of importance to Israeli industry.

In addition to the above recommendations, the Evaluation Committee also notes the need to address the following structural issues related to higher education in Israel.

- Address the challenge posed by low faculty salaries and investments in Israeli higher education;
- Modify the current retirement system, which places the financial burden on the institution and will ultimately undermine an institution's ability to remain globally competitive;
- Require colleges and universities to develop and implement interdisciplinary programs of teaching and research;
- Increase the funding available to prestigious government programs, such as the Israel Binational Science Foundation and the Israel Science Foundation.
- Modify high school curricula to include physics courses.
- Normalize the use of titles across universities and colleges; it is confusing that some institutions use the title of assistant professor, whereas others have retained the use of lecturer titles, lecturer and senior lecturer.

Signed by:



Prof. Enrique J. Lavernia-Chair



Prof. Doron Aurbach



Prof. Ronald Gibala



Prof. Dr. Reiner Kirchheim

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Prof. David N. Seidman

Appendix 1: Letter of Appointment

March 2014

Prof. Enrique J. Lavernia,
College of Engineering,
University of California, Davis
USA

Dear Professor Lavernia,

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. 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 **Material Engineering**. In addition to yourself, the composition of the Committee will be as follows: Prof. Ronald Gibala, Prof. Reiner Kirchheim, Prof. Doron Aurbach, and Prof. David Seidman.

Ms. Daniella Sandler will be the coordinator 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 the Chair of this most important committee.

Sincerely,

Prof. Hagit Messer-Yaron
Deputy Chairperson,
The Council for Higher Education (CHE)

Enclosures: Appendix to the Appointment Letter of Evaluation Committees

cc: Ms. Michal Neumann, Deputy Director-General for QA, CHE

Ms. Daniella Sandler, Committee Coordinator