



**Committee for the Evaluation of Material Science and Engineering Study
Programs**

**Ben Gurion University of the Negev
The Department of Material Engineering
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.

In 27/4/2014- 1/5/2014, the Committee held its visits of evaluation, and visited the Azrieli College of Engineering, the Technion and Ben Gurion University. During the visits, the Committee met with various stakeholders at the institutions, including management, faculty, staff, and students.

This report deals with the Department of Material Engineering at Ben Gurion University. The Committee's visit to the University took place on 1/ 5/2014.

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

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

Chapter 3: Evaluation of Material Engineering Study Program at Ben Gurion 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 Materials Engineering Department (DME) at BGU is commended for its performance in all areas of academic performance, that is teaching and research. Historically, the department has provided a curriculum that is based on the science, engineering and processing of materials, and more recently has strategically evolved to encompass high performance materials, functional materials as well as theory and computations.

The Evaluation Committee was pleased to learn that students, undergraduate and graduate students, are very satisfied with their educational experience at BGU. The students learn in a friendly atmosphere, where faculty access is readily available to all students. Moreover, based on discussions with alumni groups, the students receive an excellent education and graduates from the Materials Engineering Dept. at BGU are well prepared to excel at any academic institution, both in Israel and overseas. Current efforts to increase student quality at BGU are noted and encouraged.

The Evaluation Committee notes that, not only is the faculty productive in terms of academic research, but their contributions to Israel's high technology infrastructure is remarkable and need to be encouraged. The contributions of the faculty to the establishment of the Magnesium Consortium, the Nuclear Research Center in the Negev, as well as to various local industries, such as Intel in Kiryat Gat, represent important examples.

The research infrastructure in the department helps faculty maintain a high level of productivity, although the Evaluation Committee notes the need to update some of the teaching equipment and laboratories as well as a critical need for additional space. In terms of space, the Evaluation Committee feels strongly that current conditions in the department are sub-critical, and all members acknowledged concerns related to serious potential safety issues that can emerge when students work in crowded laboratories. The building occupied by the Materials Engineering was the very first building constructed on the Ben Gurion University campus.

The Evaluation Committee notes that the historical strength of the department in

the area of Materials Engineering is strategic, not only for BGU, but also for Israel. Therefore, the department should strive to maintain an appropriate balance between the “engineering” and “science” aspects of Materials Engineering. The Evaluation Committee makes specific recommendations regarding this topic in reference to the curriculum, as well as for future faculty appointments.

The Evaluation Committee notes that the Materials Engineering Dept. benefits from supportive administrators, dedicated faculty, excellent teaching programs, and highly skilled academic and research staff. The recommendations summarized in this report, involving all areas of academic performance, including: mission, faculty, staff, study programs, infrastructure, and research reflect the challenge of how to increase the quality of an excellent department and ensure its sustainability.

The recommendations made in this report encompass both short term (0-1 year) as well as long term (1-3 yrs.) time periods. In certain specific cases, recommendations are made until the next evaluations cycle.

2. Organizational Structure and infrastructure

Observation and Findings:

The committee met with the Rector, Prof. Zvi Ha'cohen and the Dean of the faculty of engineering, Prof. Joseph Kost. The committee was impressed by the leadership and engagement of the Rector and the Dean, as well as by their desire to promote high-level teaching and research in the department. , The committee is under the impression that the leadership understands the critical need to expand the infrastructure for the department and moreover, described construction plans underway for a new building for the MSE department; although no particular space details were provided, however. The committee was also impressed by the department chairman, Prof. Nahum Frage, who is a prominent scientist, diligent and very dedicated; moreover, he understands the challenges and opportunities faced by the MSE department. Overall, the department appears to be held in high regards by the Universities leadership, and the engagement and understanding of challenges faced by the potential student growth.

The Evaluation Committee would like to point out an important issue related to the overall curriculum management at BGU, as related to the study of chemistry by MSE students. Although this topic is dealt with further in this report, it is important to mention it here as well, since it may require direct involvement by the Rector. At the moment, the students at the MSE department study only a general course in chemistry, together with students from other departments, specifically mechanical engineering. This situation requires immediate attention, as under the present curriculum, MSE students graduate with a relatively weak background in chemistry. Poor training in chemistry will disadvantage BGU materials engineers, as they graduate and pursue careers in industry, which frequently require a strong

knowledge of chemistry for problem solving. Given the relatively small number of senior faculty members in the MSE department, it is impossible to demand from any of them to take on himself or herself the task of preparing and teaching a special course in chemistry specifically designed for materials engineers. Accordingly, it is the recommendation of the Evaluation Committee that the Chemistry Department be requested to prepare and teach a special course in chemistry specifically designed for MSE students, thereby providing them with the adequate basis in chemistry that they need. We believe that such an important change may require the intervention of the Rector to solve this critical problem.

The faculty contains 19 departments; this is an excessively high number. If one compares this number of departments, to that at most schools of engineering throughout the world it is very large. Perhaps the faculty should consider the strategic merger of departments, such as bio-medical & bio-technology engineering. The Evaluation Committee notes that the MSE department has only 1.5 positions for secretarial support. This rather small administrative staff is unacceptable, particularly if one considers the research and teaching activity of departmental faculty. Even though the current secretarial staff (1.5 of them) is very dedicated, diligent and efficient, they are unable to provide adequate administrative services to the faculty in the present situation. The Evaluation Committee strongly recommends increasing immediately the secretarial staff in the departmental office to at least two full-time secretaries.

The Evaluation Committee would like to raise another important organizational topic, related to the interactions with the NRCN. The Evaluation Committee met with adjunct academic staff and alumni of the department who are currently working at the NRCN; they were technically excellent and dedicated to students. This important national research institute hires many excellent scientists and engineers (many of which graduated from the MSE department of BGU), which would like very much to be affiliated with the MSE department at BGU. The department has immediate access to a pool of technically excellent NRCN personnel who can engage with research and teaching, for example on a part-time basis (via convenient, non-tenured employment contracts). Some of the NRCN staff can help the department with various technical issues: teaching in the student laboratories, serving as technical staff in research laboratories, and assisting in the design, operation and maintenance of specialized laboratory equipment.

It is the opinion of the Evaluation Committee that the MSE department at BGU is efficiently managed and well organized. The Dean and his team are very experienced and understand the issues that affect the MSE department. The administrative staff is clearly dedicated in support of students and faculty and the secretaries provide very good service to both the faculty members and the students. In general, the MSE department has a reasonable infrastructure for its daily and current duties in terms of research and teaching. There are sufficient lecture rooms and auditoriums as required by the curriculum. Their teaching laboratories are in reasonable shape, possessing the necessary pieces of equipment, and the computers

and networking services for the students appear to be adequate. There is a reasonable availability of computerized work stations, in which students can sit calmly, search for any needed information and do their homework. The faculty members have research laboratories that provide them the means needed to conduct first-rate research programs. The MSE department benefits from an excellent center for Nanotechnology, which serves as a central facility of advanced analytical equipment, such as high resolution electron microscopes, x-ray diffraction machines, scanning probe microscopes, spectrometers and more for the entire faculty. There is highly trained staff support (with Ph.D. degrees) in charge of this central analytical facility. This center is directed by Prof. Yuval Golan from the MSE department and the impression is that it is managed very well.

The Evaluation Committee notes, however, that despite of what is written above, the department suffers from an acute lack of space. The teaching laboratories are too small and too crowded, approaching a situation that raises serious safety concerns. The department should expand as soon as possible its teaching laboratories. There is a need to renovate some of the teaching and research laboratories. The advanced equipment on which the research of the faculty depends requires serious and expensive maintenance. Usually after a decade of operation, equipment such as electron microscopes requires replacement. The department should have adequate financial resources to meet all the above needs. The Dean, Department Chairman, and the senior academic staff should pressure the top management of BGU to place the MSE department in a central place on its endowments map. Especially acute is the situation concerning the electron microscopes of the department, which are used both for teaching and research (Dr. Louisa Meshi). These instruments are very old and should be replaced as soon as possible. The fact that the department has a senior member (Dr. Meshi), whose expertise is electron microscopy and structural analyses, justifies purchasing for the department a top level new high resolution electron microscope and also a new scanning electron microscope and a standard transmission electron microscope for more routine work. Such purchases represent a rather large financial investment, and hence require engagement with the top management of BGU and should be pushed to high priority in the endowment-raising efforts of BGU.

Recommendations:

Short terms (0-1 years)

1. Relieve overcrowded teaching laboratories.
2. Increase the departmental administrative manpower to two full-time secretaries.
3. Change the chemistry teaching level by providing a separate, dedicated course in chemistry that meets specifically the needs of materials engineers. The rector and the dean have to be involved in this change, because they have to involve the chemistry department to solve this serious problem.

Long term recommendation: (1-3 years)

1. Expand the space of the teaching laboratories by at least 30%.
Expand as well space for research activities.
2. Replace the department's old electron microscopes by new ones and include in this venture a purchase of a top high resolution electron microscope (HREM) for Dr. Louisa Meshi. Having a unique research lab in electron microscopy and structural analyses will elevate the level of the entire department and add to its prestige in terms of high-level research.
3. Strengthen further the close relationship with NRCN to enable an effective exchange of people, to the mutual benefit of both parties.

3. Mission and Goals

Observation and Findings:

Established in 1971, the Department of Materials Engineering has matured from a narrow program designed originally to respond to the needs of local industry into an excellent department that encompasses the science, engineering and processing of materials, including high performance materials (e.g., high-temperature and high-pressure applications) as well as functional materials (e.g., thermoelectrics, biomaterials and electronic materials), and including theory and computation. The Evaluation Committee was very impressed by the uniformity and consistency in comments received from faculty, students and alumni alike, which underscored the value of the Materials Engineering education that they received from this department.

The mission statement of the Materials Engineering Dept. is stated as follows:

“The mission of the Materials Engineering Department is to provide high-quality education in materials science and engineering and to carry out forefront research (both applied and fundamental) in the field, and thus to provide the academic foundation for the development of the materials research infrastructure of Israel and to satisfy the demand for qualified materials scientists and engineers”

The Evaluation Committee notes that the above statement is consistent with actual practices in the department, as well as with available data. Evidence to that effect is provided by the following factors. First, research output of the faculty is very good, if one considers both the number of publications as well as the quality of the journals that they appear in. Second, the Materials Engineering Dept. is well funded, and the Evaluation Committee was pleased to see that the number and size of research grants is high. Third, the programs of study successfully train students with skills and knowledge that were praised by the alumni groups that we met with. Fourth, the graduate students felt that they were well prepared, and moreover, comments from those who have spent time abroad suggest that their training is comparable to the best institutions around the world. For example, graduate students described presenting papers at overseas conferences as well as actively

working to publish papers in refereed journals. Fifth, the Materials Engineering graduate program provides students and postdoctoral scientists with access to state-of-the-art research facilities such as those available in the IKI nano-center.

The Evaluation Committee had an excellent visit to BGU, and after deliberations, meetings and review of all provided information, the following recommendations are made in reference to the mission statement.

Recommendations:

Short Term (0-1 year):

1. Establish a methodology to vet the mission statement with all relevant constituencies: faculty, students, alumni and industry.

Long Term (1-3 years):

1. Regularly revise the mission statement as the Materials Engineering Dept. at BGU grows as a teaching and research program and additional students enroll.

4. Study Programs

Observation and findings:

Following its mission and strategy the MSE department is offering obligatory and mandatory courses in the undergraduate program, which cover a very broad spectrum of the fundamentals of materials engineering from physics to chemistry including its engineering mission. Additionally, the students are introduced to the production, characterization, and properties of the major materials, metals, ceramics and polymers. Students and alumni studying right now or having attended the courses taught by the faculty of the department praise the quality of teaching in unison. Several of the present B.S. and M.S. students complained about the introductory course in physics as being presented with less commitment. M.S. students pointed out that in the graduate program mandatory courses are not taught. Thus, students may only choose courses which are less demanding or which cover a special field only, i.e., electronic materials.

The department is following the rapidly changing discipline of materials science by searching for new faculty members doing research in the fields of advanced materials and materials used under extreme conditions. In modifying its present program of studies the department should maintain its present balance between the areas of advanced functional materials being attractive for young students on the one hand and classic structural materials being necessary for many students who

will be employed in industries that require this knowledge: e.g., the aviation and military industries.

Based on the evaluation report and discussions with students and alumni the Evaluation Committee understands that the level of the teaching of chemistry needs to be broadened to meet the requirements of both BS and MS students. The students currently take general chemistry course with students from other engineering departments, such as mechanical engineering. This results in the materials engineering students receiving a very superficial education and background in chemistry, much below the real needs of materials engineers. It is emphasized that many industries expect that materials engineers will be able to solve problems that require a strong command of chemistry. This situation has to be immediately rectified. It should be required by the University that BGU's department of chemistry prepare and teach a special course in chemistry for the students of Department of Materials Engineering.

The lack of space for laboratory courses for B.S. and M.S. students and for offices for M.S. students slows down their studies and may already have become a serious safety issue. Very often the equipment used for laboratory courses is old or essentially antiquated and they need to be updated.

Recommendations:

Short term/immediate (~ within 1 year)

1. The department should choose or create courses in the graduate program as being mandatory by avoiding specialized and less demanding graduate level courses. This includes a course on chemistry of materials, ideally taught by faculty from Department of Chemistry. This recommendation is made to avoid a further increase of the very high teaching load of the faculty members of the Department of Materials Engineering.
2. Additional rooms should be allocated to the Department of Materials Engineering by BGU or the faculty of engineering with the highest priority concerning rooms for laboratory courses. In this context the outdated equipment of the laboratory courses need to be upgraded.

Until the next cycle of evaluation:

1. For the sake of a broad education of students and the needs of Israel's industries the Department of Materials Engineering should maintain its unique feature of providing a broad education in both advanced and classic materials and in structural and functional materials.

5. Human Resources / Faculty

Observation and findings:

5a. Faculty. The faculty of the Department of Materials Engineering (DME) at Ben-Gurion University (BGU) of the Negev consists of 12 full-time faculty members, with a distribution that includes four professors, four associate professors, and four senior lecturers. This number of faculty members is small compared to most Departments of Materials Science and Engineering in the USA and is particularly small for the large number undergraduate and research student enrollments in the undergraduate and graduate programs in the DME. The teaching of important practical engineering courses is very well done by three highly committed adjunct faculty members, so that the DME should look for additional ways to expand the use of adjunct professors. One of the faculty members will be retiring soon, and the DME is presently looking for his replacement. All faculty members are actively involved in research and teaching. The faculty research groups typically involve several graduate research students at both the M.S. and Ph.D. levels. The typical teaching load consists of six credit hours per semester and usually four courses in an academic year. The students and alumni speak very favorably about the faculty members as research and teaching advisors and rate their overall experience in the DME as excellent.

While the faculty appears to be doing a very good job of handling all of their professional responsibilities within the department, it is clear that they are overworked for the size of the research activities and the large and growing student enrollments. It is appropriate to state that the DME faculty is subcritical in size and that both immediate and longer-term increases in faculty size are needed to address this major concern of the Evaluation Committee. More importantly, it should be recognized that this relatively small increase in faculty size will have a disproportionately large positive impact on the quality and quantity of materials research and education on the BGU campus.

A component of faculty growth that should be addressed by the BGU administration and the DME department concerns the nature and extent of the entire materials community on the BGU campus. Typically for every faculty member in a materials department at a research university, such as BGU, there are three to five additional materials researchers in the other science and engineering departments. There are opportunities to promote synergisms and enhance the materials research output of the DME department and the materials research effort at BGU as a whole by defining and integrating the materials research community on the campus. Such synergisms will be enhanced by the existence of a larger DME faculty than currently exists. The development of new interdisciplinary research centers and programs, possibly in cooperation with industrial and government organizations and facilities, can also occur by such growth and collaborative initiatives.

Recommendations:

Short Term (0-1 year):

1. The DME should add to the current number of 12 full-time faculty members, both by immediately replacing the faculty member who is retiring and adding at least one new faculty member in an area of growth in the broad field of materials science and engineering.

Long Term (1-3 years):

1. The DME should probably grow by at least a few additional faculty members to represent adequately itself in the ever-evolving field of materials science and engineering and still cover its growing commitment to quality research and education on the BGU campus.
2. The DME should take the initiative to develop a more viable and visible total materials research community on the BGU campus.

5b. Technical Staff. The department currently has seven full-time university-supported technical staff members to look after and monitor its research and teaching infrastructure. While this number is probably adequate for the current activities of the DME, potential faculty growth and evolutionary changes that are occurring in materials science and engineering research require a detailed examination of future needs in the area of technical staff, both in the numbers and in the research and teaching areas where technical staff will be needed.

Recommendation:

Long Term (1-3 years):

1. The department should analyze critically and present in a very specific manner its current and future needs for technical staff members to perform effectively its research and teaching agenda.

5c. Administrative Staff. The department currently has the equivalent 1.5 administrative staff members to handle all administrative tasks of the research and teaching activities. This level of support is unquestionably inadequate for a department with a total professional portfolio as extensive as that of the DME.

Recommendation:

Short Term (0-1 year):

The administrative staff of the DME should increase to a level that is determined by a department-based detailed analysis of present and future needs for the research and teaching agendas.

6. Students

Observations and findings for 1st through 4th year students

The Evaluation Committee met with the 1st through 4th year undergraduate students and found them to be intelligent, outgoing, forthright, and articulate with respect to their educational experiences to date. They displayed a high level of *esprit de corps* and shared with committee members that they very much like the DME and that they have excellent rapport with their professors. The Evaluation committee is under the impression that the undergraduate students service courses offered by other departments aren't of the same quality as the ones taught by the DME. It was indicated as well that some of the courses offered by the DME need to be updated.

The level of the chemistry course the undergraduate students in the DME take needs to be improved on a very short time scale. Additionally, the materials engineering students need to take more than one year of chemistry as many industrial firms need materials engineers with a deeper knowledge than is presently being offered to the DME's undergraduate students.

The equipment of the undergraduate laboratories is old and needs to be updated. The space available for the undergraduate laboratories is also inadequate and this implies serious safety issues. The students also expressed the point-of-view that the DME is not well known in the faculty of engineering. Finally, they also stated that they need to work to make ends meet during their undergraduate studies, which appears to be a common problem in Israel.

Recommendations:

Undergraduate Programs:

Short term (0-1 years)

1. The quality of the service courses offered by the physics and mathematics departments to the students of the DME need to be improved in the near future.
2. The materials engineering students need the first course in chemistry to be more focused toward materials concepts and to be taught to them independent of the mechanical engineering students. There are a sufficient number of materials engineering students to justify doing this, which was stated to be 80 per year.
3. The equipment for the undergraduate laboratories needs to be upgraded. Additionally, the space for undergraduate laboratories needs to be increased to solve the serious safety issue problems.

4. The DME needs to make a strong effort in the area of marketing their department within the faculty of engineering and to also do this for different constituencies outside of BGU.
5. The DME needs to address the fact that their students need to work by providing, for example, a tuition waiver, increasing the stipends of excellent students, etc.

Long term (1-3 years)

1. The quality of the service courses offered by other departments to the students of the DME require periodic evaluation to ensure that the student's educational goals, as related to basic disciplines, i.e., chemistry, mathematics and physics, are relevant to their ultimate performance in graduate school or industry.
2. A sustainable system to periodically replace equipment in the undergraduate laboratories needs to be implemented.
3. The DME needs to develop marketing strategies for their department with the faculty of engineering, and evaluate their efficacy.

Until the next cycle of evaluation

1. The DME needs to demonstrate that all the above stated problems have been completely solved.

Observations and findings for M.Sc. students

The Evaluation Committee met with M.Sc. students, all of whom are graduates of Ben Gurion University. They informed the committee that they need a minimum of an 80 grade point average and had to be in the top 50% of their class to enter the M.Sc. program at Ben Gurion University. The Evaluation Committee found them to be intelligent, articulate and forthcoming concerning their opinions, both positive and negative. All students seem to appreciate and enjoy the very friendly atmosphere at Ben Gurion University.

The undergraduate courses need to be updated, which is consistent with what the 1st through 4th year undergraduate students shared with the Evaluation Committee. They all prepared posters for the International Materials Engineering Congress, which is held biennially. This is a very positive point and speaks well for the DME.

There is a problem with office space for M.Sc. students, which are very crowded. Chemistry at the undergraduate level is only covered at a basic level and this situation needs to be improved because of the need for more chemistry in materials engineers working in Israeli industries of all types.

Recommendations:

For M.Sc. students

Short term (0-1 years)

1. There is a pressing need for more space for M.Sc. students.
2. The undergraduate courses need to be upgraded, which is completely consistent with what the 1st through 4th year undergraduate students told us.
3. The teaching of chemistry during the first year needs to be radically improved and additional courses in advanced chemistry need to be added to the course curriculum at the undergraduate level.

Long term (1-3 years)

1. The DME Department needs to implement strategies to periodically evaluate infrastructure and curriculum to ensure that all students are being effectively educated to perform at an appropriate level in industry or graduate school.
2. The efficacies of the above strategies need to be periodically evaluated to ensure that they are achieving appropriate goals and metrics.

Until the next cycle of evaluation:

1. The DME needs to demonstrate that the above stated problems have been completely solved.

Observations and findings for Ph.D. students:

The Ph.D. students the Evaluation Committee met with were very intelligent, mature, articulate and forthcoming in their comments, both positive and negative. They all received their B.S. and M.Sc. degrees from Ben Gurion University in materials engineering. They all have published articles and attended international meetings in addition to attending the International Materials Engineering Congress, which is held biennially in Israel. They stated that 50% of the graduate courses in materials engineering are demanding and that this percentage needs to be increased in a short time frame.

Recommendations:

For Ph.D. students

Short term (0-1 years)

1. There is a pressing need to decrease the fraction of 50% of the graduate courses in materials engineering that are not demanding.

Long term (1-3 years)

1. There is a pressing need to decrease the fraction of 50% of the graduate courses in materials engineering that are not demanding.

Until the next cycle of evaluation

1. The DME needs to prove that the above problem has been solved, ideally before the next cycle of evaluation.

Observations and findings for alumni

The Evaluation Committee notes that the meeting with the alumni was very valuable because they have the advantage of time to obtain a perspective. They were all intelligent, articulate, and forthcoming in addressing what they see as long-term problems with the DME. They stated that the undergraduate students need more courses in chemistry beyond first year chemistry. They also stated that equipment for the undergraduate laboratories is old and needs to be updated. There is a need for more laboratory space because of increased enrollments, for safety reasons, and the need for the students to learn how to use modern and state of the art equipment.

Short term/immediate and long term (0-3 years)

1. There is a pressing need for more courses in chemistry beyond first-year chemistry and they should be taught a chemistry course without mechanical engineering students.
2. There is a pressing need for more laboratory space.
3. The equipment for the undergraduate laboratories needs to be updated, so that the students learn how to use modern state-of-the-art equipment.

Until the next cycle of evaluation

1. The DME needs to prove that the above problems have been solved.

7. Teaching and Learning Outcomes

The DME does not have a formal system for evaluating faculty teaching and student learning other than utilizing a university-based teaching survey and developing an extensive compilation of student grades as qualitative indicators of teaching and learning achievement. However, as a good starting point, the DME has defined five program-level educational objectives and seven learning outcomes. Moreover, intended learning outcomes have been written for nearly all of the undergraduate

courses and have been posted as part of the course syllabi. The course outcomes, typically five to eight in number, appear to be appropriate for coverage of the academic material in each of the courses and if achieved would give a good representation of student achievement. The major difficulty is that the course-level learning outcomes are not individually assessed and evaluated for student achievement and are not fitted into a process that is operating on a well-defined periodic basis. Additionally, the course-level learning outcomes are not mapped on to any of the program-level outcomes as one of the means of assessing and evaluating achievement of the program's outcomes. In summary, the DME has in place some of the elements necessary to measure teaching and learning achievement and produce continuous quality improvement of the program and its curriculum, but the current process is imperfect and lacks the structure and periodicity necessary for the DME to have a genuine "culture of evaluation."

Recommendations:

Short-term (0-1 years)

1. The department should define learning outcomes for all remaining undergraduate courses that do not yet have them. All course learning objectives should then be mapped onto appropriate program learning objectives as a means of evaluating the program outcomes and effecting continuous quality improvement of the program.

Long term (1-3 years)

1. A process of self-review of teaching and learning outcomes must be developed, which evaluates achievements of outcomes on a periodic basis that involves time scales shorter than seven-year CHE reviews.

8. Research

Observation and findings:

The amount of research funding per capita of the DME as an indicator of research quality is among the top of all departments of the faculty of engineering despite the fact that it was conducted under a high teaching load, lack of sufficient lab space, and in some cases missing modern state-of-the-art equipment. The number of articles per capita is high with respect to the area of materials science and engineering with a narrow distribution among the faculty. The research results are published in leading journals of the field, with a broad distribution of their impact factors. In this context it should be taken into account that journals devoted to materials engineering, as compared to ones with an emphasis on materials science have a significantly lower impact factor that does not reflect the quality of the

published articles. The Evaluation Committee appreciates the early involvement of B.S., M.S. and Ph.D. students in the process of preparation and writing of articles.

Recommendations:

Short and intermediate term: (0-3 years)

1. Additional laboratory space for research needs to be provided to the DME,
2. By allocating financial support to the DME. The faculty of engineering should not use the impact factor as a sole criterion as its average value is lower for journals of materials engineering in comparison with journals of the physical and life sciences.

Until the next cycle of evaluation

1. The DME should be supported to sustain its current and potentially very high level of research.

9. Self-Evaluation Process

For the purpose of preparing the self-evaluation document on which this visit has been based, the DME established an excellent process to review and evaluate the research and educational components of its total activities, the related infrastructural topics, and other pertinent elements that are part of the overall picture of what the DME is, has been, and might be in the future. The resulting document is substantial in its content, was easy to read, review and digest, and should serve as a basis for future departmental self-analyses that lead naturally to continuous quality improvement of all DME activities based on periodic and regular efforts. There is no indication, however, in the self-evaluation document that such an ongoing process is in place or will be established as a result of this effort. Rather, there is the hint that the DME will in some way prepare itself to do this type of review again in seven years, instead of shorter incremental reviews that can naturally lead up to the seven-year comprehensive review for Council on Higher Education.

Recommendation:

Short-term recommendation (0-1 years)

The department should establish a self-evaluation process that incorporates internal review of its activities on a regular time scale that is shorter, possibly even annually for some activities, than the seven-year Council on Higher Education reviews.

Chapter4: Summary of Recommendations and Timetable

Short term:

1. Relieve overcrowded teaching laboratories.
2. Increase the departmental administrative manpower to two full-time secretaries. The administrative staff of the DME should increase to a level that is determined by a department-based detailed analysis of present and future needs for the research and teaching agendas.
3. Change the chemistry teaching level by providing a separate, dedicated course in chemistry that meets specifically the needs of materials engineers. The Rector and the Dean have to be involved in this change, because they have to involve the chemistry department to solve this serious problem.
4. Establish a methodology to vet the mission statement with all relevant constituencies: faculty, students, alumni and industry.
5. Study Program- the department should choose or create courses in the graduate program as being mandatory by avoiding specialized and less demanding graduate level courses. This includes a course on chemistry of materials, ideally taught by faculty from Department of Chemistry.
6. Additional rooms should be allocated to the Department of Materials Engineering by BGU or the faculty of engineering with the highest priority concerning rooms for laboratory courses. In this context the outdated equipment of the laboratory courses need to be upgraded.
7. The DME should add to the current number of 12 full-time faculty members, both by immediately replacing the faculty member who is retiring and adding at least one new faculty member in an area of growth in the broad field of materials science and engineering.
8. The quality of the service courses offered by the physics and mathematics departments to the students of the DME need to be rapidly improved
9. The materials engineering students need the first course in chemistry to be more focused toward materials concepts and to be taught to them independent of the mechanical engineering students. There are a sufficient number of materials engineering students to justify doing this, which was stated to be 80 per year.
10. There is a pressing need to decrease the fraction of 50% of the graduate courses in materials engineering that are not demanding.
11. The equipment for the undergraduate laboratories needs to be upgraded. Additionally, the space for undergraduate laboratories needs to be increased to solve the serious safety issue problems.
12. Strong efforts need to be made in the area of marketing their department within the faculty of engineering and to also do this for different constituencies outside of BGU.

13. The DME needs to address the fact that their students need to work by providing, for example, a tuition waiver, increasing the stipends of excellent students, etc.
14. There is a pressing need for more space for M.Sc. students.
15. The undergraduate courses need to be upgraded
16. The department should define learning outcomes for all remaining undergraduate courses that do not yet have them. All course learning objectives should then be mapped onto appropriate program learning objectives as a means of evaluating the program outcomes and effecting continuous quality improvement of the program.
17. The Faculty of Engineering should not use the impact factor as a sole criterion as its average value is lower for journals of materials engineering in comparison with journals of the physical, chemical and life sciences.
18. The department should establish a self-evaluation process that incorporates internal review of its activities on a regular time scale that is shorter, possibly even annually for some activities, than the seven-year Council on Higher Education reviews.

Long term:

1. Expand the space of the teaching laboratories by at least 30%. Expand as well space for research activities.
2. Replace the department's old electron microscopes by new ones and include in this venture a purchase of a top high resolution electron microscope (HREM) for Dr. Louisa Meshi. Having a unique research lab in electron microscopy and structural analyses will elevate the level of the entire department and add to its prestige in terms of high-level research.
3. Strengthen further the close relationship with NRCN to enable an effective exchange of people, to the mutual benefit of both parties.
4. Regularly revise the mission statement as the Materials Engineering Dept. at BGU grows as a teaching and research program and additional students enroll.
5. The DME should probably grow by at least a few additional faculty members to represent adequately itself in the ever-evolving field of materials science and engineering and still cover its growing commitment to quality research and education on the BGU campus.
6. The DME should take the initiative to develop a more viable and visible total materials research community on the BGU campus.
7. The department should analyze critically and present in a very specific manner its current and future needs for technical staff members to perform effectively its research and teaching agenda.
8. The quality of the service courses offered by other departments to the students of the DME needs to be improved: specifically, chemistry, mathematics and physics.

9. The materials engineering students need the first course in chemistry taught to them independent of the mechanical engineering students. There are a sufficient number of materials engineering students to justify doing this, 80 plus each year.
10. The equipment for the undergraduate laboratories needs to be upgraded.
11. The space for undergraduate laboratories needs to be increased to solve the serious safety issue problems.
12. The DME needs to make a strong effort in the area of marketing their department with the faculty of engineering.
13. The DME needs to address the fact that their students need to work by providing, for example, a tuition waiver, increasing the stipends of excellent students, etc.
14. There is a pressing need to decrease the fraction of 50% of the graduate courses in materials engineering that are not demanding.
15. There is a pressing need for more space for M.Sc. students.
16. A process of self-review of teaching and learning outcomes must be developed, which evaluates achievements of outcomes on a periodic basis that involves time scales shorter than seven-year CHE reviews.
17. For the sake of a broad education of students and the needs of Israel's industries the Department of Materials Engineering should maintain its unique feature of providing a broad education in both advanced and classic materials and in structural and functional materials.
18. The DME needs to demonstrate that all the above stated problems have been completely solved.
19. The DME should be supported to sustain its current and potentially very high level of research.

Signed by:



Prof. Enrique J. Lavernia-Chair



Prof. Doron Aurbach



Prof. Ronald Gibala



Prof. Dr. Reiner Kirchheim

S

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

Appendix 2: Site Visit Schedule

Thursday, May 1st 2014

Location: Building 59, 1st Floor, room 120

New time	Subject	Participants
09:00 - 09:45	Opening session with the heads of the institution and the senior staff member appointed to deal with quality assessment	Rector – Prof. Zvi Ha'cohen Chair- Prof. Nahum Frage
09:45-10:15	Meeting with head of Faculty Engineering Science	Dean- Prof. Joseph Kost
10:15-11:00	Meeting with the academic and administrative heads of the Department of Material Engineering	Chair- Prof. Nahum Frage
11:00-11:45	Meeting with senior academic staff (representatives of relevant committees)*	Dr. Louisa Meshi (BS Teaching committee- chair) Dr. Hayun Shemuel (BS Teaching committee) Prof. Eli Agion (Appointment committee & Eng. Projects coordinator) Prof. Guy Makov (Appointment committee) Prof. David Fuks (Graduate teaching committee) Prof. Yuval Golan (Appointment committee) Prof. Roni Shneck Dr. Yaniv Gelbstein
11:45-12:30	Meeting with Junior academic staff * *	Shemuel Samuha (PhD student) Ayala Elkayam (MS student) Maksim Sokol (MS student) Uri Argaman (MS student)
12:30-13:15	Lunch (in the same room)	Closed-door working meeting of the committee
13:15-14:00	Meeting with Adjunct academic staff	Dr. Adi Ben Artsi Prof. Adin Stern Dr. Viktor Weissberg
14:00-14:45	Meeting with BA students**	Hadas Weisz (1st year) Amit Ben-Nun (1st. Y) Yonatan Orr (2nd Y) Yaniv Berntsik (3rd. Y) Maya Parag (4th Y) Oren Pinshow (4th Y)

		David Nahmani (4th Y)
14:45-15:15	Tour of facilities: classrooms, library, offices	Chair
15:15-16:00	Meeting with MA students**	Mahdi Halabi Idan Rosental Yael Shoval Daphna Meidan Ron Aroshas (* all Junior academic staff)
16:00-16:45	Meeting with PhD students**	Asalan Mirayev Itsik Edri Moran Amit* Ravit Bar* (*both Junior academic staff)
16:45-17:30	Meeting with Alumni**	Dr. Malki Pinkas Dr. Itsik Dahan Sasha Makonovitsky Shai Haimson Dr. Shemulik Barzilai
17:30-17:50	Closed-door working meeting of the committee	
17:50-18:15	Summation meeting with head of department	Chair- Prof. Nahum Frage
18:15-18:45	Summation meeting with heads of institution	Rector – Prof. Zvi Ha'cohen Dean- Prof. Joseph Kost

* 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.