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לכבוד  
גבי דניאלה סנדלר  
האגף להערכת איכות והבטחתה  
המועצה להשכלה גבוהה

הנדון: דו"ח הוועדה להערכת איכות הלימודים במדע והנדסה של חומרים  
מכתבך בדוא"ל מיום 20.04.16

בהמשך למכתב הנ"ל, מצ"ב תגובת הפקולטה אודות דו"ח הוועדה להערכת איכות הלימודים במדע והנדסה של חומרים בטכניון.

התגובה מייצגת את עמדת הפקולטה והנהלת הטכניון.

בברכה,

פרופסור דניאל ריטל

לוט.

העתקים: פרופ' מ. סידי, המשנה הבכיר לנשיא  
פרופ' י. רבקיין, דיקן הפקולטה למדע והנדסה של חומרים

**Technion – Israel Institute of Technology**  
**Department of Materials Science and Engineering**

Response to the evaluation report of the Council of Higher  
Education (CHE)

Haifa, 02.08.2016

## **Introduction**

The Evaluation Committee appointed by the CHE visited the Department between 27.4.2014 and 01.05.2014. The evaluation report summarizing the recommendations of the Committee was received by the Department on 21.04.2016. The recommendations of the Committee were discussed during the Faculty Council meeting on 19.05.2016. In what follows, a detailed response is given to all the recommendations listed on pages 19-21 of the Report.

### *Short term:*

1. The MSE Department should revise the mission statement to reflect a leadership role in materials research throughout the Technion.

### **Response:**

The MSE mission statement was discussed during the faculty council meeting on 19.05.2016. The revised mission statement of the Department reads:

*“The mission of the Department of Materials Science & Engineering is to serve as the national center of teaching and research in materials science and engineering, educating world class scientists and engineers, conducting cutting edge research in materials science and engineering, and playing a leadership role in current and future materials-related interdisciplinary activities throughout the Technion”*

2. The MSE Department should establish and implement a methodology to periodically assess the mission statement with all relevant constituencies: faculty, students, alumni and industry.

### **Response:**

The MSE mission statement will be periodically discussed by the Faculty Council meeting (once every two years). The Dean of the Department will be responsible for coordinating the input and feedback from the students, alumni, and industry.

3. Offer courses not taught within more than three years with a higher frequency without increasing the teaching load by, for instance, combining courses of similar content.

**Response:**

The undergraduate studies committee established a sub-committee to re-evaluate and refresh the syllabi of the undergraduate courses and to assess the possibility of combining courses with similar contents. The conclusions of the sub-committee were that combining courses will result in courses with an unreasonably high work load that must be mitigated by assigning a relatively high number of credit points, something that will increase the inhomogeneity of the learning load distribution during the semesters. Therefore, the sub-committee did not recommend combining courses.

The issue was also discussed by the graduate studies committee. It was concluded that combining the courses can be done only at the expense of the academic quality and depth and, therefore, such combinations were not recommended.

At the same time, the committee decided to remove elective undergraduate courses from the Technion catalog: courses that have not been taught for more than six years and courses for which no replacement lecturer could be found when a lecturer retired. The following courses were removed:

- 315022      Plastic deformation of materials;
- 315032      Structural ceramics;
- 315043      Failures in engineering and human errors;
- 315055      Materials for high temperatures;
- 315054      Analysis of failures and their prevention.

4. Offer seminars starting during the second year of the graduate program describing the ongoing research within the Department. It is important to maintain close contact with the

graduate students in the early stages of their studies, in order to develop from the beginning a high level of morale, i.e., *esprit de corps*.

**Response:**

The graduate students of the Department are obliged to attend the Departmental seminars which are held twice a week. The speakers in many of the seminars are the graduate students themselves, summarizing the results of their graduate studies and, therefore, the Departmental seminars provide a comprehensive overview of the ongoing research in the Department. The seminar attendance is recorded, and in the case of poor attendance, the Dean issues a formal reminder that seminar attendance is obligatory. In light of the report recommendations, post-doctoral students and faculty members returning from sabbatical will be strongly encouraged to present a seminar. This will help provide a more balanced picture of the Departmental research landscape to the graduate students.

5. Evaluate the content of courses in physics and mathematics within the undergraduate program regarding the requirements for the graduate program of the Department.

**Response:**

All undergraduate programs of the Department are “tailored” in such a way that the contents of the basic courses in physics and mathematics taught during the first three semesters anticipate the needs of the materials-related courses taught in the higher semesters and in the graduate program.

6. The Department and the institution should benchmark the research output of faculty members relative to their specific areas and sub-areas of the field of MSE. The number of publications by faculty should be continuously assessed paying particular attention to the balance between number of publications and their quality.

**Response:**

The Department Dean is continuously monitoring the professional achievements of the faculty members at the rank of Assistant and Associate Professors. The Dean holds

annual meeting with these faculty members, assesses their research achievements, and advises them on the optimal advancement strategy.

7. The Department should speed up the rate at which faculty are brought up for promotions, consistent of course with appropriate evaluation of faculty achievement.

**Response:**

The Departmental preparatory committee and the Department Dean set the promotion of the faculty members as one of their primary priorities. At the same time, the final decisions on faculty promotions are made on the Technion level by the appropriate Senate committees. During recent years these committees have exercised a somewhat conservative approach to faculty promotions. Inevitably, this approach by the Senate committees must be taken into account by the Departmental preparatory committee, in order to avoid the damage associated with Technion-level rejection of promotions submitted by the Department.

8. Applied mathematicians as opposed to pure mathematicians should teach the mathematics courses because they have a better understanding of the needs of students who become engineers working in industry, students working in research laboratories, and students becoming academicians at universities or research institutes. This is a problem that needs to be addressed by the dean of undergraduate studies. The quality of the teaching of the physics courses also needs to be seriously and vigorously addressed by the dean of undergraduate studies.

**Response:**

The Department has little influence over the choice of lecturers of the basic mathematics and physics courses taught by the respective Departments. As it is stated in the Report, this is a general Technion problem and as such it should be addressed by the Dean of undergraduate studies.

9. The problem of the *esprit de corps* of the undergraduate students needs to be examined immediately, commencing with first year students, with the goal of involving them in the minds and hearts of the faculty.

**Response:**

The Department has set as its highest priority the developing of the *esprit de corps* of the undergraduate students. The following measures have been implemented in this respect:

i. The Department has established a series of lectures for the undergraduate students entitled “The Science Club”. Three to four such lectures are given during each semester by faculty members and by guests invited from industry. The lecturers present, in a popular and entertaining manner, their Materials Science and Engineering research fields in general and their main research achievements. The lectures are held at 19:30 and then, following the lectures, the Department treats them to beer and pizza . All the faculty members are encouraged to attend these lectures and to mingle with the students afterwards. The lectures were highly successful, with more than 100 undergraduates for each lecture (the Departmental auditorium was fully packed).

ii. The Department lends its full logistic and financial support to the yearly barbeque party that the Department's undergraduate students organize each spring (“Materials on the grill”). Pictures taken during the party are posted on the Departmental home page. The faculty members and the graduate students are encouraged to attend the party and to mingle with the undergraduates.

10. The list of 51 graduate courses, Table 8 on page 23 in the SER, needs to be reexamined with the aim of serious consolidation, so that the M.Sc. and Ph.D. students are satisfied with the courses offered by the Department of Materials Science and Engineering. The committee thinks that a number of the courses can be consolidated with the aim of offering their subject matter more frequently; for example, combine *Dielectric Materials* with *Ferroelectric Materials*, combine *Polymer Blends*, *Polymer Surfaces*, and *Polymeric Materials* into one course, combine *Structure and Compositions of Interfaces* and *Structure of Interfaces*, etc.

**Response:**

The graduate studies committee has performed a thorough revision of all graduate courses and removed from the catalog the courses that have not been taught for more than six years. The committee has also discussed the possibility of course consolidation. The majority opinion was against such consolidations for the following reasons:

i. The traditional format of the graduate courses taught in the Department is two frontal class hours per week (2 credit points). The consolidation of courses, performed without compromising the academic depth or breadth, will result in higher workload courses of at least three frontal hours per week. This will create a problem of heterogeneity in the graduate core curriculum.

ii. Consolidating the courses will, in fact, reduce the number of different graduate courses offered by the Department. Taking into account that, on average, M.Sc. and Ph.D. studies in the Department take 2.5 and 4.5 years, respectively, offering consolidated courses more frequently will result in decreased attendance.

iii. Concerning the courses explicitly mentioned in the Report:

-*Dielectric Materials* and *Ferroelectric Materials*: these courses treat two different types of materials and the overlap between them is minimal;

- *Polymer Blends*, *Polymer Surfaces*, and *Polymeric Materials*: these courses are very different in their contents. *Polymer Blends* treats bulk polymers (blends and block copolymer) and their engineering application; *Polymer Surfaces* treats surface and interfacial phenomena in polymers; *Polymeric Materials* mainly treats crystalline polymers and phase transformations in polymeric materials. There is no overlap between the courses.

- *Structure and Compositions of Interfaces* and *Structure of Interfaces*: the courses mentioned in the Report probably correspond to the following courses:

318320          Thermodynamics and kinetics of interfaces,

and

318630          Structure of interfaces.



These are two very different courses. *Thermodynamics and kinetics of interfaces* is focused on a phenomenological description of interfaces, interface thermodynamics, and the kinetic properties of interfaces (diffusion, migration). *Structure of interfaces* is focused on the atomistic models of interface structure and experimental methods of high-resolution characterization of interface structure. These are two complementary courses with minimal overlap.

11. The dropout rate in the materials/physics program is unacceptably high and needs to be addressed immediately. In 2013 it was 10.1% out of the 89 students registered for this program.

12. The dropout rate in materials/chemistry program is smaller than in the materials/physics program, but nevertheless it needs to be addressed; in 2013 it was seven students (4%).

**Response:**

The Department has adopted a serious approach to fighting high dropout rates. The Department has implemented a policy of gradually increasing the threshold score required for acceptance to the Departmental undergraduate programs. For example, in the academic year 2015-16 the threshold was 85 (compared to 82-83 in the past), while during the current registration cycle (academic year 2016-17) it was raised to 86. This has led to a certain decrease in enrollment (50, as compared to the peak enrollment of 70), yet the Department is confident that the average academic level of the new students is higher, and thus the dropout rates will decrease.

At the same time, the challenging character of the Departmental joint programs (materials/physics, materials/chemistry and materials/biology) that combine engineering with high-level physics/mathematics/chemistry may be partly responsible for the high dropout rates. In this respect, the newly opened Departmental undergraduate program in Materials Engineering may appeal to those candidates who otherwise would find the joint programs too esoteric. During the current registration cycle (2016-17) the threshold score for this program was set at 84, two points below the scores for the joint programs with Physics, Chemistry, or Biology. We believe that increasing the choice of

undergraduate programs available by opening an independent program in Materials Engineering will also contribute to a decrease in the dropout rates.

13. With respect to number of publications and quality of related journals, it will be helpful for a further increase of the national and international visibility and high reputation of the Department by defining bench marks for maintaining and increasing the performance of the faculty. These bench marks have to take into account the large differences existing in the various disciplines of materials science, i.e. physics-, chemistry-, biology- and engineering-based fields. As a helpful measure of excellence the bench marks may be also used to accelerate promotion of faculty besides other measures like the performance in teaching and administration.

**Response:**

The Dean of the Department analyzes the publication pattern of the faculty members at the rank of Assistant and Associate Professors during his regular yearly career advancement meetings. The Department is blessed with dynamic and ambitious young faculty members striving to publish their research results in the international journals of highest quality and impact factor. Yet we believe that setting the numerical benchmarks (even adjusted to the respective fields) would be rather counter-productive. In many cases, publishing a paper in a timely manner is more important than the impact factor of the journal. The excessive attempts to publish in the high-impact journals result in unnecessary delays in publication and can impede the career advancement of the faculty and graduate students.

14. The department should require that all course syllabi contain a full complement of specific learning objectives that are measured, assessed, and evaluated by the faculty member in charge.

**Response:**

The learning objectives and outcomes are now available for all undergraduate courses taught in the Department. This recommendation of the CHE Evaluation Committee has been implemented fully.

*Long term:*

1. Renovate some of the teaching and research laboratories.

**Response:**

Renovation of research laboratories and their re-design according to the new safety standards is associated with costs that Department cannot bear alone. The Department has adopted a gradual approach in which the renovation and re-design of old research laboratories is tied to faculty retirement and the hiring of new faculty members. The renovation of the respective labs is then a part of the Technion budget allocated to building a new laboratory for a new faculty member. The most recent example is the Laboratory of Pharmaceutical Nanomaterial Science of Assoc. Prof. Alejandro Sosnik, which was established in place of the Laboratory of Polymer Materials when Prof. Arnon Siegmann retired. This laboratory, and the adjacent and research area-related Laboratory of Macromolecular Materials (Prof. Michael Silverstein) were treated as a single laboratory space and their renovation was supported by the budget provided by the Technion administration. In another case, the renovation of the laboratory space was made possible due to a large private donation (Laboratory of Battery Materials of Prof. Yair Ein-Eli).

At the same time, the Department considers as its highest priority the maintenance and renovation of the students teaching laboratory for advanced materials. The Department has hired a new laboratory supervisor (who started on 01.01.2016) who is in the process of updating the experiments and upgrading the laboratory equipment.

2. Be aware of the need to replace equipment, such as electron optical instrumentation.

**Response:**

This recommendation of the CHE Evaluation Committee is now fully implemented. The following upgrades were made, or are in the process of implementation, in the Departmental microscopy laboratory:

- i. The aged metallurgical optical microscope was replaced with a new one, including the newest software which allows an increased depth of focus through the acquisition of several images at different focal distances and their subsequent integration.
- ii. The high-resolution scanning electron microscope was upgraded with a new Nanoindenter (allowing the in-situ nanomechanical testing of materials) and the EBSD-TKD system allowing the acquisition of the orientation maps of the polycrystalline materials, also in the transmission mode. This upgrade became possible thanks to the support of one of the faculty members, and the funds obtained by the Department in the framework of the Guangdong-Technion project (see the response to recommendation No. 3 below).
- iii. The aberration-corrected transmission electron microscope (FEI TITAN) will be replaced at the end of this year with the newest, double aberration corrected model (TITAN Themis). This project was implemented in cooperation with the Technion's Russell Berry Nanotechnology Institute.

3. Consider recruiting more research staff to support properly the research laboratories and major analytical equipment.

**Response:**

The Department has joined the Guangdong-Technion program and has committed itself to support the establishing of Materials Engineering program in the newly established GTIIT University in Shantou, Guangdong province, PRC. In the framework of this initiative, the Department has obtained a generous enhancement package from the Technion administration. The package includes one full-time technician position starting in October 2017. It is the intention of the Department to hire an engineer (with a PhD

degree in Materials Engineering or in a related field) to support the Departmental microscopy laboratory.

4. The MSE Department should convene an Advisory Committee and include members from national and international peer institutions, alumni, industry and government.

**Response:**

The Department had an Advisory Board in the past but changes in personnel during the years made it unworkable. Re-establishing such an Advisory Board is now being considered.

5. The MSE Department should implement regular reviews of the mission statement and engage all constituencies in the process.

**Response:**

This recommendation of the CHE Evaluation Committee is now fully implemented (see responses to the *short-term* recommendations No 1 and 2).

6. Regarding the proposed additional program in materials engineering the Department may consider establishing and strengthening four programs of study: (1) materials science and physics; (2) materials science and chemistry; (3) materials science and biology; and (4) materials science and engineering.

**Response:**

This recommendation of the CHE Evaluation Committee is now fully implemented. The three existing programs of study (materials/physics, materials/chemistry, and materials/biology) has been strengthened by an increase in the threshold acceptance score, and by considering the teaching needs of these programs during hiring of new faculty members. The Department has developed a new, independent program in

Materials Engineering which was recently approved by the CHE and was opened for registration in the academic year 2016-17.

7. The institution should allow growth of the MSE department to above 20 faculty members for the Department to remain competitive with its international counterparts.

**Response:**

This recommendation of the CHE Evaluation Committee is partially implemented. The maximum number of faculty positions has been increased by two, from 17 to 19. The addition of two faculty positions is part of the Departmental GTIIT enhancement package (see the response to recommendation No. 3 above). Currently, there are 14 active faculty in the Department, and the Departmental preparatory committee headed by the Dean is actively working on identifying and attracting new promising faculty candidates.

8. The institution, with substantial input from the MSE Department, should nurture the formation of a more interactive materials research community through establishment of interdisciplinary research programs and centers that are primarily initiated through collaborative research efforts established by the Technion faculty.

**Response:**

More than half of the Departmental faculty are involved in two important interdisciplinary research programs, one in nanotechnology (Russell Berry Nanotechnology Institute) and the other in energy (Grand Technion Energy Program).

9. The MSE department must take the lead in determining and defining the additional Ph.D. level staff needed to maintain the Technion at the forefront of advanced materials research. The institution must supply the funds to support these positions.

**Response:**

See the response to the *long-term* recommendation No. 3. In addition to staffing of the Departmental central laboratories (microscopy, X-ray, and physical measurements), the

Department is in sore need of additional PhD-level staff to support the research activities of the individual faculty members. The fact that the other Departments at the Technion and at other Israeli Universities provide half a technician position to their faculty members seriously reduces the competitive edge of the Department in hiring excellent new faculty candidates. In view that the Departmental central laboratories serve the whole Technion campus, the Department urges the Technion administration to supply the funds for additional Ph.D.-level staff positions to support the research of individual faculty members.

10. Applied mathematicians, as opposed to pure mathematicians, should teach the mathematics courses because they have a better understanding of the needs of students who will become engineers working in industry, students working in research laboratories, and students becoming academicians at universities or research institutes. This is a problem that needs to be seriously and vigorously addressed by the dean of undergraduate studies.

11. The quality of the teaching of the physics courses also needs to be seriously and vigorously addressed by the dean of undergraduate studies.

**Response:**

See the response to the *short-term* recommendation No. 8.

12. The problem of the *esprit de corps* of the undergraduate students needs to be continuously addressed, commencing with first-year students, with the goal of involving them in the minds and hearts of the faculty. This should ideally increase the retention rate of undergraduate students to 100%.

**Response:**

See the response to the *short-term* recommendation No. 9.

13. There is always room for improvement, but for the evaluated Department it could already be considered to be a great success, if it maintains its present high level of research.

**Response:**

The Department thanks the CHE Evaluation Committee for evaluating its current level of research as high-level. The Department is vigorously working not only to maintain but to significantly improve this level through improvements in the quality of teaching and research, and by hiring of talented and promising new faculty members in the most cutting-edge research areas of Materials Science and Engineering (2D materials, biological materials, mechanics of materials).

14. The Department should develop a process that incorporates achieved course-level learning outcomes into the evaluation of the department-level outcome (or possibly outcomes) and that can demonstrate evidence of continuous quality improvement of the undergraduate and MSc program. At the same time, the administration of the Institute should hasten its current efforts and plans to more effectively incorporate use of learning outcomes in the broader education process at the Technion.

**Response:**

The Dean of the Department is continuously monitoring the learning outcomes of all undergraduate courses and approves the final grades of all courses. The Dean is also working with the faculty members and adjuncts who are getting low grades in the student evaluations of the lecturer performance, and seeks an individual approach in each particular case.