SCHOOL OF MECHANICAL ENGINEERING
TEL AVIV UNIVERSITY

EVALUATION REPORT

COMMITTEE FOR THE EVALUATION OF MECHANICAL ENGINEERING STUDY PROGRAMS IN ISRAEL

JUNE 25, 2018

Section 1: Background and Procedures

1.1 In the academic year 2017-18 the Council for Higher Education [CHE] put in place arrangements for the evaluation of study programs in the field of Mechanical Engineering [ME] in Israel.

1.2 The Higher Education Institutions [HEIs] participating in the evaluation process were:

- Afeka Academic College of Engineering
- Ariel University
- Ben-Gurion University
- Ort Braude Academic College of Engineering
- Shamoon Academic College of Engineering
- Technion – Israel Institute of Technology
- Tel Aviv University

1.3 To undertake the evaluation, the Vice Chair of the CHE appointed a Committee consisting of:[1]

• Prof. David Norris, Committee Chair	ETH Zurich, Switzerland
• Prof. Leslie Banks-Sills	Tel Aviv University, Israel
• Prof. Patricia Brackin	Rose-Hulman Institute of Technology, USA (ABET representative)
• Prof. David Clarke	Harvard, USA
• Prof. Kon-Well Wang	University of Michigan, USA
• Prof. William Wepfer	Georgia Tech, USA

Ms. Maria Levinson-Or served as the Coordinator of the Committee on behalf of the CHE.

1.4 The evaluation process was conducted in accordance with the CHE's Guidelines for Self-Evaluation (June 2017). Within this framework the evaluation committee was required to:

- examine the self-evaluation reports submitted by the institutions that provide study programs in ME
- conduct on-site visits at those institutions participating in the evaluation process
- submit to the CHE an individual report on each of the academic units and study programs participating in the evaluation
- set out the Committee's findings and recommendations for each study program
- submit to the CHE a general report regarding the evaluated field of study within the Israeli system of higher education including recommendations for standards in the evaluated field of study

[1]The committee's letter of appointment is attached as **Appendix 1**.

1.5 The evaluation committee examined only the evidence provided by each participating institution — considering this alongside the distinctive mission set out by each institution in terms of its own aims and objectives. This material was further elaborated and explained in discussions with senior management, lecturers, students and alumnae during the course of each one-day visit to each of the institutions.[2]

1.6 This report deals with the Mechanical Engineering School at Tel Aviv University. The Committee's visit to Tel Aviv University took place on June 12th, 2018. The schedule of the visit is attached as Appendix 2.

1.7 The committee thanks the management of Tel Aviv University and the School of Mechanical Engineering for their self-evaluation report and their hospitality towards the committee during its visit to the university.

1.8 N.B. this report will use Faculty, with a capitalized first letter to refer to the Faculty of Engineering and will use faculty with the first letter not capitalized to denote professors and lecturers collectively. This report will use Committee, with a capitalized first letter to refer to the international evaluation committee conducting this review.

Section 2: Executive Summary

The management, administration, QA process, study program, faculty, research, and students of this program met the acceptable threshold level of performance. Its vision, teaching, and infrastructure did not. In particular, the lack of a clear and detailed strategic plan is preventing the program from reaching its full potential. If such a plan were combined with a strong advocate, further resources could likely be gained to enhance ME at Tel Aviv University. The program should also adapt more innovative teaching methodologies and develop a better understanding of its overall learning objectives.

Section 3: Observations

3.1 Introduction

Tel Aviv University (TAU) is a research university with approximately 4200 students in 5 engineering units. The School of Mechanical Engineering educates ~780 students for Israeli industry and academia. It is well integrated and supported by the central administration at TAU. The Committee was confident that the School is capable of sustaining and enhancing the ME program.

[2]Prof. Leslie Banks-Sills did not participate in the visit to Tel-Aviv University or in the panel's discussions concerning the evaluation of this institution to avoid potential conflicts of interest.

3.2 Management and Administration

The senior leadership of TAU appears supportive of the School of Mechanical Engineering. The Rector and Dean expressed enthusiasm for enhancing ME. However, the standard two year term of service of the Head of the School may be too short to sustain effective leadership. The next Head will need to aggressively address some of the issues identified in this report and harness the strong support from the Faculty and the University to advance the School.

The Committee was unable to discern the true extent to which the School has autonomy in decision-making and budget allocation. It appeared that the School's faculty is collegial and that untenured faculty members have some input, but increased faculty involvement in decision making would be helpful. Three female full professors have recently retired, which has led to a decrease in gender diversity at senior ranks, but hiring efforts to address this are ongoing.

In this area of evaluation, the Committee determined that TAU meets the acceptable threshold level of performance.

3.3 Vision

The Committee heard various opinions concerning faculty governance and strategic planning. The School has a generic strategic plan with minimal specifics for growth in research as well as in the undergraduate specialization tracks. The Committee recommends that the faculty develop more detailed implementation plans. This may strengthen future requests for additional faculty positions. The School should embrace change if necessary to adapt to developing trends in modern ME.

In this area of evaluation, the Committee determined that TAU does not meet the acceptable threshold level of performance.

3.4 QA & Self-Evaluation Process

The Committee concluded that the School took the review process seriously and made significant improvements after the last review. The School took ownership of this self-study and review process, involving faculty at all levels. However, the School did not appear to have continuous internal self-evaluation mechanisms and activities. The Committee believes such efforts should be pursued regularly with all stakeholders involved via faculty retreats/meetings. The faculty can then continue to assess progress and help advance the School.

In this area of evaluation, the committee determined that TAU meets the acceptable threshold level of performance.

3.5 Study Program

Overall, the ME program provides excellent and rigorous academic preparation for students to work in industry or pursue graduate studies. In response to the

previous report, the curriculum was expanded, increasing from two to eight tracks. While the rationale for this expansion was not described, many of the new tracks are consistent with recent emerging trends in ME, *e.g.* in microsystems and optical engineering. During the same period, Materials Science and Engineering (MSE) became a separate department. Thus, courses in materials are now taught to ME students by the MSE Department.

Despite these changes, a distinct gap remains in the curriculum in robotics. This is of concern at both the undergraduate and graduate level as this topic is becoming increasingly important. The Committee was told, but could not verify, that a proposed joint hire in robotics with Electrical Engineering was rebuffed.

In this area of evaluation, the committee determined that TAU meets the acceptable threshold level of performance.

3.6 Teaching and Learning

A strategic goal at TAU is to develop and implement innovative teaching and learning methodologies. In this context, the teaching within mechanical engineering is adequate. The main tool for evaluating teaching is a student survey conducted at the end of each course. Awards are given to faculty who receive excellent evaluations and a list of "100 outstanding teachers" is maintained. Faculty with low evaluations can receive help from the Center for the Advancement of Teaching. The Committee was told that faculty who are considered poor teachers will not receive tenure.

Although students receive a syllabus that lists topics covered in the course, the content of most syllabi examined was minimal. The intended learning outcomes (ILOs) were not included. The usefulness of the syllabi was limited. The School does not have an overall picture of what their students can do at graduation, and the program does not show how the curriculum builds to support the ILOs.

The Committee encourages the faculty to consider techniques such as problem-based learning, active learning, or "flipped-classrooms" to enhance the student experience. Particular attention can be given to techniques that lower faculty members' effort over time. The final project is satisfactory. Many students report significant learning through working on their project.

In this area of evaluation, the Committee determined that TAU does not meet the acceptable threshold level of performance.

3.7 Faculty

The Committee believes that the School has too few faculty. This results in a high student-to-faculty ratio and limits growth in strategic research directions that lack critical mass. TAU and the School wish to hire "stars" in specific areas (such as robotics and artificial intelligence). The faculty are consulted in hiring

discussions. However, the School needs a strong vision and strategic plan to exploit resources available from the Rector and Dean.

The Faculty has developed, documented, and disseminated helpful guidelines on promotion and tenure. The Committee encourages the School to focus performance assessments on quality and impact and less on "numbers". In general, the faculty appeared very supportive of new hires. The School assigns one mentor to each young faculty member. However, the School should consider a more structured mentoring program with more mentors per faculty and the possibility of switching to ensure a good fit. Overall, the climate among the faculty is good and adjunct faculty enjoyed working at the School.

In this area of evaluation, the committee determined that TAU meets the acceptable threshold level of performance.

3.8 Research

Research in the School is diverse. Some new emerging topics (*e.g.* robotics and controls, and micro-/nano- systems) were pursued, as suggested during the last review. The Committee was pleased that some newer areas in mechanics, such as cell mechanics, are also now included. However, due to a recent tenure decision, research in robotics and control is sub-critical.

It appears that the School's research funding and outcomes are satisfactory. Research collaborations are established within binational and multinational programs, with quite a few grants related to international collaboration. Faculty collaborate and publish with foreign peers. However, more international collaborations should be pursued to enhance the School's reputation.

In this area of evaluation, the committee determined that TAU meets the acceptable threshold level of performance.

3.9 Students

The School reports a drop-out rate of 20-30% at the undergraduate level. Every student who drops out is interviewed. Causes of the high drop-out rate include:

- 1st year students do not understand what mechanical engineering is and the effort required to succeed.
- Many students work during their studies despite warnings from the School.
- Math preparation in high schools varies in rigor and depth.

Students take the initiative to obtain jobs during their 3rd and 4th years of study. As a result, students do not have problems getting jobs at graduation. They are well trained and can pursue industry or graduate studies. However, the connection between the School and the alumni could be enhanced.

In this area of evaluation, the committee determined that TAU meets the acceptable threshold level of performance.

3.10 Infrastructure

In general, the available high-quality space is insufficient. Once Electrical Engineering moves to their new building, additional space will be available for ME. However, a plan for future space allocations is needed, or at least better communicated. Much of the space seen by the Committee needed renovation.

In this area of evaluation, the Committee determined that TAU does not meet the acceptable threshold level of performance.

Section 4: Recommendations

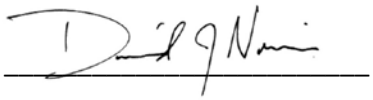
Important recommendations:

- Involve the entire faculty of the School to develop a clear and detailed strategic plan that can be used to enhance research and teaching.
- Communicate this plan to the central administration at TAU and advocate for high-quality growth in the appropriate research fields.
- Develop and implement innovative teaching and learning methodologies.
- Develop a better overall picture of what TAU ME students can do at graduation, and how the ME curriculum builds to support its intended learning outcomes (ILOs).
- Add a more structured faculty mentoring program.
- Determine if changes in admissions or student supervision are required to improve the undergraduate drop-out rate.

Desirable recommendations:

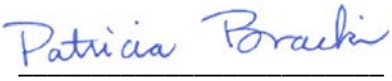
- Consider implementing a periodic internal self-evaluation process.
- Consider enhancing its connection to its alumni.

Signed By:

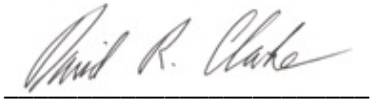


Prof. David Norris

Committee Chair

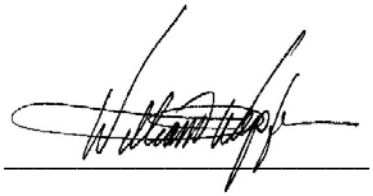


Prof. Patricia (Patsy) Brackin



Prof. David Clarke

Prof. Kon-Well Wang



Prof. William Wepfer

Appendix 1: Letter of Appointment

January 2018

Prof. David Norris
Department of Mechanical and Process Engineering
ETH Zurich
Switzerland

Dear Professor,

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 by accepting our invitation to participate in our international evaluation committees. 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 chair of the Council for Higher Education's Committee for the Evaluation of the study programs in **Mechanical Engineering**. In addition to yourself, the composition of the Committee will be as follows: Prof. Leslie Banks Sills, prof. Patricia Brackin, prof. David Clarke, prof. Kon-Well Wang and prof. William Wepfer.

Ms. Maria Levinson-Or 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 chair of this most important committee.

Sincerely,

Prof. Ido Perlamn
Vice Chair,
The Council for Higher Education (CHE)

Enclosures: Appendix to the Appointment Letter of Evaluation Committees

cc: Dr. Varda Ben-Shaul, Deputy Director-General for QA, CHE
Ms. Maria Levinson-Or, Committee Coordinator

Appendix 2: Visit Schedule

Mechanical Engineering - Schedule of site visit Tel-Aviv University Tuesday, June 12 ,2018		
09:00-09:30	Opening session with the head of the institution	Prof. Yaron Oz – Rector, Prof. Eyal Zisser, Prof. David Horn, Head of QA
09:30-10:00	Meeting with the Dean of the Engineering	Prof. Yossi Rosenwaks
10:00-11:00	Meeting with the Head of the School of ME	Prof. Slava Krylov
11:00-11:15	**Break**	**Closed-door meeting of the committee**
11:15-12:00	Meeting with senior academic staff – tenured and non-tenured	Prof. Alex Liberzon, Prof. Yoram Reich, Prof. Alex Gelfgat, Prof. Rami Haj-Ali, Prof. Avi Kribus, Prof. Yair Shokef, Dr. Ayelet Lesman, Dr. Yaron Toledo.
12:00-12:45	Meeting with Adjunct academic staff	Ms. Alla Markman-Zamir, Mr. Moshe Attar, Dr. Yaacov Barnea, Dr. Eddy Leibovich, Dr. Gideon Goldwine
12:45-13:30	**Lunch (in the same room)**	**Closed-door meeting of the committee**
13:30-14:45	Tour of facilities: Labs, Library + Final projects presentation	Projects / Posters presentation Research labs : Solar energy lab (Wolfson 208), Bio-Mechanics lab (Wolfson 359), Turbulence structure lab (near auditorium 020), Mechanics of composite materials lab (Wolfson 273), Microsystems design lab (Wolfson 349 B), Marine Eng. & Physics lab (Wolfson 363). Teaching lab : Solid Mechanics lab (Wolfson 366
14:45-15:30	Meeting with BSc students **	
15:30-16:15	Meeting with MSc and PhD students**	
16:15-17:00	Meeting with Alumni **	
17:00-17:15	**Break**	**Closed-door meeting of the committee**
17:15-17:45	Closing meeting with heads of institution, Dean of the Faculty and the Head of the School of ME	Prof. Yaron Oz, Prof. Eyal Zisser, Prof. Yossi Rosenwaks, Prof. David Horn

* 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.