

FINAL ASSESSMENT REPORT

Institutional Quality Assurance Program (IQAP) Review

Power and Energy Engineering Technology

Date of Review: May 18 - 19, 2021

In accordance with the University Institutional Quality Assurance Process (IQAP), this final assessment report provides a synthesis of the external evaluation and the internal response and assessments of the Bachelor of Technology (B.Tech) Power and Energy Engineering Technology Program. This report identifies the significant strengths of the program, together with opportunities for program improvement and enhancement, and it sets out and prioritizes the recommendations that have been selected for implementation.

The report includes an Implementation Plan that identifies who will be responsible for approving the recommendations set out in the Final Assessment Report; who will be responsible for providing any resources entailed by those recommendations; any changes in organization, policy or governance that will be necessary to meet the recommendations and who will be responsible for acting on those recommendations; and timelines for acting on and monitoring the implementation of those recommendations.

Executive Summary of the Review

In accordance with the Institutional Quality Assurance Process (IQAP), the W Booth School of Engineering Practice and Technology submitted a self-study in April 2021 to the Vice-Provost Faculty to initiate the cyclical program review of the B.Tech. Power and Energy Engineering Technology Completion Program. The approved self-study presented program descriptions, learning outcomes, and analyses of data provided by the Office of Institutional Research and Analysis. Appendices to the self-study contained the CVs for each full-time member in the department.

Two arm's length external reviewers and one internal reviewer were endorsed by the Faculty Dean, W Booth School of Engineering Practice and Technology, and selected by the Vice-Provost Faculty. The review team reviewed the self-study documentation and then conducted a review on May 18-19, 2021. The review included interviews with the Provost and Vice-President (Academic), Faculty Dean, Vice-Provost Faculty, Associate Dean Academic, Program Chair of the B.Tech. Power and Energy Engineering Technology Program within the W Booth School of Engineering Practice and Technology and meetings with groups of current students, full-time faculty and support staff.

The Program Chair of the B.Tech. Power and Energy Engineering Technology Program and the Dean of the Engineering submitted responses to the Reviewers' Report (September 2021 and April 2022, accordingly). Specific recommendations were discussed and clarifications and corrections were presented. Follow-up actions and timelines were included.

The program offered is highly successful and has gained a strong following amongst students. Most students are part-time and their engagement is limited to the program and they do not generally participate in campus/university affairs. This program is primarily a professional teaching and learning type, with a focus on applied and experiential learning.

The admission requirements are highly commendable and can attract highly qualified individuals who conscientiously choose the B.Tech. stream as opposed to the B.Eng. stream.

The 3-hour long lecture periods were questioned as being too long, as the practical individual retention periods are normally shorter. However, the students preferred fewer, but longer class periods instead of more-shorter but more-often classes; this was a concern due to travel times to campus that students had to adhere to. Post COVID, it appears, online classes will be preferred by students.

The reviewers felt that the DCP ENERTECH course map should be forward-looking rather than backward-looking, and topics/subjects that were traditionally accepted in the past should be looked at in a new perspective.

The reviewers felt that there is a need to diversify the faculty and provide an extra full-time support faculty member. The heavy reliance on sessional lecturers may have some continuity and program quality concerns.

The governance system used to assess the program and implement changes appears consultative and inclusive.

The support of academic services appeared adequate. Due the amalgamation of McMaster and Mohawk activities, the scheduling concerns may need some verification.

The following program strengths were identified:

- The program offered is highly successful and has gained a strong following amongst students.
- Instructors are experienced and connected with local community and provide a high-quality teaching environment.

The following areas of improvement were suggested:

- The course map should be forward-looking rather than backward-looking, and topics/subjects that were traditionally accepted in the past should now be looked at in a new perspective.
- Diversify the faculty and provide an extra full-time support faculty member.
- Improve on-campus student engagement.

More specific areas program enhancement described in the report are directly reflected in the recommendations, discussed below.

Implementation Plan

Recommendation	Proposed Follow-Up	Responsibility for Leading Follow-Up	Timeline for Addressing Recommendation
<p>It is recommended to develop a stronger and sustainable post-program interaction for students of the program.</p>	<p>Conduct a survey of current and former ENRTECH students to determine the kind of post-program interaction that the students would like to see.</p>	<p>Program Chair will investigate whether ENRTECH graduates will benefit from post-program activities including but not limited to:</p> <ol style="list-style-type: none"> 1. Helping with senior projects 2. Sharing of industry experience 3. Attending tutorials in preparation for PEO exams 4. Attending mini-courses on advanced power systems engineering. 	<p>Preliminary investigation completed by August of 2022.</p> <p>Recommendations ready by January of 2023.</p> <p>Implementation begins in September of 2023.</p>
<p>The course on “Power Systems and Electrical Machines” should be changed to deal with “Electromagnetics and Electrical Machines”. This is more logical since there is a heavy reliance on fundamental knowledge of electromagnetics for application in electrical machines. Since this impacts the Level 4 course on Power Transmission, this should be jointly considered with that course.</p>	<p>Review the course contents of ENRTECH 3EP3 “Power Systems and Electrical Machines” _and ENRTECH 4EM3 “Transmission Lines and Electromagnetics” _and identify whether it is beneficial to redistribute the contents of these two courses.</p>	<p>Program Chair will meet with course instructors to discuss pros and cons of the reviewers’ recommendation.</p>	<p>Preliminary study completed by August 2022.</p>

<p>Remove the course on “Mechanics of Fluids”. However, this may have negative implications on PEO accreditation. In that case, it could be merged with the course on Thermodynamics. But, this will free up one core course slot, to be replaced as a new core course on “Programming for Power Engineers.” This new course will also introduce software programming skills using Matlab, and other softwares like emtp-rv, to students who have expressed a desire for this.</p>	<p>Determine whether it is beneficial to retail ENGTECH 4TF3 “Mechanics of Fluids” as a technical elective and offer a new technical elective on computer applications in power engineering.</p>	<p>Program Chair will discuss with current and former ENRTECH students to consult their opinions.</p>	<p>Recommendation ready by August of 2022.</p> <p>Implementation by September of 2023.</p>
<p>Industrial Electronics should cover more general power electronics topics. A rationalization of some course content may be needed.</p>	<p>Review the course contents of ENRTECH 3IE3 “Industrial Electronics” to identify what contents can be modified and changed.</p>	<p>Program Chair will discuss with course instructor and Program Advisory Committee members on how to modify this course and perhaps rename it as “Power Electronics”.</p>	<p>Recommendation ready by August of 2022.</p> <p>Implementation will start in September of 2023.</p>
<p>Mathematics plays a key role in understanding concepts/fundamentals of electrical and power engineering. The two courses on mathematics should be re-named “Introduction to Mathematics” and “Advanced Mathematics.” Some course content may need to be re-examined.</p>	<p>Look into the benefits of renaming “Mathematics V” to something else.</p> <p>Review the course contents of Advanced Math to see if some contents can be changed.</p>	<p>Program Chair will meet with the course instructors to identify change.</p>	<p>Recommendation ready by August of 2022.</p> <p>Implementation will start in September of 2023.</p>

<p>Some comments on the “Senior Engineering Project” were received that this could be extended to cover two- semesters. This will incorporate flexibility and allow some research/design aspects to be added to the Project. Faculty had expressed some interest to do research-based projects rather than simply do applications-oriented projects.</p>	<p>Investigate whether it is beneficial to make the senior project a two-term project, say ENGTECH 4EP3 and a new course ENRTECH 4XX3. The first course will focus on literature search, a project proposal, and a pre-feasibility study report. The second course will cover detailed analysis and a final report/technical paper.</p>	<p>Program Chair will meet with the upper management to discuss possibilities.</p>	<p>Recommendation ready by August of 2022.</p> <p>Implementation will start in September of 2023.</p>
<p>The two courses “Renewable Power Generation from Wind, Solar and Hydro” and “Fuel Cell, Geothermal and Biomass Power Generation” should be combined into one course called “Renewable Generation”. A second course on battery storage and energy management systems should then be introduced.</p>	<p>Investigate the merits of merging the two renewable energy courses into one and introducing a new technical elective focusing on energy management systems with high penetration of renewable energy.</p>	<p>Program Chair will meet with course instructors to determine how best to implement this recommendation.</p>	<p>Recommendation ready by August of 2022.</p> <p>Implementation will start in September of 2023.</p>
<p>Course on “Power Quality” should be renamed “Converter Control for Power Systems” and should also cover components of HVDC Transmission and FACTS technology. Aspects of Microgrids and the smart grid could be covered.</p>	<p>Enhance the course content by adding state-of-the-art power quality improvement techniques based on smart grid and FACTS technology.</p> <p>The Program Chair recommends keeping the course name as “Power Quality” since it is easily understood in the power industry.</p>	<p>Program Chair will meet with the course instructor identify potential changes to the course contents.</p>	<p>Recommendation ready by August of 2022.</p> <p>Implementation will start in September of 2023.</p>

<p>Course on “Transmission Lines and Electromagnetics” should be rationalized and renamed “Power Systems and Transmission Lines”. Some content will be exchanged with Level 3 course on “Electromagnetics and Electrical Machines”.</p>	<p>See Recommendation 2</p>	<p>See Recommendation 2</p>	<p>See Recommendation 2</p>
<p>Course on “Systems and Control” should be renamed “Control of Power Systems”.</p>	<p>Investigate whether it is desirable to split this course into two, one for ENRTECH and one for MANTECH.</p>	<p>Program Chairs of MANTECH and ENRTECH will meet to discuss options.</p>	<p>Recommendation ready by August of 2022.</p> <p>Implementation will start in September of 2023.</p>
<p>Course on “Artificial Intelligence” should be renamed “Computational Techniques for Power Systems”. The course content should introduce other software (ETAP, EMTP, etc.) as well as deal with AI algorithms.</p>	<p>See Recommendation 3</p>	<p>See Recommendation 3</p>	<p>See Recommendation 3</p>
<p>Diversify the faculty and provide an extra full-time support faculty member. The heavy reliance on sessional lecturers may have some continuity and program quality concerns. Perhaps, McMaster should commit to maintaining at the least 50% to 75% full time tenured and/or tenure-track professors devoted to this program. These</p>	<p>This recommendation is highly desirable.</p>	<p>Program Chair to discuss with Director of SEPT on any budget constraints and succession plan.</p>	<p>First round of discussions will take place at the next performance review meeting.</p> <p>Any recommendation will be implemented September of 2023.</p>

professors might be cross appointed in various departments and be explicitly directed to teach these courses.			
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Dean's Response

The power and energy responses seem fine. The comments in this case were very granular and at the individual course level which is often difficult to implement. The point about sessionals is well taken and I would note that the School in general typically tries to convert faculty members as appropriate. I would also note that the BTech instructors are amongst the most dedicated in the Faculty.

Quality Assurance Committee Recommendation

McMaster's Quality Assurance Committee (QAC) reviewed the above documentation, and the Committee recommends that the B.Tech. Power and Energy Engineering Technology program should follow the regular course of action with an 18-month progress report and a subsequent full external cyclical review to be conducted 7 years after the start of the last review.