FINAL ASSESSMENT REPORT

Institutional Quality Assurance Program (IQAP) Review

INTEGRATED BIOMEDICAL ENGINEERING & HEALTH SCIENCES (UG)

Date of Review: April 1 and 2, 2024

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 undergraduate program delivered by the Integrated Biomedical Engineering and Health Sciences 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 Faculty of Health Sciences jointly with the Faculty of Engineering submitted a self-study in February 2024 to the Vice-Provost Teaching and Learning to initiate the cyclical program review of the Integrated Biomedical Engineering and Health Sciences program. The approved self-study presented program descriptions, learning outcomes, and analyses of data provided by the Office of Institutional Research and Analysis.

Two arm's length external reviewers and one internal reviewer were endorsed by both the Vice-Dean, Education of Faculty of Health Sciences, and Dean of Faculty of Engineering and subsequently selected by the Vice-Provost Teaching and Learning. The review team reviewed the self-study documentation and then conducted a virtual site visit on April 1 and 2, 2024**.** The visit included interviews with the Vice-Provost Teaching and Learning, Deputy Provost, Executive Vice-Dean and Associate Vice-President Academic of Faculty of Health Sciences, the Vice-Dean Education of Faculty of Health Sciences, Dean of Faculty of Engineering, Associate Dean (UG) Faculty of Engineering, Co-directors of the IBEHS program, and meetings with groups of current students, full-time faculty, and support staff.

The Vice-Dean Education of Faculty of Health Sciences, Associate Dean (UG) Faculty of Engineering, and Co-directors of the IBEHS program submitted responses to the Reviewers' Report in July 2024. Specific recommendations were discussed, and clarifications and corrections were presented. Follow-up actions and timelines were included.

Strengths

- The iBioMed program is a trailblazer and model for how to design and deliver a truly interdisciplinary and innovative curriculum. All 8 B.Eng.BME specializations meet the Canadian Engineering Accreditation Board (CEAB) graduate attributes. The Hons.B.H.Sc. specialization in Health, Engineering Science and Entrepreneurship (HESE) has additional learning outcomes specific to innovation and entrepreneurship. Students in the 9 different specializations come together via common Integrated Biomedical Engineering and Health Sciences (IBEHS) courses with team-based design projects. These courses provide multiple touch points across the curriculum that allow students from different engineering disciplines and from the HESE stream to work together on interdisciplinary teams. This enables students to learn how to speak the languages of the different disciplines.
- The delivery of courses and types of assessments based on design projects, problem finding, innovating solutions, and working with stakeholders with emphasis on communication and teamwork skills prepares students very well for future careers in a VUCA (volatile, uncertain, complex, ambiguous) world. There are several examples of faculty co-instruction and often several of the same instructors are teaching throughout the program, so they understand well the scaffolding of the courses. There is a logical sequence of project courses in which learning objectives change from year to year, such that students develop skills to prepare them well for their culminating capstone and thesis projects. There many unique learning experiences in the curriculum, such as the wet labs in year one and interactions with patients and clinical stakeholders, which is a real recruiting strength of the iBiomed program.
- The emphasis on entrepreneurship is already paying dividends as demonstrated by the number of startups and innovative devices that have been developed by students and alumni. Even 1st year students have been inspired to take their prototypes and turn them into products with support from the Clinic @Mac. Students seem to be more motivated by the intrinsic reward of helping patients and stakeholders rather than making money with their products members, with a good mix of tenure track and teaching track faculty, rather than sessional instructors.
- The leadership, involving Co-directors and Associate directors that span the Faculties of Engineering and Health Sciences, are all very committed to the success of the iBiomed program. There is excellent management of the program by leadership, who hold regular weekly meetings with administrative and technical staff. The instructors for the HESE Entrepreneurship courses, Design Project, and BME courses value their contributions to program and provide input via regular touch points such as the yearly retreat in summer. These touch points allow the program to be agile, put changes into place, and iterate each year to address issues that come up.
- The student experience is another strength of the program with multiple supports in terms of faculty, technical staff, administrative staff, the student iBiomed society, and upper-year TAs serving as mentors to students. The students are very engaged and committed to giving back to the program via providing feedback and serving as mentors. The environment seems more collaborative rather than competitive and the program fosters a culture of appreciation for interdisciplinarity. Students in each stream come to see the strengths of their peers in the other streams and how they can complement each other in various group projects across the curriculum

Opportunities for Improvement and Enhancement, including appropriateness of resources

- Increase students' opportunities to gain experience in the complete product development life cycle, particularly the stages that occur after initial prototype development. Such an enhancement would be particularly valued by the HESE students.

- Continue to enhance students' exposure to technical business skills in the entrepreneurship courses.

- Make a concerted effort in Year 1 to recruit more students into the Civil and Biomedical Engineering option.

- Alumni expressed an interest in additional in-person events to keep them connected to the program.

- Bolster the explicit development of teamwork and conflict management skills in Year 1 courses.

- Explore opportunities to recruit more Black and Indigenous students into the program and consider options to add Indigenous perspectives to the curriculum.

Recommendation #1: **Stability of Program Funding** Ensure that the iBiomed program leadership is confident that the program will have stable funding to maintain its currently excellent level of instructional, laboratory, and support staffing resources that is not contingent upon when the provincial government chooses to revise the university's enrollment corridor.
Department's Response and Actions to be Taken: This is a recommendation at the Faculty level.
Dean's Response: We fully understand the importance of securing sustainable funding for all eight iBioMed programs, particularly given that these programs are not associated with any weighted grant units (WGUs). To address this, we have been proactively exploring multiple funding avenues. The Provost currently provides annual top-up funding to support the program - $2.81M for FY23 and decreasing to $1.175M by FY26 – with a re-evaluation planned in FY27 for top-up funding beyond then. Given this decreasing annual commitment, we are committed to recruiting a minimum of 17 international students each year to help offset costs. This commitment would progressively increase our international student full-time equivalents (FTEs) across the program to 72 students. This financial model is designed to break even, assuming we can consistently attract the necessary number of international students. In addition to these efforts, we are committed to operating a fiscally responsible program, ensuring that expenses are kept as low as reasonably possible without compromising the quality of instruction, laboratory experiences, and support services. We will continue to advocate for funding for this novel program. By diversifying our funding sources and closely managing our budget, we are confident that the iBioMed program will continue to provide the high level of educational excellence our students and faculty expect, independent of any potential changes in provincial funding models.

Recommendation #2: **Student-preparedness for BME Curriculum** Ensure students from the Chemical, Materials, and Software Engineering streams and the HESE option still have the opportunities to excel in the imaging and instrumentation courses that were previously positioned as part of the core curriculum. The additional upper-year technical courses being introduced are positive changes, but the program should be sensitive to the risk of some students believing they were steered away from certain courses.
Department's Response and Actions to be Taken: Agreed. The program leadership will be meeting with the instructors of the BME technical courses later in the summer to review calibration of course topics, competencies and learning objectives across the curriculum. A few strategies will be proposed to address this recommendation: • Develop a competency map that outlines how various technical competencies are connected and overlap across the curriculum,

- Work with instructors and student groups to identify pain points where students feel they aren't as prepared and develop a series of asynchronous materials all students will have access to.

To enable these action items, a work study student will be hired to work with the instructors and run student focus groups over the summer of 2025. For the choice elective courses, we will monitor enrollment to see the composition of students-by-program in each course.

Dean's Response: We fully support the approach proposed by the program and agree that the competency map will be a valuable tool, not only for addressing the above recommendation but also for maintaining and improving the curriculum. However, we recommend that the program carefully consider whether the identified 'pain points' are best addressed through asynchronous materials, or if some instances may warrant curriculum changes.

Recommendation #3:

Informing HESE students about career and co-op opportunities

Address concerns raised by some of the HESE students about their career pathways, including helping them feel better prepared to market themselves to employers and attempting to provide a greater diversity of co-op employment options to supplement the technical engineering-focused opportunities available currently.

Department's Response and Actions to be Taken:

The program has maintained contact with as many HESE graduates as possible and invited them back for information sessions. Now that three cohorts have graduated, we can now build a robust data base about future careers, along with additional efforts and strategies:

1. In the spring of 2024, the program gathered information on as many of our iBioMed graduates as possible from the first three cohorts that have graduated. We now have data on the distribution of careers that our graduates move on to (including graduate and professional programs). We also have the names of companies and positions that our graduates have held. All of this information is in the process of being added to our website.
2. The program is also creating a LinkedIn group for HESE graduates in order to better inform HESE students about potential career paths. This will also facilitate networking for our students.
3. For the past two years, the program has held annual HESE information nights and has brought recent HESE graduates for a Q&A panel and mix and mingle session. We will use this same model and hold an annual HESE careers night that will be open to all HESE students.
4. The iBioMed Student Society proposed a "grad mentorship program". We will collaborate with the student society on this initiative. The program already has a lineup of HESE graduates who are keen to participate in mentoring HESE students and new HESE grads.
5. Create an annual career planning workshop in collaboration with the Engineering Co-op and Career Services office to prepare HESE students for marketing themselves in preparation for entering the workforce.
6. The program will meet with the Engineering Co-op and Career Services office in August of 2024 to review and strategize on expanding the diversity of co-op employment options for HESE students.

Dean's Response:
We are supportive of the program's approach to this recommendation.

McMaster University

Implementation Plan

Summary of the Reviewers' Recommendations with the Department's and Dean's Responses

Recommendation	**Action(s) to be Taken**	**Responsibility for Leading Action** (specify the role(s) that will be responsible for each action item e.g. Program Chair.)	**Timeline for Completing Action** (indicate specific timelines (e.g. not 'ongoing') for action)
1. Stability of Program Funding	A) Review budget with Program and Faculty leadership regularly B) Continue to advocate for funding	A) Faculty Director of Finance B) Faculty Leadership	A) Completed annually B) Prior to FY27
2. Student-preparedness for BME Curriculum	C) Meet with BME instructors to review calibration of courses across curriculum D) Identify pain points for students E) Develop a competency map F) Develop asynchronous resources for students to have access to G) Monitor enrollment in choice elective courses	IBEHS Co-Director and Associate Director, Engineering	C) August 2024 D) Fall/Winter 2024/25 E) Spring/Summer 2025 F) Spring/Summer 2025 G) Fall/Winter 2024/25 and 2025/26

3. Informing HESE students about career and co-op opportunities	A) Data from the first three cohorts of graduates has been collated and is being added to our website. B) Create a LinkedIn group for HESE/iBioMed graduates. C) Hold an annual HESE careers night that will be open to all HESE students. D) iBioMed Student Society "grad mentorship program". E) Annual career planning workshop. F) Meet with the Engineering Co-op and Career Services office to expand co-op options for HESE students. G) Schedule a feedback session through MacPherson Institute to evaluate the above measures	IBEHS Co-Director and Associate Director, FHS	A) August 2024 https://www.eng.mcmaster.ca/ibiomed-alumni/ B) August 2024 https://www.linkedin.com/groups/8168412/ C) February 2025 D) Fall 2024 E) January 2025 F) August 2024 G) Fall 2025

Quality Assurance Committee Recommendation

McMaster's Quality Assurance Committee (QAC) reviewed the above documentation at the November 28, 2024, meeting. The committee recommends that the **Integrated Biomedical Engineering & Health Sciences** undergraduate program should follow the regular course of action with an 18-month progress report and subsequent full external cyclical review to be conducted no later than eight years after the start of the last review.