



Chemical and Biochemical Engineering

Final Assessment Report & Implementation Plan

Faculty / Affiliated University College	Faculty of Engineering, Western University
Degrees Offered	Bachelor of Engineering Science (BESc)
Modules Reviewed	General Chemical Engineering Biochemical and Environmental Engineering Chemical Engineering and HBA (dual degree) Chemical Engineering and Law (dual degree) Chemical Engineering and Biomedical Engineering (concurrent degree program)
External Consultants	Suzanne Kresta, PhD, PEng, Dean, University of Saskatchewan Arvind Rajendran, PhD, PEng, Professor, University of Alberta
Internal Reviewer	Karen Danylchuk, EdD, Associate Dean (Undergraduate Programs), Faculty of Health Sciences
Date of Site Visit	November 23-24, 2020
Evaluation	Good Quality
Approval Dates	SUPR-U: March 24, 2021 SCAPA: April 7, 2021 Senate (for information only): April 16, 2021
Year of Next Review	Year of next cyclical review: 2027-28

Overview of Western’s Cyclical Review Assessment Reporting Process

In accordance with Western’s Institutional Quality Assurance Process (IQAP), the Final Assessment Report (FAR) provides a summary of the cyclical review, internal responses, and assessment and evaluation of the undergraduate modules delivered by the **Department of Chemical and Biochemical Engineering**.

This report considers and reports on the following documents: the program’s self-study, the external consultants’ report, and the responses from the Department and the Associate Dean of Science.

This Final Assessment Report (FAR):

- i) provides an Executive Summary of the Review Process, including an overview of the Department as outlined in the Self-Study brief;
- ii) identifies the strengths of the program;
- iii) identifies opportunities for program enhancement and improvement; and,
- iv) prioritizes the recommendations of the external consultants in the Implementation Plan.

The Implementation Plan details the recommendations from the Final Assessment Report that are required for implementation, identifies who is responsible for approving and acting on the recommendations, outlines any action or follow-up that is required, and provides the timeline for completion.

The Final Assessment Report and Implementation Plan is sent for approval through SUPR-U, SCAPA, Senate and the Ontario Universities’ Council on Quality Assurance and is made available on a publicly accessible location on Western’s IQAP website. The Final Assessment Report with the Implementation Plan is the only document resulting from the undergraduate cyclical review process that is made public; all other documents are confidential to the Program/School/Faculty and SUPR-U.

Executive Summary (as identified in the Self-Study Brief)

Overview

The Department of Chemical and Biochemical Engineering offers five programs leading to the degree of Bachelor of Engineering Science (BESc) in

- i) General Chemical Engineering
- ii) Biochemical and Environmental Engineering

and dual degrees in

- iii) Chemical Engineering and HBA
- iv) Chemical Engineering and Law
- v) Chemical Engineering and Biomedical Engineering (concurrent degree program)

providing its students with innovative ways to

use a multiscale engineering approach to design commercial processes that sustainably transform raw materials, living cells and microorganisms into useful consumer products at minimum cost in a safe way, and return spent products and by-products to the environment in an ecologically responsible manner...by providing strong fundamental knowledge in chemical, biochemical and environmental engineering principles.

The Department has a diverse faculty complement with 29 fulltime faculty members, seven of whom are female with five joint appointments. Faculty research is equally diverse and covers Biomaterials and Biochemical Engineering, Environmental and Green engineering, Reaction and Process Systems Engineering, Particle Technology and Fluidization, Macromolecular and Materials Engineering, and Water and Energy. Besides promoting dual and combined degrees, the Department encourages certificate option programs, industrial internships and co-ops, international opportunities such as WE Go Global, leadership opportunities, and an accelerated master's program

Strengths/Innovations of the Program (as identified in the Self-Study brief)

- Strong support staff (administrative staff, laboratory technicians. and teaching assistants)
- Diverse faculty with multiple teaching and research awards
- Student/instructor ratio of 6:1.
- Student curriculum counseling
- Undergraduate Services and Career Services Offices
- Laboratory resource
- Library resources
- Flexible programming
- Strong design component
- International Collaborative Undergraduate Degree Programs with Zhejiang University, Tianjin University, East China University of Science and Technology and Zhejiang University of Technology)
- International study opportunity for students at the Ecole Nationale Supérieure des Industries Chimiques (ENSIC) in Nancy, France to expose students to: (i) Social and business/industrial

culture through lectures and visits to selected cultural sites, (ii) Engineering educations practices through hands-on experience, and (iii) State-of-the-art industrial technologies

- Excellent students with entering minimum Grade 12 average of 87.5%

Challenges (as identified in the brief)

- Updating the undergraduate curriculum to reflect the shifting in the discipline from traditional areas (process engineering, oil and gas, etc.) to new societal challenges associated with energy preservation, sustainability and environmental stewardship

Recent Changes (as identified in the brief)

- Introduction of Assistant Dean (First Year Studies)
- Introduction of First Year Curriculum Committee
- Restructuring and differentiation of Environmental and Biochemical Engineering module

Changes under development in the Department (as noted in the Brief)

- New course development to reflect challenge noted above

Self-Study Process

In preparing for this review, the department was involved in extensive collection of quantitative and qualitative data from undergraduate students, alumni, industry, the Curriculum Committee, and through faculty meetings. As well faculty included through reviews of course specific indicators for graduate outcomes and course marks/student performance on project-based courses. It is noted that the undergraduate programs also undergo cyclical accreditation by the Canadian Engineering Accreditation Board (CEAB) and this information fed into this review process.

Review Process

Due to the pandemic, the onsite review was postponed and the external review committee (comprised of the two external reviewers: *Dr. Suzanne Kresta, University of Saskatchewan* and *Dr. Arvind Rajendran, University of Alberta*; and one internal reviewer: *Dr. Karen Danylchuk, EdD, Associate Dean, Faculty of Health Sciences*) conducted the external review virtually via ZOOM interviews held over two days. The external review committee members were provided with Volumes I and II of the program's self-study brief in advance and then held virtual meetings with the following over the course of the two days.

- Dr. Jeff Hutter, Acting Vice-Provost, Academic Programs
- Dr. Margaret McGlynn, Acting Vice-Provost of Academic Planning Policy and Faculty
- Dr. Ken Coley, Dean, Faculty of Engineering
- Dr. Jeff Wood, Associate Dean, Faculty of Engineering
- Dr. Amarjeet Bassi, Chair, Chemical and Biochemical Engineering
- Dr. José E. Herrera, Undergraduate Chair, Chemical and Biochemical Engineering
- Curriculum Committee Members (faculty), Chemical and Biochemical Engineering

- Teaching Assistants, Chemical and Biochemical Engineering
- Faculty, Chemical and Biochemical Engineering
- Undergraduate students, Chemical and Biochemical Engineering
- Laboratory Technicians, Chemical and Biochemical Engineering
- Administrative Staff, Chemical and Biochemical Engineering
- University Librarian

Following the review, the external reviewers submitted a comprehensive report of their findings which was sent to the Chair and the Dean for review and response. These formative documents, including Volumes I and II of the Self-Study, the External Report, and the Faculty response, have formed the basis of this summative assessment report of undergraduate programs in Chemical and Biochemical Engineering.

Summative Assessment – External Reviewers’ Report

The external reviewers wrote that:

the review committee found a department that is collegial and welcoming to new faculty members. ...These faculty members are well recognized for their research and innovation and include a number of award-winning instructors. ... We found that the program is strong... Students were enthusiastic about their courses and their choice of program.

Strengths of the Program

- Program and departmental mission/vision align with university
- Course contents and program structure satisfy the requirements of a high-quality chemical engineering program
- Proactive department in developing new program options and courses to reflect current state of the field
- Passionate, engaged, and mutually supportive instructors and TAs
- Motivated and enthusiastic students
- Award-winning faculty
- Healthy engagement of faculty in review and accreditation processes
- Experiential learning opportunities
- Student employment rates

Challenges for the Program

- Aligning assessments with the Canadian Engineering Accreditation Board requirements
- Ventilation in laboratories
- 8-month contracts for laboratory technicians leaves these persons out of important discussions and decision-making processes
- Need for undergraduate chair

Reviewers' Recommendations and Department/Faculty Responses

REVIEWERS' RECOMMENDATIONS	DECANAL/DEPARTMENT RESPONSE
<i>We recommend that the department/faculty consider engaging a professional recruiter/communications/marketing team to shift the messaging from chemical engineering to process engineering, sustainable (bio)processes, and life cycle analysis to make key innovations and strengths of the program more visible.</i>	Noted that the Dean commented on three of the recommendations, leaving the others to the department for comment. Department: Agreed; in implementation stage
<i>First-year exposure - We recommend that the Process Engineering, Life Cycle Analysis, and/or Sustainability aspects of the chemical engineering program be effectively highlighted in the first-year program as a module(s) where students can see and experience process engineering and systems thinking before selecting their discipline.</i>	<u>Department:</u> Agreed and in progress for Fall 2021
<i>TA training - We recommend that a basic TA training program be implemented at the faculty level at the beginning of each term. The time saved and quality gained from one-hour workshops on 1) how to grade consistently and efficiently 2) how to do effective lab demonstrations which include safety as a culture of how we speak and act, 3) basic time-management, and 4) early interventions and identifying students at risk which build supportive learning communities have been shown to return the investment many times over.</i>	<u>Dean:</u> Agreed with follow-up in progress <u>Department:</u> Agreed. The curriculum will be updated with planned required implementation for Fall 2021.
<i>Faculty-wide framework for GA/CI metrics - We recommend that the faculty and department consider establishing a framework for the graduate attribute assessment (GA) and continuous improvement process (CI) at the Faculty level so that there is consistency across all programs and the process and metrics are developed once. This can provide substantial efficiencies for everyone.</i>	<u>Department:</u> This is underway both at the Faculty level and at the department level. An external stakeholder group, a CBE Quality Assurance Committee, and student representatives are being involved in this process.
<i>Organic chemistry labs ventilation - We recommend that the department initiates a process to determine if appropriate ventilation standards are being met in organic chemistry labs housed in the Chemical Engineering building.</i>	<u>Department:</u> This has been resolved and clarified with the Safety Officer of the Faculty and the instructors. The ventilation system is only used in lab experiments with very small amounts of reagents and thus the ventilation is adequate.

<p><i>8-month lab technician appointments - The 8-month sessional lab technician appointments were identified as a high risk for a chemical engineering program where the safety of students needs to be paramount, equipment requires ongoing maintenance and renewal, and new labs are normally developed during the summer months. We recommend that the department considers a 12-month appointment for lab-technicians and integrate meaningful CI of labs during the summer months.</i></p>	<p><u>Department:</u> Resolved; positions converted to fulltime positions.</p>
<p><i>Recognition of Associate Chair Undergraduate contributions - We recommend that the department considers appointing an Associate Chair (undergraduate).</i></p>	<p><u>Dean:</u> Active search now underway</p> <p><u>Department:</u> Agreed</p>
<p><i>Teaching metrics - The metrics and accountabilities for quality of teaching, engagement with the curriculum and course development, peer-to-peer faculty mentoring, and leadership in engineering educational scholarship are not visible to faculty members in terms of the standards for promotion, tenure, and merit. We recommend that clear metrics for this core competency should be established or reviewed and actively communicated to faculty.</i></p>	<p><u>Dean:</u> in progress as a requirement of continued accreditation with the Canadian Engineering Accreditation Board. ... This recommendation suggests that both a review of this mapping and perhaps an internal education for Program leaders across the Faculty are required.</p> <p><u>Department:</u> We recommend a CBE task force be established to review these points: quality of teaching, engagement with the curriculum and course development, peer-to-peer faculty mentoring, and leadership in engineering educational scholarship. The task force will review this issue and present a report in September 2021.</p>

Implementation Plan

The Implementation Plan provides a summary of the recommendations that require action and/or follow-up. The Department Chair/Director, in consultation with the Dean of the Faculty/Affiliated University College Principal will be responsible for monitoring the Implementation Plan. The details of progress made will be presented in the Deans’ Annual Report and filed in the Office of the Vice-Provost (Academic).

Recommendation	Proposed Action and Follow-up	Responsibility	Timeline
1. Make key innovations and strengths of the program more visible	Engage a professional recruiter/communications/marketing team to shift the messaging from chemical engineering to process engineering, sustainable (bio)processes, and life cycle analysis	Department	In progress
2. Increase exposure of the aspects of chemical engineering to first-year students	Effectively highlight the Process Engineering, Life Cycle Analysis, and/or Sustainability aspects of the chemical engineering program in the first-year program as a module(s) where students can see and experience process engineering and systems thinking before selecting their discipline	Department - first-year planning group	Fall 2021
3. Enhance the current basic TA training program	Consider workshops focused on: 1) how to grade consistently and efficiently, 2) how to do effective lab demonstrations that include safety as a culture of how we speak and act, 3) basic time-management, and 4) early interventions and identifying students at risk	Associate Dean, Graduate Studies for the Faculty & CBE Grad Chair, with follow-up from the Dean	Fall 2021
4. Establish a Faculty-wide metrics framework for the graduate attribute assessment (GA) and continuous improvement process (CI)	Ensure this framework is consistent across all Faculty programs	Department and Faculty with an external stakeholder group, a CBE Quality Assurance Committee, and student representatives	In progress