UNIVERSITY OF CALGARY

Curriculum Review

Department of Chemical & Petroleum Engineering

Schulich School of Engineering

http://schulich.ucalgary.ca/

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1. Context:

The Department of Chemical & Petroleum Engineering delivers two undergraduate programs: Chemical Engineering and Oil & Gas Engineering.

The **Chemical Engineering program** was started in 1966 to train engineers for Canada's process industries. Chemical engineering involves "taking chemistry out of the laboratory". The practice includes the design, construction and operation of a large variety of chemical processing plants and systems. Industries that employ chemical engineers include petroleum, pulp and paper, nuclear energy, biotechnology, synthetic materials, food production and processing, waste treatment and environmental protection, chemicals and polymer or plastics production. Chemical engineers are involved in large scale production of industrial chemicals for commercial and domestic uses, in manufacturing intermediates such as petrochemicals and in making quality-controlled pharmaceutical products to name a few. Careers may be in research, development, design and operation of a wide variety of processes.
The Chemical Engineering Program is built around certain basic foundations for general practice. The principles of energy and mass conservation, and unit operations, have central roles in the core courses. Students study the design of reactors, cascade separation or purification processes, process dynamics and control, and mathematical modeling or transport phenomena. The highlight of the curriculum is a year-long, team process design project, which culminates in a public presentation to examining faculty and industry representatives. The topics for the design projects cover a wide spectrum of industries, such as chemical processing, manufacturing, petrochemicals, biotechnology and hydrocarbon recovery and processing. The projects include both technical and economic analyses. Throughout the curriculum, and during the design project, use of state-of-the-art computer tools are emphasized. To support this, the department has its own up-to-date computer lab and sophisticated software licensed from companies for undergraduate students.
The program has grown in the 2015-16 academic year to 165 entering undergraduate students per year in four "specializations" (regular, with a minor in petroleum engineering, with a specialization in biomedical engineering and with a specialization in energy and the environment) from about 36 students at the time the department name was changed in 1980 from Chemical to Chemical & Petroleum Engineering. The Energy Engineering program (with 50 students entering) is graduating its first class in 2017 and is being taught by both the Chemical & Petroleum and Mechanical Engineering departments.

The **oil and gas engineering program** was started in 1998 in response to longstanding lament from the Canadian oil and gas industry that the University in "the oil and gas capital of Canada" did not have an engineering program targeted to the needs of the industry. The local oil and gas industry was hiring many graduates of our chemical engineering program and retraining them to work as petroleum engineers, but they wanted to hire graduates who would not need such extensive retraining. The oil and gas engineering program was developed by the department in consultation with an advisory council comprising the captains of the oil and gas industry. Eight students were the first graduates from the program in 2001.
The program was initiated in the Department of Chemical & Petroleum Engineering to take advantage of the synergy between chemical engineering and petroleum engineering education. Many of the fundamental concepts are in common for both programs and many chemical

engineering professors are world renowned researchers in oil and gas reservoir and extraction studies. The Oil and Gas Engineering Program was thus designed to share a number of junior courses with the Chemical Engineering Program to engage students in up and downstream operations and expand the employability of graduates. The senior level courses concentrate on petroleum reservoir and extraction engineering (upstream) and production operations. The integration is a distinguishing feature of our program.

The program capacity was increased to from 16 to 40 students in 2004 and then to 70 students in 2015 in response to the then increased demand for oil and gas engineering graduates. The demand had been very strong while the oil industry was booming in Alberta. Lately, the demand has been depressed as the industry is experiencing low prices for crude oil and jobs have become relatively scarce for new graduates. However, there are clear signs of turn-around in the health of the industry and students entering this program will have very good opportunities to work in a rejuvenated oil and gas sector as one of the best paid engineering professionals.

3. Guiding questions:

Chemical Engineering

(i). How current is the program? What is being emphasized? Are we preparing graduates for traditional and/or emerging roles?
(ii). Who are our students and what do they want out of the program?
(iii). How best to allocate resources to deal with large increases in the Chemical Engineering cohort? Should sessional instructors be employed to reduce class sizes in core courses?
(iv). How does our Chem. Eng. program align with CEAB graduate attributes?

Oil and Gas (plus Petroleum Minor)

(i). How current is the program? What is being emphasized? Are we preparing graduates for traditional and/or emerging roles?
(ii). Do we have the right prerequisites for upper-level courses, e.g. are the Petroleum minor students being properly prepared for capstone design? Is ENCH 427 really a prerequisite for ENPE 505, 511 and 551?
(iii). Where are the bottlenecks in the program? Should we 'resolve' them or should they remain as bridges which students must cross to prove their suitability for Petroleum Engineering? If they (e.g. ENCH 315, ENCH 427, ENPE 429) should be resolved, how to do it?
(iv). How does our ENOG/ENPE program align with CEAB graduate attributes?

8. Action Plan:

Recommendations: Course level			
Recommendation	**Action Item**	**Timeline for Implementn.**	**Lead Responsibility**
Provide additional resources to students at risk of failing ENCH 315	Develop additional examples and instructional material aimed at improving engagement of ENOG students	1 year	Course instructor
	Coordinate with Devon Centre the creation of an additional tutorial session for ENOG students taking ENCH 315.	1 year	Associate Head, Undergraduate
	Monitor performance and failing rates for the course and effectiveness of implemented actions.	2-3 years	Associate Head, Undergraduate
Identify places to reintroduce Mass Transfer into the 3rd year.	Move Mass Transfer topics from ENCH 505 to ENCH 405, and move Liq-Liq and Solid-Liq Extraction topics to ENCH 505	1 year	Department Head Faculty members
Add design components into our curriculum in 2nd and 3rd year.	Add a small team-based design project to ENCH 331. Introduce a joint design project into ENCH 405 and ENCH 421 to test the implementation of multi-course design projects. Evaluate the possibility of a multi-course design course in second year and in O&G program in future years.	1 year	Department Head, Faculty members Reader Demonstrators
	Add VMGSim and CMG based design projects to ENCH/ENPE 423 to better prepare students for ENCH/ENPE 511/531.	1 year	ENPE/ENCH 423 and ENPE/ENCH 511/531 instructors

Re-introduce safety training into the curriculum	Reinstitute ENPE 555 as a Tech elec.	1 yr	Department Head
	Introduce safety concepts into ENCH/ENPE 551. Apply and Assess safety concepts in ENCH/ENPE 511/531	1yr	Department Head Instructors

Recommendations: Program level			
Recommendation	**Action Item**	**Timeline for Implementation**	**Lead Responsibility**
Make learning opportunities available for our faculty to gain best practices for teaching and assessing GAs 4-12.	Work with Dean's office and Taylor Institute to offer information sessions and training on teaching and assessing each of the GAs	2 years	PQAC committee
	Update GA curriculum map and identify appropriate courses to add in GA 8-12 content	1 year	PQAC committee, Instructors
Add more software training into the curriculum.	Add CMG/VMGSim projects to ENCH/ENPE 511/531	1 year	Faculty members
Evaluate recommendations for preparing Petroleum Minors for ENPE 511/531	Introduce a requirement in ENPE 511/531 that the groups require at least one Oil & Gas student and at least	1 year	Department Head Faculty members

	one Petroleum Minor student.		
Provide additional computer access for students to reduce overcrowding the the existing computer labs.	Install necessary ENCH and ENOG software in ENG 203 for use by ENCH and ENOG students when the computer lab is available. This depends on our ability to acquire more site licenses.	1 yr	Department Head
	Discuss and evaluate the possibility of purchasing a server to be managed by IT which gives students the ability to use software on their personal computer	1y	Department Head, Associate Head (U) IT facilities manager

We plan to further fine tune our survey questionnaire to employers to elicit more specific feedback in certain areas with respect to our curriculum and course contents.

Recommendations – Administration			
Recommendation	**Action Item**	**Timeline for Implementn.**	**Lead Responsibility**
Develop a process for ongoing employer feedback on our programs	Improve our survey questionnaire to employers.	1 year	Department Head, Industry Advisory Council
	Improve the operation of our industrial advisory council, plan regular meetings, with agenda and actions.	1 year	Department Head, Industry Advisory Council
Ensure all of the above recommendations are being implemented as per the recommended timeline.	At the annual retreat the progress of the action plan will be reviewed and updated. Any necessary leads from each action item will be invited.	3 years	Department Head, Associate Head Undergraduate