First-Year Core Engineering Curriculum for the BC Post-Secondary Sector

FINAL REPORT

Prepared for and Funded by:

The British Columbia Council on Admissions and Transfer

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EXECUTIVE SUMMARY

The BC Council on Admissions and Transfer (BCCAT) Engineering Articulation Committee expressed its desire to explore the feasibility of developing a common, first-year engineering curriculum within the BC post-secondary sector in May-2014. In February 2015, the BCCAT approved this initiative as a Transfer Innovation (TI) project.

ACTIVITIES

The TI grant provided for a course release and partial travel subsidy for the author to conduct a year-long consultative process with stakeholders culminating in this report. Primary activities included initial information gathering to produce a preliminary discussion paper; facilitating a round-table on that report with most receiving institutions; presenting the paper including round-table feedback to the BCCAT Engineering Articulation meeting in May-2016; and submission of this final report.

OUTCOMES

Although there exists some diversity within the first year engineering programs at receiving institutions, sufficient overlap was found to develop a sector-wide common first year engineering curriculum. Upon adoption, this curriculum provides a *content* framework for students in *all* regions of the province to begin the first year of engineering studies at their institution of choice, and transfer to *any* of the major research institutions to complete their degrees. The *process* within which students transfer (e.g., minimum GPA, time frame for completion) continues to be owned by the receiving institutions.

In addition to the core curriculum, specific recommendations and requirements to strengthen the engineering transfer system were described including:

- **Quality**: Develop a process to track student success rates through their academic careers with respect to their pathway.

- **Transparency**: Ensure all current and new engineering transfer agreements within the sector are made available to all members of the Engineering Articulation Committee.

- **Professionalism**: Instructors for designated first year engineering courses have a professional engineering designation (P. Eng or Eng. L).

- **Safety**: Students completing their first year of engineering studies will have workplace hazardous materials training (WHMIS).

- **Growth**: Developing cohort-centred engineering programs based on the core engineering curriculum to enhance the student learning experience and local community engagement.

PROJECT SCOPE

Support for *First-Year Core Engineering* initiative was sought and obtained from BCCAT in the form of a Transfer Innovation project grant.

The primary goal of this project is to determine the *feasibility* of developing a first year core engineering curriculum. Deliverables supporting this goal include:

1. A study of transfer statistics between sending/receiving institutions including measures of student success, retention, and other relevant factors.
2. A summary of current engineering transfer options between all articulated post-secondary institutions (e.g., letter of agreement or LOA, block transfer, BCCAT course-by-course transfer).
3. A set of core, first-year expectations of receiving institutions.
4. A set of core, first-year competencies from the Canadian Engineering Accreditation Board (CEAB).
5. A suggested course mapping consistent with Items 3 and 4.

BACKGROUND

Interest in engineering education has been growing in recognition of its importance to the provincial economy. The BC Council on Admissions and Transfer (BCCAT) Engineering Articulation Committee currently has representation from six accredited receiving institutions, 17 sending institutions, and from the Association of Professional Engineers and Geoscientists of British Columbia (APEGBC). Engineering education is a field where the province's transfer system could improve cost efficiencies, and provide expanded opportunities and access for students within all regions of the province.

Engineering schools traditionally offer a common first year of study that provides a foundation of science, mathematics, and engineering design before specializing in second year. This creates a natural transfer point. Further, engineering schools work under the auspices of a heavily invested national accreditation body (CEAB) so the accredited receivers necessarily have a set of shared requirements. Their accreditation creates extra responsibilities for any transfer arrangement, but well-regulated standards are a goal that BCCAT shares with CEAB. Indeed, recent accreditation processes at the University of Victoria and the University of British Columbia suggested that their first-year curriculum might be aligned based on a core set of competency requirements.

BENEFITS

A first-year core curriculum, if clearly articulated and regulated, can provide:

- Efficiencies at sending institutions through alignment of course offerings towards a common standard regardless of the student's transfer destination. This is currently not the case.
- An enhanced student learning environment through better cohort development, a pedagogy that can work very much to the benefit of some students, and which promotes needed outcomes of teamwork and project management.

- Clear and verified documentation regarding transfer curriculum and instructional credentials that can be used to support the accreditation process for receiving schools.
- Potentially improved transfer to and from other jurisdictions to broaden student career options. Engineering is incredibly diverse and often expensive to deliver. Some specializations (e.g., petrochemical and aerospace) are more accessible closer to their resource or industrial base.

Innovation and effort is required by both receiving and sending institutions to maintain transfer paths that ensure minimal impact on our students' academic success. Alignment of core, first-year competency requirements should increase the efficiency of the overall transfer process and improve student flexibility and choice in their learning pathway.

CANADIAN ENGINEERING ACCREDITATION BOARD (CEAB)[1]

When considering transfers (especially when articulated in an agreement), receiving schools must consider:

1. Does the core curriculum of the sending school meet the accreditation requirements of the receiving school?
2. Does the sending school provide sufficient background (both technical and "soft" skills) to ensure student success upon transfer?

Engineering accreditation in Canada has traditionally been input-based, with a focus on accreditation units (AUs). AUs are effectively a measure of instructional time and programs must show that they have delivered the CEAB-mandated minimum number of AUs in various categories (i.e. mathematics, natural science, engineering science, engineering design, and complementary studies). Of particular concern for sending institutions is the need for specific engineering science and engineering design content to be taught by instructors with professional engineering licensure (e.g. Eng. L, or P.Eng.). Receiving institutions must be able to show the instructor at the sending school was licensed, or else that course work cannot be counted towards the specific AU requirements. As CEAB applies a *minimum path analysis* when counting AUs (i.e. the student graduation pathway that results in the lowest AU count is used), the inability to count course work may impact a receiving institution's accreditation.

More recently, CEAB has added an outcomes-based accreditation system to the AU system whereby receiving institutions must demonstrate their programs deliver a set of twelve graduate attributes:

1. *A knowledge base for engineering*
2. *Problem analysis*
3. *Investigation*
4. *Design*
5. *Use of engineering tools*
6. *Individual and team work*
7. *Communication skills*
8. *Professionalism*
9. *Impact of engineering on society and the environment*
10. *Ethics and equality*
11. *Economics and project management*
12. *Life-long learning*

[1]Details drawn from www.engineerscanada.ca/accreditation

Each attribute has three target competency levels:

Introduction	Recall/understanding/generalization
Developing	Analysis/speculation
Advanced	Synthesis/evaluation/innovation

Receiving institutions must map when these attributes are developed and assessed, as well as describe what assessment tools are used. These assessment tools can vary widely between institutions. Student performance relative to program expectations are to be subsequently evaluated.

Under the outcomes-based approach, CEAB allows for flexibility in when and how the attributes are developed and assessed and so does not dictate a specific set of core first-year competencies. It also does not apply a minimum path analysis and considers only the average student's graduation pathway. As only the *graduation* attributes are specified by CEAB, those attributes may require progressively developed skill sets over a student's academic career (i.e., implied prior year learning outcomes) but do not require that this prior learning occur in the same year for all programs and all institutions.

CONSULTATIVE PROCESS

This report was formed through an inclusive consultative process outlined in Figure 1. Stakeholder input was solicited in-person and through email correspondence with principal contacts at the majority of BC post-secondary institutions (both receiving and sending), APEGBC, and BCCAT. Further input was obtained from CEAB, the Engineering Graduate Attribute Development (EGAD) group[2], and MacEwan University (Alberta). Details of engineering program offerings were obtained through publically available program pages[3] and confirmed with the principal contact at each institution, whenever possible. Detailed outlines for courses were used to supplement this data and provided for comparison across institutions. A list of principal contacts and selected on-site meetings are provided in Appendix A and B.

Based on the stakeholder feedback, a discussion paper was drafted which consisted of a summary of findings plus five recommendations addressing the project objectives. This paper was brought forward for feedback at a round-table hosted by UBC-Vancouver and facilitated by the author. Representatives from UBC-Vancouver, the University of

[2]EGAD (egad.engineering.queensu.ca) is a collaboration sponsored by the National Council of Deans of Engineering and Applied Science (NCDEAS), in association with Engineers Canada. This group was created to help gather and create resources and tools to provide practical assistance to Canadian engineering schools transitioning to outcome-based programming, assessment, and accreditation as required by CEAB.

[3]Retrieved between 30.Sept.2015 and 15.Dec.2015

Victoria (UVic), the University of Northern British Columbia (UNBC), BCCAT, and the Chair of the BCCAT Engineering Articulation Committee were in attendance[4].

Updates were made to the discussion paper based on the round-table conversation before being presented to the BCCAT Engineering Articulation Committee meeting in May-2016 for further advice. All communication and data was subsequently consolidated into a draft report, which had one further cycle of comment from the BCCAT Engineering Articulation Committee before its final submission.

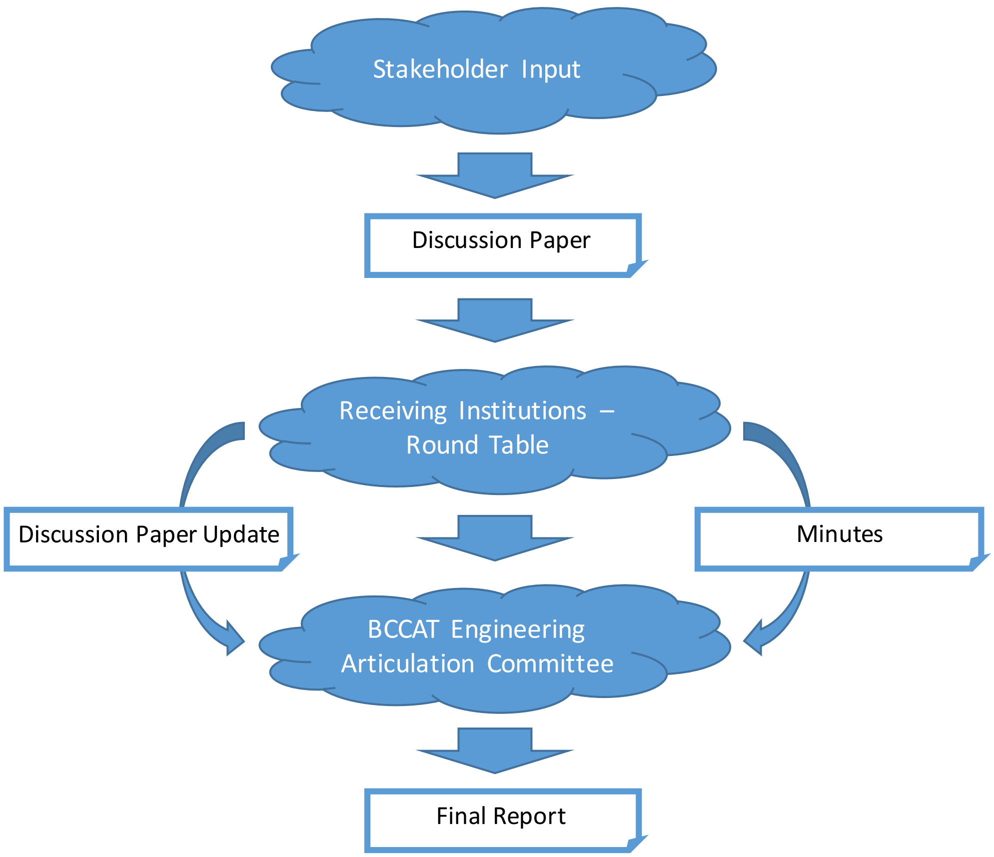

FIGURE 1. CONSULTATION PROCESS

FINDINGS AND OUTCOMES

The author would like to first express that during the consultative process, the stakeholders and participants showed a spirit of genuine co-operation and willingness to enhance the transfer process to improve access, flexibility, and choice for prospective engineering students in all regions of the province. This encouragement and support made for productive discussions leading to the findings contained in this report.

[4]Both UBC-Okanagan and SFU were unable to attend but provided feedback on the process during follow-up conversations.

A. ISSUES AND CHALLENGES

A number of challenges were identified in developing first-year core curriculum:

- The curriculum needs to be coordinated over different departments of arts and science at each sending school. Sending institutions typically "house" the curriculum outside of a dedicated engineering department.
- Sending schools may not have credentialed (Eng. L, P. Eng) instructors for dedicated engineering courses as required by CEAB.
- Sending institutions typically lack the ability to track student progress upon transferring, a key element of continuously improving their program offerings.
- Each receiving institution must continuously adapt to the changing needs of the professional engineering community.
- Each receiving institution is at a different phase within their accreditation cycle.
- Capacity issues at receiving institutions constrains their ability to accept an increased number of transfer students from sending institutions.

B. REQUIREMENTS AND RECOMMENDATIONS

Two statements on program requirements and three statements on process-driven recommendations were generated as this feasibility study evolved. These statements are intended to facilitate and certify the transition towards broadly implementing the core engineering curriculum provided later in this document.

Requirement #1

Instructors for designated engineering courses (typically those covering engineering science, engineering design, project work, and/or an introduction to the engineering profession) must have a professional engineering credential (P. Eng, or Eng. L).

APEGBC provides a specific path to the Eng. L credential for university professors requiring:

> *10 years of engineering experience relevant to the teaching of engineering science or design including up to four years spent in post-secondary education; and two in post-graduate education. The last two years must have been either teaching engineering science or design, or doing applied research in an engineering faculty at a university*[5].

Historically, APEGBC has not accepted instruction at a first or second year level as fulfilling the teaching requirement for the credential. This policy has proven a barrier for instructors within the college and teaching-university sector towards obtaining their Eng. L. Recent discussions with APEGBC, however, have led to the removal of this barrier as it does not reflect the current engineering curriculum and instructor practice.

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[5]www.apeg.bc.ca/Become-a-Member/How-to-Apply/Professional-Membership-and-Licence/Limited-Licence

APEGBC encourages all instructors of engineering science or design to consider registering for their Eng. L credential. On a personal note, the author suggests that the practice of applying for the credential, including attending APEGBC's law and ethics seminar and writing the professional practices exam, provides valuable insight when demonstrating to students "What it means to be an engineer".

The typical application process is shown in Figure 2 while an example of scope of practice is provided in Appendix C.

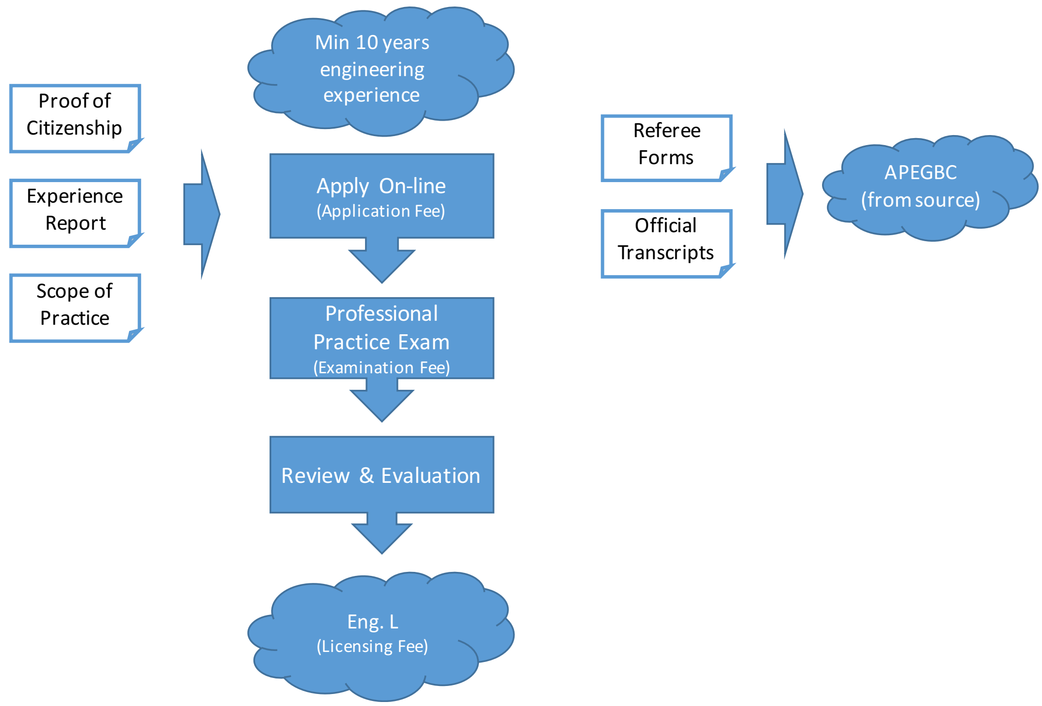


FIGURE 2. APPLICATION PROCESS FOR ENG. L. CREDENTIAL

Requirement #2

Sending institutions require all students taking classes within the engineering common core to complete Workplace Hazardous Materials Information System (WHMIS) training before undertaking course lab work.

WorkSafe BC regulations require employers to ensure all workers have WHMIS training, including those students who may be working in a laboratory environment. As much design project work takes place in spaces where safety of students is a concern, some receiving institutions demand proof of completion of this training as a *requirement* for transfer. These courses are often offered as a module that can be attached to most on-line learning environments with very little time commitment by students to complete.

Recommendation #1

Develop a process to track student progression and success through their academic careers with respect to their study pathway.

There is strong support by both sending and receiving institutions for maintaining and making available student progression data (see Figure 3), although challenges have been identified (e.g., sufficient resources, anonymizing data, partial versus full first year transfer). Sending institutions are heavily invested in their student achievement but typically lack the ability to follow student progress upon transfer; indeed, sending institutions often are not aware of what transfer path a student may take. Further, receiving institutions need to assure CEAB of their program quality. Creating an oversight mechanism contributes to continuous program improvement at sending and receiving institutions; ensures student success is not impacted by locale of first year studies; and provides evidence to CEAB of overall program quality.

One suggested mechanism for going forward with this recommendation is to make use of the student personal education number (PEN). Both sending and receiving institutions collect the PEN as part of a student's academic record, although each institution maintains different data and no agency is mandated to collect system-wide data within a central registry. For example, current studies of student transfer (such as those conducted by STP and BCCAT) are undertaken by direct requests to individual post-secondary institutions. The Freedom of Information and Privacy Protection Act (FOIPPA) of British Columbia further restricts sharing of data that provides an identifiable path to individual students.

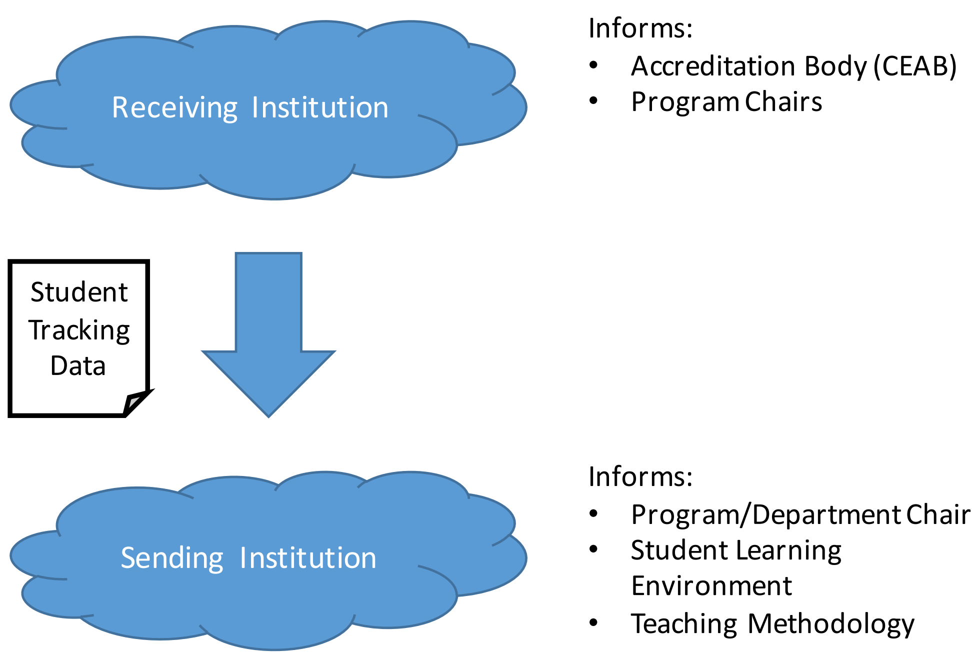


FIGURE 3. STUDENT PROGRESSION DATA FLOW

The Ministry of Education, which assigns the PEN, does provide a mechanism for amalgamating and anonymizing information to fulfil FOIPPA. The Ministry may provide a channel for collecting and analyzing student progression data provided the project scope is well defined. Figure 4 illustrates the concept using selected institutional data as examples:

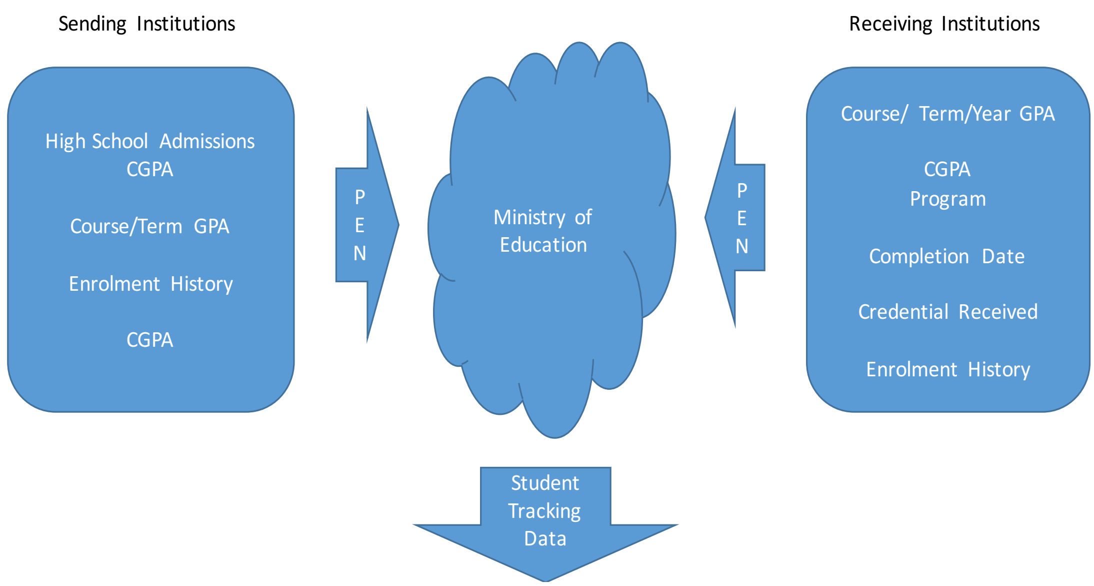


FIGURE 4. SUGGESTED DATA TRACKING PROCESS

Note: The data indicated above feeds into the Central Data Warehouse (CDW), which collects information from institutes, colleges, and teaching intensive universities, but does not contain course/term/year GPA data from the research-intensive universities. The Student Transitions Project (STP) contains data from all public institutions but does not currently collect course/term/GPA information from institutions. Recommendation #1 could be accomplished through a STP project, an individual researcher working with BCCAT, or as an institutional project conducted by the Institutional Research (IR) office.

Recommendation #2

Current transfer agreements, particularly those that provide a block transfer[6] of courses, between sending and receiving institutions to be made available to the Engineering Articulation Committee with the goal of building a common transfer agreement framework applicable for all post-secondary institutions within the province.

Formal[7] transfer agreements typically have not existed between institutions; sending and receiving institutions have relied on course-by-course articulation (through BCCAT) or historic, informal agreements to facilitate student transfer. There is a strong desire, particularly from sending institutions, that specific agreements in place are broadly disseminated to promote consistency in the transfer process, clarity in student expectations, and streamline program development processes. Receiving institutions are broadly supportive of this initiative.

Individual receiving institutions have considered transfer agreements differently depending on their context. The general framework applied to incoming transfer students by each receiving institution (excluding UNBC) is described below:

[6]Block transfer: Where one or more courses at a sending institution is equivalent for the purpose of transfer to one or more courses at the receiving institution. Course-by-course transfer is where a course at the sending institution is treated as equivalent to one course at the receiving institution.

[7]Formal Agreement: A signed agreement between institutions specifying criteria and terms for transfer (see Appendix D).

Informal Agreement: Transfers are typically under a blanket agreement/policy or informally through historical practice.

UBC - Vancouver (Engineering Transfer)	Students at eight post-secondary institutions who complete the first-year engineering curriculum within eight months (Sept-April) at one institution with a GPA of at least 2.8[8] are considered for admission into 2nd year engineering. Admission into specific programs is competitive. Institutions generally transfer course-by-course as articulated through BCCAT, although some block transfer agreements exist.
UBC - Vancouver (University Transfer)	Students are required to achieve a minimum GPA of 3.3[7] to be considered for entry into 2nd year engineering. The actual entry GPA is typically much higher for these students as second year seats are first allocated to direct entry and engineering transfer students. Limited capacity has increasingly made entry through the university transfer route problematic as direct entry and engineering transfer demand continues to rise.
UBC - Okanagan	UBC-O generally follows the admission process of UBC-Vancouver, although there is more reliance on block transfer of courses as opposed to individual course-by-course.
University of Victoria	Students transfer through individual course articulation (BCCAT) or via transfer agreements in place between the sending institution and the University of Victoria. Typically, these agreements have provided a guarantee of admission into 2nd year engineering at UVic provided the student has completed the first-year curriculum within one or two years and has a minimum of a 'C' in any individual course and a minimum 'C+' over the previous 12 credits (UVic measure). Entry into specific engineering programs is competitive although all students (regardless of first-year origin) are considered to be equivalent.
SFU - Burnaby	Limited transfer agreements exist for SFU - Burnaby due to its two-year common curriculum across all its programs. Vancouver Community College replicates the first-year SFU program and students from VCC are required to maintain a minimum GPA and completion time to be considered for admission. The agreement with Vancouver Island University mixes course-by-course articulation for part of the curriculum and a block transfer for the remaining portion. Again, students are required to maintain a minimum GPA and maximum completion time to be a considered for admission. In both cases, there is a cap on the number of overall admissions.
SFU - Surrey	No transfer agreements exist for SFU - Surrey. Student transfer eligibility is provided on a case-by-case basis with credit granted for courses articulated through BCCAT.

[8] As of Jul-2016

The University of Victoria has actively pursued building formal agreements, and has emphasized course-by-course articulation. Agreements in place were provided to the BCCAT Engineering Articulation Committee at its last annual meeting (May-2016). UBC-Okanagan has provided details on course transfer equivalencies between their first year program and most sending institutions, while the UBC-Vancouver has recently changed their first year curriculum to include two new design courses (APSC 100/101) and current transfer agreements in place have not yet been updated. Further, capacity constraints have restricted the ability of UBC-Vancouver to expand on the number of institutions covered under its engineering transfer program.

Recommendation #3

Sending institutions encapsulate their first year engineering curriculum as a recognized credential and aligned to the common engineering core curriculum.

Historically, the engineering transfer curriculum has often been an orphan at most sending institutions; students enroll in a set of first year courses that, collectively, provide a transfer path to specific receiving institutions. Indeed, receiving institutions still accept students based on their course history.

The CEAB shift towards graduate attributes, implicitly requiring an earlier introduction to students of the concepts professionalism, engineering ethics, and the role of the engineering in society, creates an opportunity for sending institutions to consider broader program level objectives and enhance their students' learning experience. Structuring the first year engineering transfer curriculum as a recognized credential aligned to the common core requirements may help realize this opportunity.

A number of sending institutions have recently moved towards a first year engineering experience program model (e.g., certificate program in engineering at Kwantlen Polytechnic University; engineering foundations certificate at Douglas College). These cohort-centred programs help to promote a supportive environment for students; enhancing their self-awareness, peer instruction, networking, and team building. In the author's experience, creating the fundamentals of engineering certificate program at VIU has provided a number of additional benefits to the above including:

- Increased profile of engineering both within the institution and local community;
- Improved student intake management and tracking student progress post-transfer;
- Improved resourcing/community sponsorship to aid program growth and enhance the student learning experience;
- Strengthened connections to the local engineering community (e.g., local APEGBC branch); and
- Opportunities to enhance students' experiential learning (e.g., co-op, field trips).

D. CORE CURRICULUM

The core engineering curriculum is intended to capture the minimal threshold of topical coverage that is acceptable by all receiving institutions and can be treated as *equivalent* to their first year of engineering studies. Although differences inevitably will still exist between this common core curriculum and the first year program at individual receiving institutions, the essential learning outcomes and expectations from first year are deemed not to be detrimental to student success nor to accreditation requirements. Students would be expected to complete the *full coverage* of the core curriculum in order to satisfy the *content* for transfer. The *process* within which students transfer (e.g., minimum GPA, time frame for completion) continues to be owned by the receiving institutions (Figure 5).

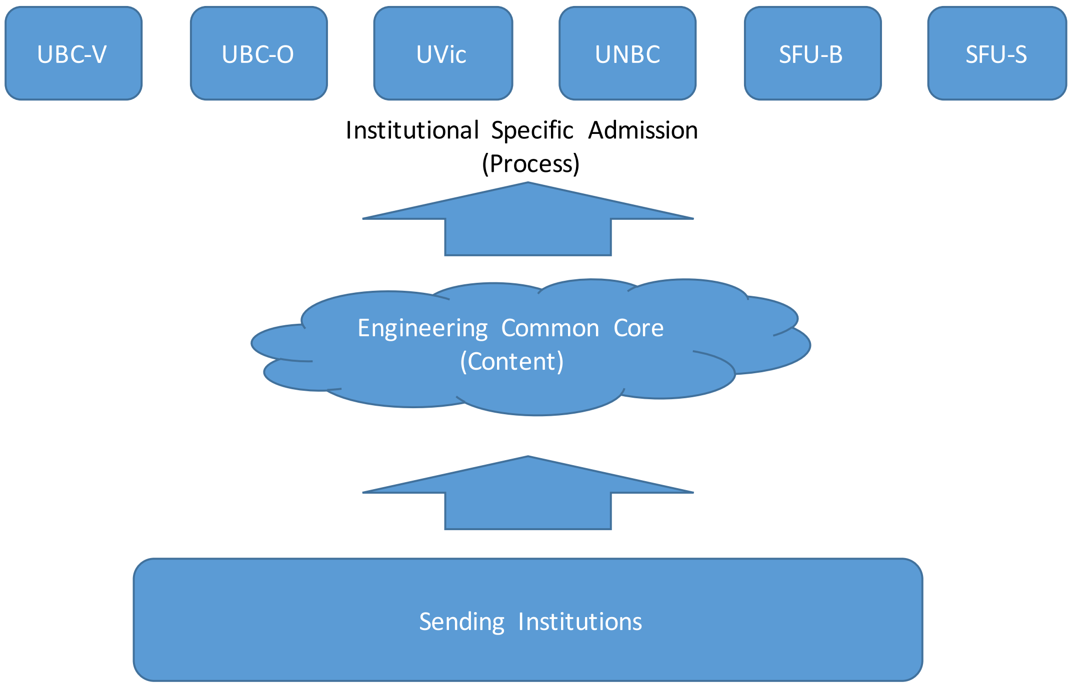


FIGURE 5. GENERALIZED TRANSFER PROCESS

APPROACH

The approach to develop a core engineering curriculum focused first on commonalities across the curricula for the six major receiving institutions[9]. Where curricular expectations differ, technical and accreditation outcomes were evaluated to determine overlap and establish a minimum threshold of topical coverage and the depth that might be acceptable to all receiving institutions.

One consideration was the desire to ensure efficiencies within the post-secondary system and provide flexibility to students. Hence, although it is important to consider the core curriculum holistically in terms of its ultimate learning objectives, whenever reasonable, course-by-course articulation and alignment to general BSc requirements was undertaken.

[9]SFU - Surrey, SFU - Burnaby, UBC - Vancouver, UBC - Okanagan, UNBC, and UVic

CORE CURRICULUM - GENERAL FRAMEWORK

A general framework for the common first year engineering curriculum requirements is provided in Figure 6. Courses within the curriculum have been attached to the accreditation unit (AU) components required by CEAB. Each of these courses is assumed to be weighted at no less than three credits, with specific contact hours and description given in the sections which follow.

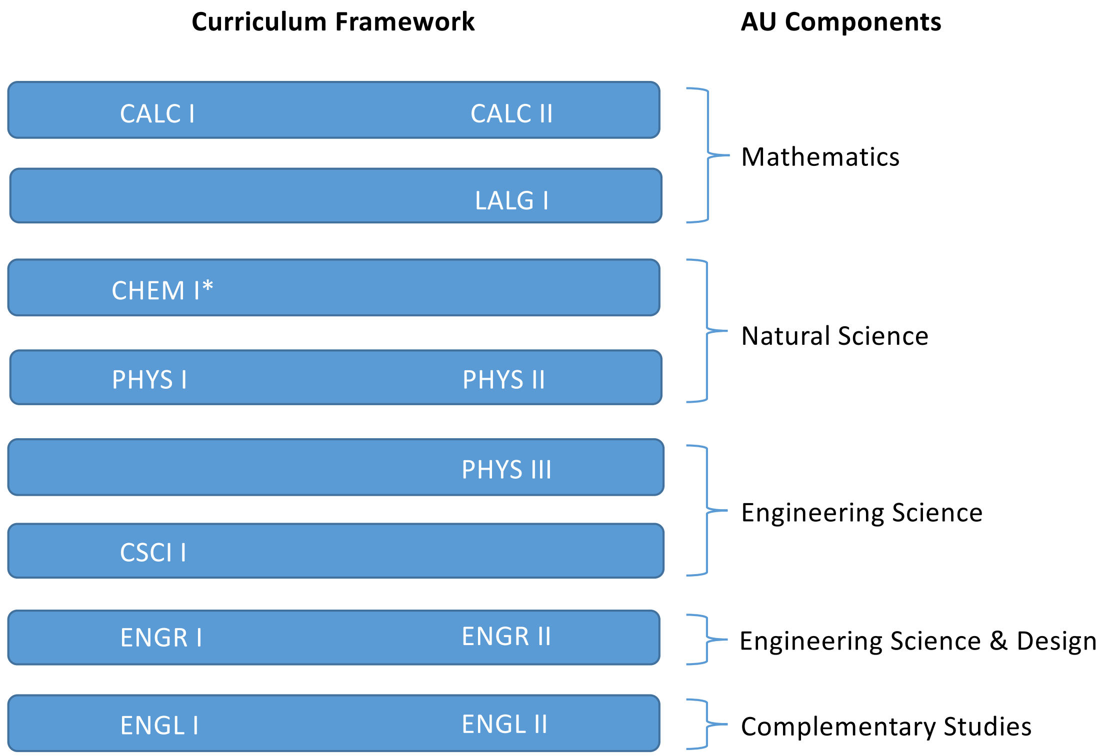


FIGURE 6. CORE CURRICULUM FRAMEWORK

CORE CURRICULUM - CALC I/II (Calculus I/II)

Calculus I (Derivative) and Calculus II (Integration) have been standardized for the science stream across all BC post-secondary institutions under a BCCAT TI project entitled *First-year Core Calculus*[10]. The BC Transfer Guide shows the equivalent of Calculus I and II are articulated across all receiving institutions on a course-by-course basis.

It is *strongly recommended* that subject matter within Calculus I and Calculus II be integrated as much as reasonable with the Physics I and Physics II curriculum to aid student understanding.

[10]http://www.bccat.ca/pubs/calculus.pdf (as of 16.Jul.2016)

It is *required* that sending institutions ensure the topics "sequences and series" and "polar coordinates and parametric equations" are covered as part of the Calculus I and II curriculum. Lack of exposure to these topics have been shown to impact student success in their 2nd year of engineering studies.

CALC I and CALC II are each generally **52 contact hours** (lecture/tutorial) over the term[11].

CORE CURRICULUM - CHEM I* (Chemistry I*)

Chemistry I* is a single course which combines the learning outcomes from both Chemistry I (CHEM I) and Chemistry II (CHEM II), the two standard chemistry courses within the first year of a Bachelor of Science program at most institutions.

Although specific topical coverage for CHEM I* may differ slightly between receiving institutions, the typical syllabus for this course includes:

- Electronic structure of atoms
- Periodic properties
- Basic concepts of chemical bonding
- Molecular geometry and bonding, metallic bonding
- Intermolecular forces
- Gases
- Thermochemistry
- Liquids
- Chemical equilibrium
- Chemical thermodynamics
- Electrochemistry
- Chemical kinetics

Although CHEM I and CHEM II, as a block, may be applied towards the first year chemistry requirement within a common engineering curriculum, it is *recommended* that for those institutions not offering CHEM I*, a one-credit course be developed to supplement material not covered in CHEM I but required for CHEM I*. Typically, this material will consist of thermochemistry, thermodynamics, and electrochemistry and will be covered in no less than **13 contact hours** (lecture/tutorial) and **9 contact hours** (lab) over the term. The combined block of CHEM I plus this one credit course ought to fulfill the chemistry requirements within a common engineering curriculum without adding considerably to the student course load.

[11]Contact hours are listed as an *approximate* total over a study term. For a standard term at most institutions, 52 contact hours equates to 4 contact hours per week over 13 weeks of study. Variation from the reported number will exist due to statutory holidays and other scheduling issues.

For institutions offering CHEM I*, it is *suggested* that this course be offered over two terms to better balance student workloads, with the caveat that students would no longer be able to use this course for credit if they choose to transfer out of engineering after the first term. If CHEM I* is offered for only a single term, it is *recommended* that it be treated as *equivalent* to CHEM I for the purpose of entry into CHEM II. This recommendation allows students the flexibility to more easily switch to a bachelor of science (BSc) if they choose not to continue their studies in engineering.

The thermodynamics coverage described as part of PHYS III (see next section) is expected to augment the above list and is a *requirement* of the common curriculum.

CHEM I, CHEM II, and CHEM I* are each generally **52 contact hours** (lecture/tutorial) and **30 contact hours** (lab) over the term.

CORE CURRICULUM - PHYS I/II/III (Physics I/II/III)

For the purposes of this report, it has been convenient to consider the Physics requirements for first year as being split across three distinct courses: Physics I (mechanics I and waves), Physics II (electricity and magnetism), and Physics III (mechanics II and thermal physics). The topical coverage for each has been allocated in such a way that Physics I/II will typically transfer as a block between sending and receiving institutions, each comprising of what may typically be found within the standard first year physics requirements of a BSc program at most institutions. Physics III captures topics which are mostly reserved for the engineering stream of Physics (e.g., UBC-Vancouver) and/or dedicated mechanics courses at the first year level (e.g., UVic).

In Figure 7, a general outline of topics covered in each of Phys I, II, and III are provided. The order of these topics is suggested to best align the engineering curriculum with that of a BSc, but is not demanded by the requirements of the engineering curriculum itself. Each of the topics listed should be allocated (on average) approximately one week (or three to four hours) of lecture time.

It has been generally agreed by all receiving institutions that a portion of the PHYS III coverage shall be based on a standard text: Hibbler, *Statics and Dynamics*. The specific edition of the text *must be* the 10th edition or greater, and the section coverage *must be no less than* those indicated in Figure 7. This section coverage is deemed to have satisfied both PHYS 170 (UBC-Vancouver) and ENGR 141 (UVic), as well as the relevant topics covered within APSC 180 and APSC 181 (UBC-Okanagan). Simon Fraser University does not require the Hibbler content as part of their first year curriculum.

It is noted that the mechanics topics covered within PHYS I and PHYS III -- particularly the content within Hibbler Chpts 1-3, 8, 12 and 13 -- have considerable overlap; principles are introduced in former, while in the latter, these principles are elaborated and applied.

PHYS I

- Vectors
- Projectile Motion
- Circular Motion
- Newton's Laws and Free Body Diagrams
- Friction
- Work and Energy
- Conservative Forces, Potential Energy, and Work-Energy Theorem
- Center of Mass, Momentum, and Collisions
- Reference Frames, Rotational Kinetics, Moment of Inertia, and Torque
- Rotational Dynamics
- Statics
- Angular Momentum and Rolling Bodies
- Simple Harmonic Motion and Pendulums
- Waves, Sound, Interference and Standing Waves, Doppler Effect

PHYS II

- Coulomb's Law, E-Fields
- Flux, Gauss' Law
- Electric Potential, Conductance and Capacitance
- DC Circuits: Ohm's Law, Kirchoff's Laws
- RC Circuits
- Magnetic Fields, Force on Charges, Torque on Currents
- Biot-Savart Law, Ampere's Law
- Lenz's, and Faraday's Laws
- AC Circuits (incl. LC, RLC)
- Properties of EM Waves, Light, and Polarization
- Physical Optics – Reflection, Refraction, and Lenses
- Wave Optics – Superposition, Interference, Reflection
- Quantum Theory

PHYS III

- Zeroth Law and Heat Capacity
- Kinetic Theory, First Law of Thermodynamics
- Heat Engines
- Statics and Dynamics [From Hibbler*]
  - *Chpt 1.1-1.6 – General Principles*
  - *Chpt 2.1-2.9 – Force Vectors (excl 2.4)*
  - *Chpt 3.1-3.4 – Equilibrium of a Particle*
  - *Chpt 4.1-4.10 – Moments*
  - *Chpt 5.1-5.7 – Rigid Body*
  - *Chpt 6.1-6.6 – Structural Analysis*
  - *Chpt 7.1-7.3 – Internal Forces*
  - *Chpt 8.1-8.4 – Friction*
  - *Chpt 12.1-12.8 – Kinematics*
  - *Chpt 13.1-13.6 – Kinetics*

*Hibbler, R.C., *Statics and Dynamics, 13th Edition*, Pearson Prentice Hall (2013)

FIGURE 7. TOPICAL COVERAGE IN PHYS I/II/III

It is *recommended* that institutions consider more strongly coupling PHYS I and PHYS III to improve efficiency of delivery and aid student understanding. It is *suggested* that PHYS III be spread over a full academic year to supplement material in PHYS I as appropriate.

It is *required* that the attached laboratory for PHYS I and PHYS II include at least two sessions on AC circuits with emphasis on instrumentation.

PHYS I and PHYS II are each generally **52 contact hours** (lecture/tutorial) and **30 contact hours** (lab) over the term.

PHYS III is generally **52 contact hours** (lecture/tutorial) over the term.

CORE CURRICULUM - ENGL I/II (English I/II)

ENGL I is a standard university academic writing course historically required by all sending and receiving institutions (excluding, most notably, Simon Fraser University). It typically consists of an introduction to critical thinking and reading, academic writing, and research skills consistent with the expectations of university. Within the common core context, it is *recommended* that this course be offered as a collaborative effort with ENGR I.

ENGL II focusses on communicating technical information clearly and concisely, managing issues of persuasion when communicating with diverse audiences, presentation skills, and teamwork. It is a requirement of all receiving institutions excluding the University of British Columbia. In its place, UBC requires complementary studies credit (for which ENGL II can be applied) or a second first year English course, which allows students to waive its language proficiency testing requirement. Within the common core context, it is *recommended* that this course be offered as a collaborative effort with ENGR II.

ENGL I and ENGL II are each generally **39 contact hours** (lecture/tutorial) over the term.

CORE CURRICULUM - LALG I (Linear Algebra I)

Linear Algebra is required by all receiving institutions although it can be numbered as either a 1st or 2nd year course. The BC Transfer Guide shows the equivalent of Linear Algebra articulated across most receiving institutions on a course-by-course basis. It is *required* that MatLab (or equivalent tool) and its application be introduced to students as part of the course content, preferably as a lab component. A typical syllabus includes:

- Systems of linear equations and matrices
- Matrix algebra
- Determinants
- Linear independence and bases in R^n
- Linear transformations
- Eigenvalues and eigenvectors
- Applications of linear algebra

Within the common core context, it is *recommended* that this course be offered as a collaborative effort with PHYS III to provide tools to assist students with more advanced problems in mechanics.

LALG I is generally **52 contact hours** (lecture/tutorial) and **6 contact hours** (lab) over the term.

CORE CURRICULUM - CSCI I (Introduction to Programming)

An introduction to programming (typically in C/C++) is a required course by all receiving institutions although emphasis on practical applications of programming may vary. A typical syllabus based in C/C++ includes:

- Introduction to computer programming
- Manual execution, testing, and debugging
- Variable and data types
- Expressions
- Addresses, pointers, and storage allocation
- Functions and parameter passing mechanisms
- Control structures
- Arrays
- Elementary searching and sorting
- Strings
- Structures and unions
- Recursion

Within the common core context, it is *required* that this course is a pre-requisite for ENGR II to support its emphasis on the practical application of programming skills using a microcontroller (e.g., Arduino).

It is *recommended* that CSCI I be structured as a collaborative effort with ENGR I and ENGR II to improve student learning outcomes.

CSCI I is generally **52 contact hours** (lecture/tutorial) and **24 contact hours** (lab) over the term.

CORE CURRICULUM - ENGR I/II (Engineering I/II)

An effective engineer requires a broad understanding of a large body of expertise, separate from and independent of the sciences. The increasing emphasis of CEAB on graduate attributes encourages developing students' understanding of engineering design, the engineering profession, and engineers' roles in society at a much earlier point in their academic career. To promote these key knowledge areas, all receiving institutions have core engineering courses in their first year:

UBC-Vancouver	:	APSC 100/101
UBC-Okanagan	:	APSC 169/171
UVic	:	ENGR 112/121
SFU-Burnaby	:	ENSC 100W/180/120
SFU-Surrey	:	MSE 100/102/110
UNBC	:	ENGR 117/151/152

These core engineering courses are typically counted by the receiving institutions towards the accreditation requirement and no less than a defined minimum amount of engineering science and engineering design content can be taught by instructors with professional engineering licensure (e.g., Eng. L, or P. Eng.). Hence, it is a *requirement* within the context of the engineering core curriculum that ENGR I and ENGR II be instructed by an engineering licensee.

As CEAB is silent on specific content for each graduate attribute, the approach each receiving institution takes on its delivery may differ. However, the broader learning objectives for students by the end of first year are commonly accepted.

General Learning Objectives[12]

- [GLA #3] Identify relevant background information including engineering and scientific principles and methods; a priori art; regulatory constraints; environmental considerations; and stakeholder interests.
- [GLA #4] Apply the engineering design process to well-defined and well-constrained engineering design problems and understand its iterative nature.

[12]Partially drawn from the Learning Outcomes for UBC APSC 100/101 and UVic ENGR 112/121. The relevant CEAB Graduate Learning Attributes (GLA) are identified.

- [GLA #4] Propose innovative solutions for engineering design problems.
- [GLA #4] Evaluate alternative conceptual designs using a formal decision making process.
- [GLA #4] Apply engineering and scientific principles and methods to develop a detailed design.
- [GLA #6] Describe and demonstrate key principles in effective team functioning.
- [GLA #7] Effectively prepare and deliver oral presentations and technical reports both as an individual and as part of a team.
- [GLA #8] Discuss the concept of a profession and how it relates to engineering.
- [GLA #8] Know the role of the engineer in society, including responsibility for protecting the public interest.
- [GLA #9] Describe the contribution that an engineer can make to society and analyze the impact (both positive and negative) of an engineering project on society and the environment.
- [GLA #10] Demonstrate ethical behaviour and, as an engineering professional, understand their ethical obligations i.e., the engineering code of ethics.
- [GLA #11] Apply selected tools for effective management of time and resources in the context of an engineering design project.
- [GLA #12] Identify individual learning needs or gaps, and recognize the expectation of life-long learning and continuing professional development.

In addition to the general learning objectives, each receiving institution may introduce technical content that may have considerable impact on student success in subsequent years. To ensure that the core engineering curriculum provides sufficient background for students to transfer to any receiving institution, the following technical content (both topic and depth) is required.

Specific Technical Requirements

General Course Delivery

Although specific institutional course delivery models may differ, ENGR I and ENGR II typically consists of both lecture and lab/project sessions and often run sequentially and with progressive student development over a full academic year. Generally, ENGR I focuses on providing students with a firm understanding of the engineering design process, team work, and includes at least two minor projects (e.g., impact of technology on society and the environment, CAD/CAM). The focus of ENGR II is for students to demonstrate the ability to successfully plan, deliver, and communicate a major project using engineering design principles and the tools and resources introduced throughout the ENGR I/II curriculum.

It is *generally recommended* that the following coverage applies to the ENGR I/II curriculum.

Team work / group development (GLA #6)

- Understand and apply the Tuckman model for group development
- Demonstrate models for building successful teams
- Assess different personality types
- Demonstrate conflict resolution
- Demonstrate giving / receiving feedback

Professionalism & Ethics (GLA #8, #10, and #12)

- Demonstrate the difference between social and professional responsibility
- Understand the CEAB core competencies
- Understand the requirement for continuous improvement
- Identify the Engineering code of ethics and understand its tenets
- Effectively resolve ethical conflicts
- Evaluate case studies

Engineering Design (GLA #2, #3, #4, and #7)
[Topic demonstrably embedded over a minimum of one standard term[13]]

- Describe and identify tools within each step of a general Engineering Design process:

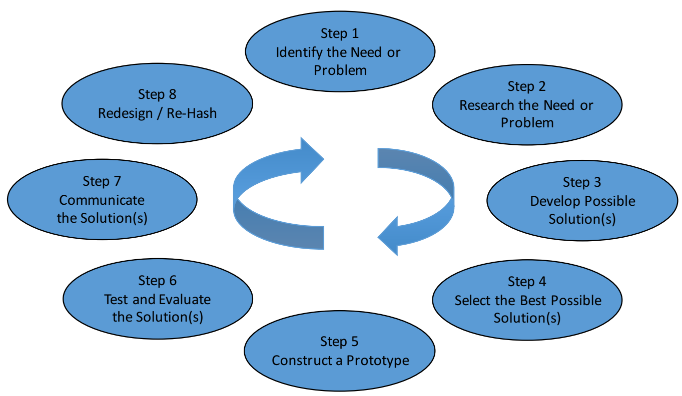


FIGURE 8. GENERAL ENGINEERING DESIGN CYCLE

- Understand the relationship between client and design team
- Identify and engage stakeholders
- Identify project scope (function and constraints)
- Integrate design considerations (e.g., manufacturability, assembly, safety, environment)
- Understand the concepts of risk and hazards
- Use brainstorming and creative thinking tools
- Evaluate alternative solutions (e.g., Pugh, weighted decision matrix, AHP)

---

[13]A standard term in the contact of this report equates to a study period of approximately **13 weeks** where ENGR I and ENGR II each have **2 contact hours** (lecture/tutorial) and **2 contact hours** (lab) per week. The course delivery model at specific institutions may vary.

- Develop metrics for evaluating performance
- Build / test prototypes (modeling tools, testing methods)
- Demonstrate effective written and oral presentation skills

Impact of Technology on Society and the Environment (GLA #9)
[Topic demonstrably embedded over a minimum of one-half of one standard term]

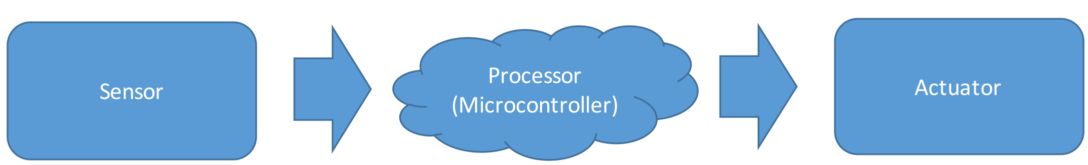
- Describe the three pillars of sustainability
- Demonstrate the difference between traditional engineering design criteria and sustainable engineering design criteria
- Illustrate the concepts of life cycle assessment / "cradle to grave" / inventory analysis
- Evaluate case studies
- *Project focus*

Engineering Drawing / CAD / CAM (GLA #5)
[Topic demonstrably embedded over a minimum of one-half of one standard term]

- Demonstrate sketching
- Demonstrate isometric drawing
- Demonstrate orthographic / multi-dimensional drawing
- Demonstrate lines/angles/dimensioning
- Demonstrate CAD (e.g. using SolidWorks) up to and including 3D sketching and exploded views and produce prototypes by interfacing CAD with fabrication tools (e.g. 3D printers)
- *Project Focus*[14]

Major Project Work (GLA #2, #3, #4, #7, and #11)
[Topic demonstrably embedded over a minimum of one standard term]
Students, working in teams, follow a structured process to design a sophisticated system comprising of multi-disciplinary subsystems (e.g., electrical, mechanical, and software) and including the following characteristics:

- Students are to demonstrate progress at several milestone stages with associated technical reporting including a final report in both oral and written form.
- Client-based e.g. the client prescribes the scope and constraints and verifies the final product delivery.
- Consists of the following structure:



[14]Many colleges/teaching universities already offer a CAD course due to historic informal agreements with UBC-Vancouver. It is suggested that these courses be modified such that their objectives lead towards an engineering deesign project.

FIGURE 9. MAJOR PROJECT COMPONENTS

- Include student-sourced components
- *Suggested:* Include student designed and fabricated printed circuit board components
- Students consider regulatory constraints, the business case, stakeholder interests, and environmental considerations as part of an iterative project design:

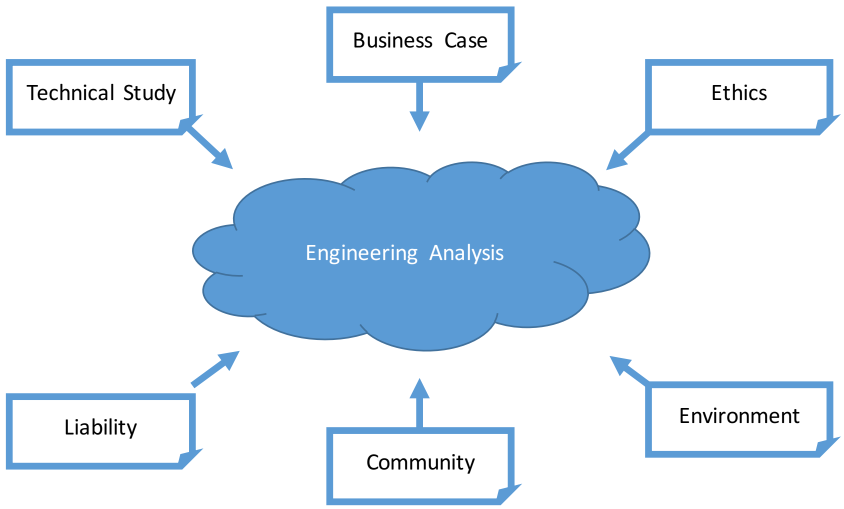


FIGURE 10. SELECT ENGINEERING DESIGN CONSIDERATIONS

Examples of major projects include constructing a robot that can maneuver around obstacles and perform specified tasks, or building a moveable bridge that detects and controls ship and vehicle flow. In each of these cases, students are required to design, build and test several sensor and actuator subsystems, program and test the central control unit (e.g., Arduino microcontroller), and integrate and test the final design.

It is *recommended* that the major project be developed as a collaborative effort with ENGL II.

ENGR I and ENGR II are each generally **26 contact hours** (lecture/tutorial) and **20 contact hours** (lab) over the term.

CORE CURRICULUM - SUGGESTED CURRICULUM MAPPING

Figure 11 summarizes the above text through a suggested mapping of courses according to strongly recommended or required linkages (indicated by an arrow) or suggested linkages (indicated by a side box). This mapping is just one suggestion and based upon a two-term schedule. Other configurations may be deemed by individual institutions to be more effective to promote student learning and/or applicable given their particular constraints.

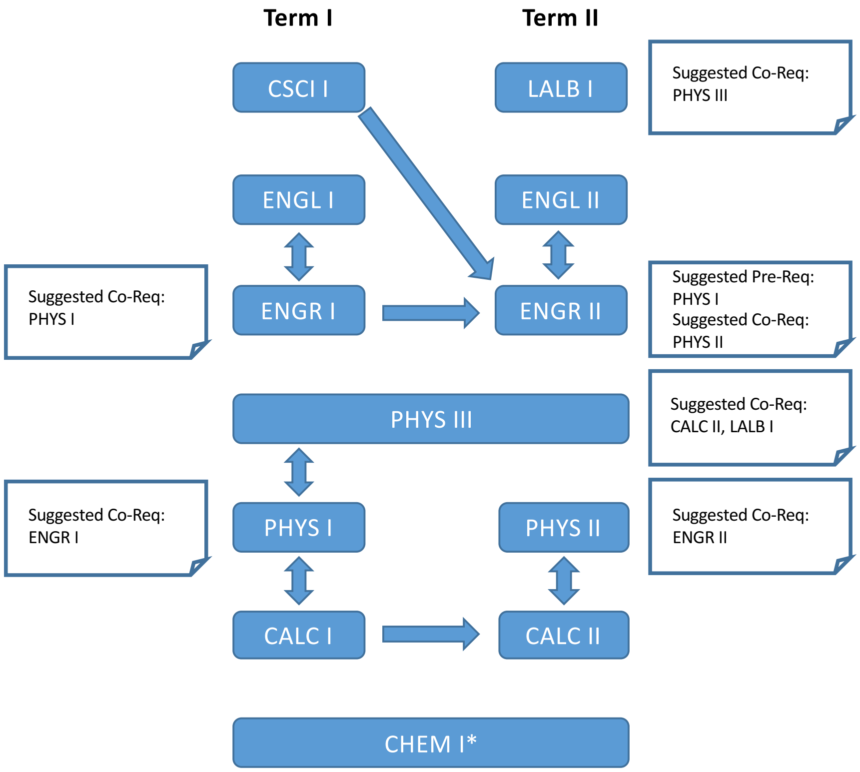


Figure 11. Suggested Core Curriculum Mapping

E. ANCILLARY OUTCOMES

In addition to successfully accomplishing its primary tasks, the author notes that this initiative has resulted in a generally increased level of collaboration amongst sending and receiving institutions. Several supplementary benefits and outcomes have resulted:

- A clearer understanding of the constraints experienced by the receiving institutions in terms of their accreditation requirements and seat capacities;
- Improved feedback on transfer student progress to sending institutions during the annual BCCAT Engineering Articulation meeting;
- An initiative to develop open text books and/or open source learning resources attached to proposed common core courses; and
- An initiative to develop an inter-school design competition.

GOING FORWARD

The primary goal of this project was to determine the *feasibility* of developing a first year core engineering curriculum. This report contains the following deliverables supporting this goal:

1. A study of transfer statistics between sending/receiving institutions including measures of student success, retention, and other relevant factors.

   Recommendation #1 encapsulates the start of a conversation on how best to articulate student progress for both sending and receiving institutions. Further study is required if and when this project moves to the implementation stage.

2. A summary of current engineering transfer options between all articulated post-secondary institutions (e.g., letter of agreement or LOA, block transfer, BCCAT course-by-course transfer).

   This report (and the supporting discussion paper released in Dec-2015) broadly summarizes transfer options available with the post-secondary sector of British Columbia. **Recommendation #2** addresses the need to promote availability of these options to the wider BCCAT Engineering Articulation Committee, member institutions, and their communities.

3. A set of core, first-year expectations of receiving institutions.
4. A set of core, first-year competencies from the CEAB.
5. A suggested course mapping consistent with Items 3 and 4.

   The bulk of **this report delivers a core engineering curriculum framework** that aligns the *expectations* of all receiving institutions into a common set of learning outcomes consistent with the *graduate attributes* prescribed by CEAB. It further packages these learning outcomes into recognizable course blocks that have been *mapped* to promote enhanced student learning, flexibility, and choice.

TRANSFER INNOVATIONS PROJECT RECOMMENDATIONS

The Phase I (feasibility) stage to develop a first year core engineering curriculum has been successful. It is recommended to the BCCAT Engineering Articulation Committee (or its representative) that a proposal for Phase II (implementation) be submitted to BCCAT under its Transfer Innovations program.

We must continue to *strive to create an environment which offers opportunities for each student to discover and pursue those aspects of engineering in which he or she will excel*[15].

---

[15] from Jones, John, *The Betterment of the Human Condition, 2nd Edition*, Pearson (2011)

APPENDIX A: INSTITUTIONAL CONTACTS

TABLE A1. INSTITUTIONAL CONTACTS

Institution	Contact
Capilano University	Tomberli, Bruno
Camosun College	Ballinger, George
College of New Caledonia	Rudecki, Barbara
College of the Rockies	Beugeling, Trevor
Columbia College	Todoruk, Tara
Douglas College	Majdanac, Allan
Langara College	Stuckless, J. Todd.
Kwantlen Polytechnic University	Poon, Michael
North Island College	Lightfoot, Dennis
Northwest Community College	Sibbald, Regan
Okanagan College	Christie, Richard
Selkirk College	Switslishoff, Elroy
Simon Fraser University (both Burnaby and Surrey)	Park, Edward Trautman, Marilyn
Thompson Rivers University	Ahmed, Fahmed
University of British Columbia – Okanagan	Cao, Yang Briskham, Megan
University of British Columbia – Vancouver	Jaeger, Carol Murphy, Mary Ostafichuk, Peter
University of Northern British Columbia	Whitcombe, Todd
University of the Fraser Valley	Mulhern, Peter
University of Victoria	Jackson, LillAnne Gwyn, Margaret
Vancouver Community College	Sellwood, Andy
Vancouver Island University	Dick, Brian
BC Council on Admissions and Transfer	FitzGibbon, John
Association of Professional Engineers and Geoscientists of BC	Maxwell, Francine
Engineering Graduate Attribute Development Project	Kaup, Frank Frank, Brian

APPENDIX B: ACTIVITY RECORD

Meeting Schedule

Date	*Location*	*With*	*Representing*
20.Mar.2015	SFU-Burnaby	Jones, John	SFU-Burnaby
30.Apr.2015	SFU-Burnaby	Engineering Articulation Committee Discussion	
16.Jun.2015	UBC-Vancouver	Jaeger, Carol	UBC-Vancouver
18.Sep.2015	Langara	Project Status w/ Stuckless, Todd J.	
23.Oct.2015	SFU-Surrey	Rad, Ahmad	SFU-Surrey
26.Oct.2015	UVic	Jackson, LillAnne	UVic
		Wild, Peter	
12.Nov.2015	UBC-Okanagan	Cao, Yang	UBC-Okanagan
		Briskham, Megan	
		Taheri, Ray	
19.Nov.2015	VIU	Jaeger, Carol	UBC-Vancouver
24.Nov.2015	NIC	Lightfoot, Dennis	NIC
21.Mar.2016	VCC	Sellwood, Andy	VCC
21.Mar.2016	Langara	Project Status w/ Stuckless, Todd	
01.Apr.2016	UBC-Vancouver	Jaeger, Carol	UBC-Vancouver
		Ostafichuk, Peter	
		Murphy, Mary	
		Jackson, LillAnne	UVic
		FitzGibbon, John	BCCAT
		Stuckless, Todd	Eng. Art. Comm.
		Whitcombe, Todd	UNBC
06.Apr.2016	Camosun	Ballinger, George	Camosun
15.Apr.2016	UBC-Vancouver	Jaeger, Carol	UBC-Vancouver
		Murphy, Mary	
05.May.2016	UNBC	BCCAT Engineering Articulation Committee	
12.May.2016	CapU	Tomberli, Bruno	CapU
		Rezaie, Erfan	
16.May.2016	BCCAT	FitzGibbon, John	BCCAT
		Adamoski, Robert	
		Tikina, Anna	
25.May.2016	SFU-Burnaby	Park, Edward	SFU
		Trautman, Marilyn	
26.May.2016	UBC-Vancouver	Ostafichuk, Peter	UBC-Vancouver
27.May.2016	Burnaby	Mulhern, Peter	UFV
14.Jul.2016	Douglas	Kirkey, Jennifer	Douglas
		Majdanac, Allan	
		Verma, Nakul	

E-mail/Phone correspondence also included:
CNC, CotR, KPU, VIU, TRU, APEGBC, CEAB, MacEwan University (Alberta) and EGAD

Other Relevant Activities

- *Attendee* - APEGBC Panel Discussion: Internationally Trained Engineers & Geoscientists: Bridging Supply & Demand Gaps in BC Engineering & Geoscience
- *Invitee* - APEGBC Focus Group: Licensee designation
- *Attendee* - UBC Safety Learning Forum (in collaboration with Minerva Canada and WorkSafeBC)

APPENDIX C: ENG.L SCOPE OF PRACTICE EXAMPLE

The Association of
PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
of the Province of British Columbia

LIMITED LICENCE

Brian Dick has signed an undertaking and is therefore authorized to engage in the practice of Professional Engineering in the Province of British Columbia, within the limited scope as specified hereunder:

Limited to teaching courses in classrooms and laboratories in electrical engineering, fundamental engineering design, microfabrication/nanostructures, technology and society, and general physics.

Scope Limitations:
The Licensee's work must be primarily research or teaching and carried out in a university setting.

Granted June 17, 2015

APPENDIX D: FORMAL ENGINEERING TRANSFER AGREEMENT EXAMPLE

University of Victoria | Faculty of Engineering | Engineering Undergraduate Office
Engineering Office Wing, Room 206, PO Box 1700 STN CSC Victoria BC V8W 2Y2
Canada T 250-721-6012| engr@uvic.ca | uvic.ca/engineering

Langara College - University of Victoria Engineering Transfer

Langara College (LANG), founded in 1965, is an accredited public post-secondary institution that enrolls nearly 8,550 full time students per year, including international students, in a variety of credit classes and programs. LANG is located in Vancouver, British Columbia.

- This transfer agreement provides for direct transfer to second-year Engineering at the University of Victoria. Individual course equivalencies, established in the BC Transfer Guide, form the foundation of this agreement. Students in LANG take all first year Bachelor of Engineering courses, except ENGR 130, then transfer to UVic at the beginning of their second year.
- ENGR 130 (Introduction to Professional Practice) is a course completed by all students in the engineering program soon after they begin the UVic program.
- This transfer agreement features *guaranteed admission* to the second year of one of the Bachelor of engineering programs for students who have successfully completed all of the courses in the agreement with a *minimum UVic GPA* of *C+ (or UVic 3.0 or LANG 2.33)* and who have *no courses with grades less than C*.
- LANG applicants will compete on an equal footing with UVic students for placement in their chosen program: Computer, Electrical, Mechanical, Biomedical, Civil or Software, which begin in second year. Where any program is over subscribed, competitive grades will be considered. Students whose grades are not competitive to gain admission in their first choice of program will be offered an alternate second year program.
- The Faculty of Engineering expects this agreement will yield between 5 and 10 transfer applications per admission cycle.

This transfer agreement will be reviewed annually with respect to calendar changes and expires in two (2) years from the date of signing.

Dr. Ian Humphreys Vice-President Enrolment and Business Development Langara College	Dr. Tom Tiedje Dean Faculty of Engineering University of Victoria
Date 2016.03.04	Date May, 10, 2016

Engineering Transfer Program, Langara College to the University of Victoria

University of Victoria	
First Year	
Term 1A	
CSC 111	Fundamentals of Programming with Engineering Applications
ENGR 130	Introduction to Professional Practice
ENGR 110	Design and Communication I
MATH 100	Calculus I
MATH 110	Matrix Algebra for Engineers
PHYS 110	Mechanics for Engineers
Term 1B	
CHEM 150	Engineering Chemistry
ENGR 120	Design and Communication II
ENGR 141	Engineering Fundamentals: I
MATH 101	Calculus II
PHYS 111	Fundamentals of Physics

Langara College		
First Year		
LANG Course	UVic Equivalent	Justification
CPSC 1150 or 1155	CSC 110[1] or 111	BCCAT[2]
* Must take at UVIC *		
ENGL 1127 & CPSC 1090 & CPSC 1490[2]	ACWR 100 lev[2], MECH 200 lev[2], ENGR 121[2]	BCCAT & Footnote 2
MATH 1171 or 1173	MATH 100	BCCAT
MATH 1252 or 2362	MATH 211[3]	BCCAT
PHYS 1125 & 1225[4]	PHYS 110 and 111[4]	BCCAT
CHEM 1154	CHEM 150	BCCAT
CMNS 2228 or 1118[7] CPSC 1490	ENGR 240 or ENGL 225[6] ENGR 121[5]	BCCAT BCCAT
PHYS 1219	ENGR 141	BCCAT
MATH 1271 Or (1273 & 1283)	MATH 101	BCCAT
PHYS 1225 & 1125[4]	PHYS 110 and 111[4]	BCCAT

Notes:

1. UVIC CSC 110 replaces the CSC 111 requirement in the UVIC program.
2. Although the courses transfer individually (in BCCAT) as ACWR 100 level, MECH 200 level and ENGR 121, students whose transcripts include all 3 courses and who are admitted to UVIC's Engineering programs will have the requirement to complete ENGR 110 waived.
3. UVIC MATH 211 replaces the MATH 110 requirement in the UVIC program
4. LANG PHYS 1125 and 1225 = UVIC PHYS 110 and 111.
5. UVIC ENGR 240 or ENGL 225 and ENGR 121 replace the ENGR 120 requirement in the UVIC program.

In addition: Students targeting Biomedical, Civil, Computer, Electrical or Mechanical Engineering typically take CHEM 150 in 1st year, while students targeting Software Engineering take UVIC CSC 116 (or CSC 115) in 1st year then CHEM 150 in 2nd year. Langara students who complete the above courses, but not a course that transfers to CSC 116 (or 115) will be as admissible Software engineering as the other programs, but will need to pick up the course as soon as possible in order to make suitable 2nd year schedules.

APPENDIX E: SECTOR 1ST YEAR ENGINEER INTAKE

TABLE E1. RECEIVING INSTITUTIONS: 1ST YEAR INTAKE AND AVAILABLE PROGRAMS

Institution	Students Admitted (est. 2015)	Programs
SFU - Burnaby	250	Biomed, Computer, Electronics, Eng. Phys
SFU - Surrey	90	Mechatronics, Systems
UBC - Okanagan	300	Civil, Electrical, Mechanical
UBC - Vancouver	800	Biomed, Chem & Bio, Civil, Computer, Electrical, Eng.Phys, Environmental, Geo., Integrated, Materials, Mech., Materials, Mining
UNBC	60	Environmental (joint with UBC-V)
UVic	450	Biomed, Civil, Computer, Electrical, Mech., Software
Total:	**1950**	

TABLE E2. SELECT SENDING INSTITUTIONS: 1ST YEAR INTAKE AND TRANSFER AGREEMENTS

Institution	Students Registered (est. 2015)	Transfer Agreements
Capilano University	35	UBC-V[16], SFU-B, UVic
College of New Caledonia	35	UBC-V[13], UVic
College of the Rockies	12	UVic
Kwantlen Polytechnic University	37	UBC-V[13], SFU-B, UVic
Langara College	27	UBC-V[13]
North Island College	12	UVic
Selkirk College	12	UBC-V[13], UBC-O
Thompson Rivers University	60	UVic (2-year), UBC-V[13], UBC-O
University of the Fraser Valley	24	UBC-V[13], UVic
Vancouver Community College	25	SFU-B, UBC-V
Vancouver Island University	48	UBC-V[13], UVic, SFU-B
Total	**327**	

[16] Capilano University, College of New Caledonia, Kwantlen Polytechnic University, Langara College, Selkirk College, Thompson Rivers University, University of the Fraser Valley, and Vancouver Island University are eligible to transfer to UBC-Vancouver under their engineering transfer program.

APPENDIX F: RECEIVING INSTITUTIONS: FIRST YEAR CURRICULUM[17]

TABLE F1. UBC - VANCOUVER: FIRST YEAR CURRICULUM

Course #	Description	Credits
APSC 100	Introduction to Engineering I	3
APSC 101	Introduction to Engineering II	3
APSC 160	Introduction to Computation in Engineering Design	3
CHEM 154	Chemistry for Engineering	3
ENGL 112	Strategies for University Writing (or equivalent)	3
MATH 100	Differential Calculus	3
MATH 101	Integral Calculus	3
MATH 152	Linear Systems	3
PHYS 157	Introductory Physics for Engineers I	3
PHYS 158	Introductory Physics for Engineers II	3
PHYS 159	Introductory Physics Lab for Engineers	1
PHYS 170	Mechanics I	3
ABCD 100	Humanities and Social Sciences elective	3

TABLE F2. UBC - OKANAGAN: FIRST YEAR CURRICULUM

Course #	Description	Credits
APSC 169	Fundamentals of Sustainable Engineering Design	3
APSC 171	Engineering Drawing and CAD/CAM	3
APSC 172	Engineering Analysis I	3
APSC 173	Engineering Analysis II	3
APSC 176	Engineering Communication	3
APSC 177	Engineering Computation and Instrumentation	3
APSC 178	Electricity, Magnetism, and Waves	4
APSC 179	Linear Algebra for Engineers	2
APSC 180	Statics	3
APSC 181	Dynamics	3
APSC 182	Matter and Energy I	3
APSC 183	Matter and Energy II	3

[17] Retrieved 18.Jul.2016

TABLE F3. UNIVERSITY OF NORTHERN BC: FIRST YEAR CURRICULUM

Course #	Description	Credits
CHEM 100	General Chemistry I	3
CHEM 101	General Chemistry II	3
CHEM 120	General Chemistry Lab I	1
CHEM 121	General Chemistry Lab II	1
CPSC 110	Introduction to Computer Systems and Programming	3
ENGR 110	Technical Writing	3
ENGR 117	Engineering Design I	3
ENGR 151	Engineering Tools I	1
ENGR 152	Engineering Tools II	1
MATH 100	Calculus I	3
MATH 101	Calculus II	3
PHYS 110	Introductory Physics I : Mechanics	4
PHYS 111	Introductory Physics II : Waves and Electricity	4

TABLE F4. UNIVERSITY OF VICTORIA: FIRST YEAR CURRICULUM

Course #	Description	Credits[18]
CHEM 150	Engineering Chemistry	3
CSC 111	Fundamentals of Programming with Engineering Applications	3
ENGR 110	Design and Communication I (or ENGR 112 + ENGL 135)	5
ENGR 120	Design and Communication II (or ENGR 121 + ENGL 225)	5
ENGR 130	Introduction to Professional Practice	1
ENGR 141	Engineering Mechanics	3
MATH 100	Calculus I	3
MATH 101	Calculus II	3
MATH 110	Matrix Algebra for Engineers	3
PHYS 110	Introductory Physics I	4
PHYS 111	Introductory Physics II	4

[18] Credit count for UVic adjusted to align with most other receiving institutions.

TABLE F5. SFU - BURNABY: FIRST YEAR CURRICULUM

Course #	Description	Credits
CHEM 121	General Chemistry and Lab	4
CMPT 128	Introduction to Computer Science and Programming for Engineers	3
ENSC 100W	Engineering, Science and Society	3
ENSC 105W	Process, Form and Convention in Professional Genres	3
ENSC 120	Introduction to Electronics Laboratory Instruments	1
ENSC 180	Introduction to Engineering Analysis	3
MATH 151	Calculus I	3
MATH 152	Calculus II	3
MATH 232	Applied Linear Algebra	3
PHYS 120	Mechanics and Modern Physics	3
PHYS 121	Optics, Electricity, and Magnetism	3
CMPL xxx	Complementary Studies elective	3

TABLE F6. SFU - SURREY: FIRST YEAR CURRICULUM

Course #	Description	Credits
CHEM 120	General Chemistry I (or CHEM 121)	4
CMPT 130	Introduction to Computer Science and Programming I	3
MSE 100	Engineering Graphics and Design	3
MSE 101W	Process, Form and Convention in Professional Genres	3
MSE 102	Applied Science Technology and Society	3
MSE 110	Mechatronics Design I	3
MATH 151	Calculus I	3
MATH 152	Calculus II	3
MATH 232	Applied Linear Algebra	3
PHYS 140	Studio Physics : Mechanics and Modern Physics	3
PHYS 141	Studio Physics : Optics, Electricity, and Magnetism	3
CMPL xxx	Complementary Studies elective	3

APPENDIX G: REVISION HISTORY

Version	Comments	Date
1.00	Initial Draft	19.Jul.2016
1.01	Draft title change; Revision history added; minor edits	26.Jul.2016
1.1	Emphasis on PHYS I/III topic overlap; Grant MacEwan correspondence added; Differential equations dropped from LALG topics; Language around ENGL II expanded; suggestion to spread CHEM I* over two terms added, Figure 11 adjusted; minor grammar and spelling errors	09.Aug.2016
1.2	Selkirk College detail added; CEAB section re-written to better capture the accreditation process; Sustainability changed to "Impacts of Technology on Society and Environment"; ENGL II recommended as a collaborative effort with ENGR II; Contact hours added to courses and sub-components of ENGR I/II; One-Credit CHEM course added; Figure 6 (Curriculum Framework) re-worked; Graduate Attribute linkages to ENGR I/II added; minor edits	31.Aug.2016
1.21	Minor edits	29.Sept.2016