

Open Educational Resources (OER) for First-Year Engineering Curriculum

Introduction

Quality open educational resources (OER) are available for a number of first-year courses in engineering programs throughout the Province. Many faculty across B.C. and beyond have long been involved in creating, adapting, and adopting OER for their courses. With that in mind, BCcampus is exploring potential paths to Zero Textbook Cost (ZTC) programs in STEM in B.C., including for first-year engineering. [ZTC programs](#) enable students to earn credentials without incurring costs for textbooks.

BCcampus has recognized the need to search for and align available OER with the common curriculum for first-year engineering (CFYEC). The goal is to ensure that relevant and quality OER are available for all first-year engineering courses, thus making possible a Zero Textbook Cost pathway in engineering. This document includes a *preliminary* list of available OER for the CFYEC to assist those preparing for fall 2020 courses.

Why OER for Engineering Is Needed Now More than Ever

With the pivot to online learning due to COVID-19, the need for and benefits of OER are even greater than before, as OER save instructors' time, help cash-strapped students, and provide immediate online availability and accessibility. To illustrate this, BCcampus created an [infographic showing the advantages of OER](#) and published the article [OER: Trial by COVID-19](#).

Regardless of the current situation, textbook costs for first-year engineering students can amount to hundreds of dollars per student/year. The CFYEC includes courses from a variety of STEM disciplines that have already demonstrated high numbers of [OER adoptions in B.C.](#) (e.g., physics, chemistry, and math).

As a number of engineering programs across B.C. are presently undergoing curriculum redesign, now is the perfect time to consider shifting to OER so that further reworking of the curriculum is not necessary down the road.

Excerpts from Blog Post: [Exploring an Open Path for First-Year Engineering](#)

Gap Analysis

In order to determine what OER is available and what gaps might exist, BCcampus has undertaken a gap analysis and mapping of OER to the common first-year curriculum for engineering. The analysis was led by Brian Dick, Chair, Department of Physics, Engineering, and Astronomy at Vancouver Island University. Identified gaps will be provided later in this document.

Available OER for CFYEC Curriculum

The table below lists available OER for the CFYEC – some of which have already been adopted by Engineering programs in BC. It also includes some *free resources* (FR) which are not openly licenced but are available to students at no cost and are already in use at some institutions.

OER and FR will be reviewed for quality and relevance so that those programs and faculty looking to adopt can do so with confidence in the near future. Full results from this work are expected in later in 2020.

| CFYEC Course | Existing OER or FR |
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| CALC I/II – Differential and Integral Calculus | <p><i>OER Adopted in BC Engineering Programs:</i></p> <p>https://openstax.org/details/books/calculus-volume-1</p> <p>https://openstax.org/details/books/calculus-volume-2</p> <p>https://activecalculus.org/</p> <p>http://www.apexcalculus.com/</p> <p>https://www.math.ubc.ca/~CLP/</p> <p><i>Free resource:</i></p> <p>https://www.desmos.com/calculator</p> |
| CHEM I - Engineering Chemistry | <p><i>OER Adopted in BC Engineering Programs:</i></p> <p>https://openstax.org/details/books/chemistry-2e</p> |
| CSCI I – Introduction to Programming | <p><i>OER Adopted in BC Engineering Programs:</i></p> <p>https://open.umn.edu/opentextbooks/textbooks/how-to-think-like-a-computer-scientist-c-version-1999</p> <p><i>Free resource:</i></p> <p>https://rooksguide.org</p> |
| ENGL I – University Academic Writing | <p><i>OER not known to be formally adopted for Engineering within BC PSIs:</i></p> <p>Writing for Success</p> |
| ENGL II – Technical Writing | <p><i>OER not known to be formally adopted for Engineering within BC PSIs:</i></p> <p>https://open.umn.edu/opentextbooks/textbooks/technical-writing-2016; Additional material required for engineering</p> <p>Portion of https://pressbooks.bccampus.ca/technicalwriting/ May be applicable.</p> |



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| ENGR I/II – Engineering Design | <p><i>OER not known to be formally adopted for Engineering within BC PSIs:</i></p> <p>AutoCAD 2D eBook AutoCAD 3D development project currently underway at VCC (Drafting Program)</p> <p>https://edtech.engineering.utoronto.ca/project/principles-engineering-drawings</p> <p>https://edtech.engineering.utoronto.ca/project/project-management-oo</p> <p>https://edtech.engineering.utoronto.ca/project/ethics-engineers</p> <p><i>Free Resource:</i> https://www.colorado.edu/eplu/resources/introductory-engineering-design-textbook</p> |
| LALG I – Linear Algebra | <p><i>OER Adopted in BC Engineering Programs:</i></p> <p>https://lyryx.com/linear-algebra-applications/</p> <p>https://lyryx.com/wp-content/uploads/2017/06/Kuttler-LinearAlgebra-AFirstCourse-2017A.pdf</p> <p><i>OER not known to be formally adopted for Engineering within BC PSIs:</i></p> <p>A Brief Introduction to Engineering Computation with MATLAB (BCcampus) may be useful for MATLAB component of this course.</p> |
| PHYS I/II – Calculus-based Introductory Physics | <p><i>OER Adopted in BC Engineering Programs:</i></p> <p>https://openstax.org/details/books/university-physics-volume-1</p> <p>https://openstax.org/details/books/university-physics-volume-2</p> <p>https://openstax.org/details/books/university-physics-volume-3</p> <p>https://github.com/OSTP/PhysicsArtofModelling</p> <p>https://physlets.org/tracker/ - Modelling tools</p> <p>https://phet.colorado.edu/ - Modelling tools</p> <p><i>OER not known to be formally adopted for Engineering within BC PSIs:</i></p> <p>http://www.lightandmatter.com/ (Mechanics & Fields and Circuits)</p> <p>https://newton-physics.utoronto.ca/</p> |

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| PHYS III – Statics and Dynamics | <p><i>OER not known to be formally adopted for Engineering within BC PSIs:</i></p> <p>http://mechanicsmap.psu.edu/</p> |
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Wondering about virtual lab resources?

The *Virtual Lab and Science Resource Directory* is now available, featuring virtual labs and online activities.

Identified Gaps

Few BC Engineering programs have adopted OER for courses within the CFYEC; it is unclear, without suitable review, whether existing OER will adequately cover required learning topics and outcomes.

Based on the preliminary environmental scan, the following is suggested:

Existing Gaps with (possible) OER coverage

CALC I/II, CHEM I*, CSCI I, ENGL II, ENGR I/II (Engineering Drawing Module, Engineering Ethics Module, Project Management Component), LALG I, PHYS I/II,

For these materials, OER texts (or portion of texts) are pre-existing and, in all but CSCI I, have been adopted by one or more PSIs within BC. Both CALC I/II and LALB I have two or more options available and adopted. PHYS I/II have three options (plus modelling tools) available, but only the OpenStax version is known to have been adopted in BC. CHEM I* version used by VIU may more closely match the CFYEC requirements than the unmodified OpenStax text.

Existing Gaps with no OER coverage

PHYS III.

It is noted that there is an on-going project to support development of OER for PHYS III.

Contact

For more information or if you are interested in participating in the review process for OER and Free Resources, please contact Melanie Meyers, STEM Open Education Project Manager at mmeyers@bccampus.ca.