



## ENGR 305 (3) Engineering Economic Analysis

APSC 305 Section 201

Instructor: Dr. John Brereton

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Office Hours: by appointment, EME 3252 If my door is open, come in!

- Lectures: Mondays, Wednesdays, Fridays 8:00 - 8:50 am, in COM 201

### Academic Calendar Entry

#### ENGR 305 (3) Engineering Economic Analysis

Cost concepts, accounting, time value of money; depreciation and taxes; public sector projects; economic evaluation techniques; handling uncertainty; sustainability in economic evaluation; societal context; infrastructure management needs; project impacts, mitigating risk. Case studies. [3-0-0]

*Prerequisite:* Second-year standing in the B.A.Sc. program

UBC Okanagan Academic Calendar: <http://www.calendar.ubc.ca/okanagan/>

### Course Format

- Three hours of lecture per week with in-class discussions, PowerPoint lectures with worked examples.
- Due to the ongoing COVID-19 pandemic, lectures will be held on-line for the first 2 weeks (at least). Access the Zoom lecture meetings according to the instructions posted on Canvas.
- In-person lectures are expected to commence January 24 (subject to change). Watch for announcements on Canvas. In-person lectures will also be accessible on-line via the Zoom link and recorded. Recorded lectures will be posted on the 305 Canvas Media Gallery.
- Mid-term and Final Exams are tentatively scheduled to be held on campus in-person.

### Course Overview, Content and Objectives

**Engineering economics is a foundational skill set that every successful P.Eng. will rely heavily on throughout their career.** It is the practice of allocating scarce resources - if, how, how much, and when - to one or more engineering projects (i.e., economic decision making techniques for engineers), regardless of your discipline. Please don't be deceived by the simple sounding nature of the word 'economics', which by definition, is a social science that studies the valuation, production, distribution, and/or consumption of goods and services (scarce resources), and the material welfare of humankind. This course therefore ties directly to and will enable you to fulfill your responsibilities under our Engineer's Code of Ethics, specifically, **to hold paramount the protection of the environment and welfare of the public!**

ENGR 305 will involve traditional engineering economic concepts coupled with leading-edge, social cost benefit analysis techniques, to reinforce emerging sustainability-oriented concepts and systems-based, life-cycle analysis engineering approaches. Moreover, you will be introduced to a myriad of engineering economic concepts, each building on the previous, such that if you do not prep the posted notes, attend the lectures, work the examples, and study hard, you will risk failing miserably – we have seen this happen all too often. Pay the costs (your time and effort) and reap the benefits (you pass ENGR 305, leading to a successful career). So already we are into engineering economics – the direct, indirect, and external costs/benefits – the foundational concepts of passing this course! We will apply these to a time line (e.g. present value, future value), then adjust for their value as it varies over time (i.e. time value of



money), and equip you with related cost-benefit analysis techniques for making related replacement and project decisions. Of course, not all costs and benefits can be quantified in monetary forms, so we'll give you multiple account evaluation (MAE) and analytical hierarchy process (AHP) decision tools that help when more abstract factors impact your decision. Last, we'll step back and look at all our assumptions necessary to build a cash flow model and cost benefit analysis, asking 'what if' we are wrong, and what is the risk we are 10%, 20% or more out on our estimates of present/future estimates of societal impacts (externalities), and direct/indirect costs and benefits? This will involve you learning about Inflation Analysis, Sensitivity Analysis and Monte Carlo Simulation Risk Analysis techniques. All these tools we give you will include problem-based applications via our in-lecture examples, your in-class discussions, and your team term project work.

### **Course Outline**

A summary course outline is as follows:

1. Introduction
2. Cost/Benefit
3. Qualitative & Triple-Bottom Line (Sustainability) Considerations
4. Multiple Account (Criteria) Evaluations
5. Time Value of Money
6. Cash Flow Analysis
7. Evaluation of Projects
8. Depreciation
9. Replacement Decisions
10. Uncertainty & Risk
11. Taxes
12. Inflation
13. Financial Accounting

### **Learning Outcomes**

Upon completion of the course, students should be able to:

- Undertake decision-making for engineering projects, taking account of qualitative considerations and multiple criteria
- Evaluate the suitability of an engineering project and select between alternative projects using several possible approaches
- Understand and be able to determine if and when an asset should be replaced under a range of circumstances
- Describe key features of businesses: types, governance and org. structures, & approaches to planning, financial analyses etc.
- Understand the time value of money and perform a cash flow analysis for a range of circumstances
- Explain the key features of public sector projects and do a social benefit-cost analysis (SCBA) of such projects
- Model the depreciation of an asset
- Calculate the effects of taxation and inflation on a project
- Analyze the effects of uncertainty and risk in engineering projects
- Demonstrate ethical behavior including adherence to UBC policies, Course Syllabus, and APEGBC Code of Ethics



## Engineering Accreditation

The Canadian Engineering Accreditation Board requires students to have achieved competency in a twelve main areas by graduation. To ensure that our program provides sufficient instruction in these 12 graduate attributes, course learning outcomes have been mapped to the graduate attributes for each course. The relevant graduate attributes for this course are identified below.

Course Learning Outcomes	Graduate Attributes (as defined below)											
	1	2	3	4	5	6	7	8	9	10	11	12
Undertake decision-making for engineering projects, taking account of qualitative considerations and multiple criteria	A											
Evaluate the suitability of an engineering project and select between alternative projects using several possible approaches											A	
Understand and be able to determine if and when an asset should be replaced under a range of circumstances											A	
Describe key features of businesses: types, governance and org. structures, & approaches to planning, financial analyses etc.											A	
Understand the time value of money and perform a cash flow analysis for a range of circumstances		A			A				A			
Explain the key features of public sector projects and do a social benefit-cost analysis (SCBA) of such projects		A			A				A			
Model the depreciation of an asset		A			A				A			
Calculate the effects of taxation and inflation on a project		A			A				A			
Analyze the effects of uncertainty and risk in engineering projects									A		A	
Demonstrate ethical behavior including adherence to UBC policies, Course Syllabus, and APEGBC Code of Ethics						A	A	A				

I=Introduced

D=Developed

A=Applied

### CEAB Graduate Attributes

- A knowledge base for engineering:** Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.
- Problem analysis:** An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions.
- Investigation:** An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data, and synthesis of information in order to reach valid conclusions.
- Design:** An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.
- Use of engineering tools:** An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.
- Individual and team work:** An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.
- Communication skills:** An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.
- Professionalism:** An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.
- Impact of engineering on society and the environment:** An ability to analyze social and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.
- Ethics and equity:** An ability to apply professional ethics, accountability, and equity.



11. **Economics and project management:** An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations.
12. **Life-long learning:** An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge.

### **Evaluation Criteria and Grading**

The marks for this course will be assessed as follows:

Assignments	10%
In-class activities	15%
Midterm Exam (date TBA)	25%
Final Exam	50%

#### *Final Exam*

**A minimum 50% grade on your final exam is required to pass ENGR 305.** Please note that, due to class size and logistics, the final exam for ENGR 305 will consist of multiple choice questions (i.e., using a bubble sheet). Please familiarize yourself with this exam format.

### **Required Readings and Videos**

There is no required text for this course. All course materials – lectures, previous exams, syllabus, term project requirements, academic ethics policy – will be provided via Canvas. Where noted, some content may only be provided in lectures. If students wish to purchase a text for your career, one good engineering economics reference is *Engineering Economics: Financial Decision Making for Engineers*, by N.M. Fraser, E.M. Jewkes, I. Bernhardt, M. Tajima, Pearson, 3rd edition, 2006; and later editions.

### **Final Examinations**

Students are required to be available during the posted examination period to write the exam as scheduled. Except in the case of examination clashes and hardships (three or more formal examinations scheduled within a 24-hour period) or unforeseen events, students will be permitted to apply for out-of-time final examinations only if they are representing the University, the province, or the country in a competition or performance; serving in the Canadian military; observing a religious rite; working to support themselves or their family; or caring for a family member. Unforeseen events include (but may not be limited to) the following: ill health or other personal challenges that arise during a term and changes in the requirements of an ongoing job.

Further information on Academic Concession can be found under Policies and Regulation in the *Okanagan Academic Calendar* <http://www.calendar.ubc.ca/okanagan/index.cfm?tree=3,48,0,0>

### **Academic Integrity**

The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or exam and more serious consequences may apply if the



matter is referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences. A more detailed description of academic integrity, including the University's policies and procedures, may be found in the *Okanagan Academic Calendar* at <http://okanagan.students.ubc.ca/calendar/index.cfm?tree=3,54,111,0>

#### *Assignments*

This course assesses student understanding of course material based on completed assignments. It is important to note that according to the UBC Okanagan Academic Calendar cheating includes the following:

*“falsification of any material subject to academic evaluation, including research data;”*

For example in this course, this includes, but is not limited to, copying another student's work or allowing another student to copy your assignment. Students are expected to submit original work for their assignments in this course.

*“use of or participation in unauthorized collaborative work;”*

While collaboration is encouraged in some circumstances, not all collaboration is authorized. For example in this course, unauthorized collaboration includes, but is not limited to, working in teams to complete projects that are intended as individual assessment.

#### *Exams*

This course assesses student understanding of course material based on midterm and final examinations. It is important to note that according to the UBC Okanagan Academic Calendar cheating includes the following:

*“use or possession in an examination of any materials (including devices) other than those permitted by the examiner;”*

This includes, but is not limited to, possession during an exam of a cell phone, programmable calculator, or watch that is capable of storing unauthorized materials, unless specifically allowed.

*“use, possession, or facilitation of unauthorized means to complete an examination (e.g., receiving unauthorized assistance from another person, or providing that assistance);”*

This includes, but is not limited to, looking at another student's exam paper during the examination time.

#### *Plagiarism*

This course assesses student understanding of course material based on written reports. It is important to note that the UBC Okanagan Academic Calendar includes the following comprehensive description of plagiarism:

*“Plagiarism, which is intellectual theft, occurs when an individual submits or presents the oral or written work of another person as his or her own. Scholarship quite properly rests upon examining and referring to the thoughts and writings of others. However, when another person's words (i.e., phrases, sentences, or paragraphs), ideas, or entire works are used, the author must be acknowledged in the text, in footnotes, in endnotes, or in another accepted form of academic*



*citation. Where direct quotations are made, they must be clearly delineated (e.g., within quotation marks or separately indented). Failure to provide proper attribution is plagiarism because it represents someone else's work as one's own. Plagiarism should not occur in submitted drafts or final works. A student who seeks assistance from a tutor or other scholastic aids must ensure that the work submitted is the student's own. Students are responsible for ensuring that any work submitted does not constitute plagiarism. Students who are in any doubt as to what constitutes plagiarism should consult their instructor before handing in any assignments."*

Students are responsible for ensuring all work is original and source use is properly documented.

### **SoE Academic Integrity Procedures**

The following steps will be followed if there are questions surrounding the academic integrity of course material or processes:

- The instructor will discuss the instance with the student
- The instructor will inform the relevant SoE Associate Director and Engineering Advisor
- The instructor and student will meet with the relevant Associate Director
- The instructor and relevant Associate Director will decide the severity of punishment depending on the severity of misconduct
- The student's behaviour will be recorded in the student's SoE file, but not necessarily the student's transcript
- In some cases, the SoE will present the academic misconduct to the President's Advisory Committee on Student Discipline.

### **Grading Practices**

Faculties, departments, and schools reserve the right to scale grades in order to maintain equity among sections and conformity to University, faculty, department, or school norms. Students should therefore note that an unofficial grade given by an instructor might be changed by the faculty, department, or school. Grades are not official until they appear on a student's academic record. Further information on Grading Practices can be found in the *Okanagan Academic Calendar*  
<http://www.calendar.ubc.ca/okanagan/index.cfm?tree=3,41,90,1014>

### **Student Service Resources**

#### **UBC Okanagan Disability Resource Centre**

The Disability Resource Centre ensures educational equity for students with disabilities and chronic medical conditions. If you are disabled, have an injury or illness and require academic accommodations to meet the course objectives, please contact Earlene Roberts, the Diversity Advisor for the Disability Resource Centre located in the University Centre building (UNC 214).

UNC 214      250.807.9263  
email: [earlene.roberts@ubc.ca](mailto:earlene.roberts@ubc.ca)  
Web: [www.students.ok.ubc.ca/drc](http://www.students.ok.ubc.ca/drc)



### **UBC Okanagan Equity and Inclusion Office**

Through leadership, vision, and collaborative action, the Equity & Inclusion Office (EIO) develops action strategies in support of efforts to embed equity and inclusion in the daily operations across the campus. The EIO provides education and training from cultivating respectful, inclusive spaces and communities to understanding unconscious/implicit bias and its operation within in campus environments. UBC Policy 3 prohibits discrimination and harassment on the basis of BC's Human Rights Code. If you require assistance related to an issue of equity, educational programs, discrimination or harassment please contact the EIO.

**UNC 216**      250.807.9291

email: [equity.ubco@ubc.ca](mailto:equity.ubco@ubc.ca)

Web: [www.equity.ok.ubc.ca](http://www.equity.ok.ubc.ca)

### **Health & Wellness**

At UBC Okanagan health services to students are provided by Health and Wellness. Nurses, physicians and counsellors provide health care and counselling related to physical health, emotional/mental health and sexual/reproductive health concerns. As well, health promotion, education and research activities are provided to the campus community. If you require assistance with your health, please contact Health and Wellness for more information or to book an appointment.

**UNC 337**      250.807.9270

email: [healthwellness.okanagan@ubc.ca](mailto:healthwellness.okanagan@ubc.ca)

Web: [www.students.ok.ubc.ca/health-wellness](http://www.students.ok.ubc.ca/health-wellness)

### **SAFEWALK**

*Don't want to walk alone at night? Not too sure how to get somewhere on campus? Call Safewalk at  
**250-807-8076.***

*For more information, see: [www.security.ok.ubc.ca](http://www.security.ok.ubc.ca)*