# ENGG*3240 Engineering Economics

Fall 2018
Section(s): C01

School of Engineering
Credit Weight: 0.50
Version 1.00 - September 05, 2018

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# 1 Course Details

## 1.1 Calendar Description

This course covers the principles of project evaluation; analysis of capital and operating costs of engineering alternatives, benefit-cost ratio; break-even studies, evaluations recognizing risk, replacement and retirement of assets; tax considerations, influence of sources of funds.

**Pre-Requisite(s):** MATH*1210
**Restriction(s):** Registration in the Engineering program.

## 1.2 Course Description

The main goals of the course are:

1. To acquire and independently apply concepts and techniques of economic analysis used to form engineering decisions.
2. To assess cost implication in engineering design and application.
3. To select a preferred course of action based upon monetary and non-monetary considerations
4. To assess risks and uncertainty associated with engineering economic decisions.

## 1.3 Timetable

**Lectures**:

Tuesday 1:00 - 2:20 PM WMEM

Thursday 1:00 - 2:20 PM WMEM

## 1.4 Final Exam

Wednesday, December 5, 2018, 2:30 - 4:30 pm, location TBA

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# 2 Instructional Support

## 2.1 Instructor(s)

**Soha Eid Moussa**
**Email:** smoussa@uoguelph.ca
**Telephone:** +1-519-824-4120 x56141
**Office:** THRN 1341
**Office Hours:** open door policy or by appointment

## 2.2 Teaching Assistant(s)

**Teaching Assistant:** Ian Cabral
**Email:** icabral@uoguelph.ca
**Office Hours:** TBA on Courselink

**Teaching Assistant:** Sandra Dusolt
**Email:** sdusolt@uoguelph.ca
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**Teaching Assistant:** Colin Gibson
**Email:** cgibso05@uoguelph.ca
**Office Hours:** TBA on Courselink

**Teaching Assistant:** Claudia Smith
**Email:** csmith33@uoguelph.ca
**Office Hours:** TBA on Courselink

**Teaching Assistant:** Praveena Thirunathan
**Email:** pthiruna@uoguelph.ca
**Office Hours:** TBA on Courselink

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# 3 Learning Resources

Course material, news, announcements, and grades will be regularly posted to the ENGG*3240 Courselink site. You are responsible for checking the site regularly.

## 3.1 Required Resource(s)

**Custom Supplement for ENGG*3240 (Notes)**
This custom document must be purchased and brought to all midterms and the final exam. It contains the interest tables as well as the various equations needed to be able to perform economic analysis of cash flows.

**Clickers: clickers will occasionally be used to verify understanding and encourage class participation, please bring your clicker to class regularly (Equipment)**

## 3.2 Recommended Resource(s)

**Niall M. Fraser, Elizabeth M. Jewkes, Mehrdad Pirnia 2016. Engineering Economics: Financial Decision Making for Engineers, 6th Edition. Pearson Education Canada. (Textbook)**

## 3.3 Additional Resources

**Lecture Information**: All the lecture notes will be posted on Courselink (week #1-#12).

**Lab Information**: N/A

**Assignments**: Download the assignments, all the solutions will be posted.

**Miscellaneous Information**: Other information may also be posted on the web page.

## 3.3 Communication and Email Policy

Please use lectures and office hours as your main opportunity to ask questions about the course. Major announcements will be posted to the course Courselink website. **It is your responsibility to check the course Courselink website regularly.** As per University regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

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# 4 Learning Outcomes

## 4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Apply the concepts of time-value of money, taking into consideration the impact of interest on investment decisions by comparing between potential candidates and identifying the better investment
2. Select the appropriate evaluation method for comparing between alternate investment opportunities by identifying important factors such as life expectancy and measure of interest (dollar value vs rate of return)
3. Demonstrate understanding that assets having different life expectancies can not be directly compared through use of common life concepts or by using annual worth comparisons
4. Evaluate different project/investment opportunities to select the most beneficial by applying the appropriate evaluation method
5. Determine the rate of return of a project through analysis of cash flows, whether they are positive or negative, and how frequently they change from positive to negative.
6. Determine the book value of an asset for accounting and tax purposes by applying knowledge of depreciation
7. Understand basic accounting concepts through identification of elements of a balance sheet and income statement
8. Determine the after-tax viability of a project through the application of after-tax cash flow analysis using capital tax factors, capital salvage factors, tax rates, and depreciation rates.
9. Evaluate when an asset should be replaced through the use of replacement analysis both before and after tax by determining its economic life.
10. Demonstrate ability to calculate asset/project value due to inflation through application of concepts of real dollars versus actual dollars.
11. Recommend public-sector projects to be implemented by applying benefit cost ratio analysis

## 4.2 Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

| # | Outcome Set Name | Course Learning Outcome |
|---|---|---|
| 1 | Knowledge Base | 2, 6 |
| 1.3 | Recall, describe and apply fundamental engineering principles and concepts | 2, 6 |
| 2 | Problem Analysis | 1, 2, 3, 4, 5, 8, 9, 10, 11 |
| 2.1 | Formulate a problem statement in engineering and non-engineering terminology | 2, 3, 4, 5, 8, 9, 10, 11 |
| 2.2 | Identify, organize and justify appropriate information, including assumptions | 1, 2, 3, 4, 5, 8, 9, 10, 11 |
| 2.3 | Construct a conceptual framework and select an appropriate solution approach | 1, 2, 3, 4, 5, 8, 9, 10, 11 |
| 2.4 | Execute an engineering solution | 2, 3, 4, 5, 8, 9, 10, 11 |
| 2.5 | Critique and appraise solution approach and results | 2, 3, 4, 5, 8, 9, 10, 11 |
| 11 | Economics and Project Management | 4, 5, 8, 9, 10, 11 |
| 11.3 | Estimate economic impact and feasibility of an engineering project or design using techniques such as cost benefit analysis over the life of the project or design | 4, 5, 8, 9, 10, 11 |

# 5 Teaching and Learning Activities

## 5.1 Lecture Schedule

| Topic | Learning Objectives |
|---|---|
| Making economic decisions, sea of problems, role of engineering economics analysis, decision making process, engineering costs, cost estimation methods, estimation of benefits. | 1 |
| Cash flow diagram, computing cash flow, time value of money, interest and equivalence, compound interest formulas: single payment, uniform series, arithmetic and geometric gradient series, nominal and effective interest rates and | 1, 2 |

| | |
|---|---|
| continuous compounding. Assumptions in solving economic problems, economic rules, application of present worth analysis, Annual cash flow analysis, annual cash flow calculation. Analysis period. | |
| Equivalent Uniform Annual Cost (EUAC). Equivalent Uniform Annual Benefits (EUAB). Annual worth analysis Evaluation of Alternatives with: equal lives, common multiple lives, continuous lives, and fixed study period. | 1, 2, 3 |
| Internal rate of return, Minimum attractive rate of return. Present worth versus Interest Rate. Calculation of internal rate of return. Incremental internal rate of return. Multiple IRRs. External Rate of Return (ERR). Modified Internal Rate of Return (MIRR). Selection of best alternative by incremental and graphical analysis. | 4 |
| Future worth, minimum attractive rate of return, benefit cost and payback period analysis techniques. Sensitivity and break-even analysis | 4 |
| Concept of depreciation, book value, depreciation methods, depreciation and asset disposal, depreciation for tax purpose (capital cost allowance factor), and calculation of capital coat allowance factor. | 5 |
| The role of accounting in engineering economy. Divisions within an organization, Balance sheet and income statement, Assets, liabilities, equity and evaluation of indices (Ratios). | 6 |
| Taxes. Individual and corporate, incremental nature of taxes, combined tax rates. After tax cash flow analysis, taxable income, after tax present worth and rate of return. | 7 |
| Replacement Analysis. Factors affecting replacement, Replacement analysis techniques. Concept of challenger and defender. Challenger is different from defender. Sequence of identical challengers, challenger is not repeated and defender and challenger with unequal lives. Complications in replacement analysis. After tax replacement analysis. | 6, 7 |
| Inflation in engineering economy. Measurement of Inflation. Relationship between actual dollar and real dollar. Price Indexes. Inflation and tax calculations. Effect of inflation on MARR and IRR. | 8 |
| Economic analysis in the public sector. Public decision factors. Interest rates for public projects Benefit-Cost Ratio, conventional and modified B/C and Incremental B/C. Financing duration and politics of investments | 9 |
| Uncertainty in engineering economic analysis. Range of estimated values for evaluation. Probability and joint probability distributions, expected value, measurement and consideration of risk | 3 |

## 5.2 Other Important Dates

Thursday, 6 September 2018: First class

Monday, 8 October 2018: Thanksgiving holiday

Tuesday, 9 October 2018: Study Break Day

Friday, 2 November 2018: drop date – 40th class

Thursday, 29 November 2018: replaces Study Break Day  (Tuesday Schedule in effect)

Friday, 30 November 2018: last day of class (replaces Thanksgiving, Monday Schedule in effect)

Please refer to the undergraduate calendars for the semester scheduled dates.

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# 6 Assessments

## 6.1 Assessment Details

**Midterm 1 (25%)**
**Date:** Tue, Oct 16, 1:00 PM, WMEM
duration 60 minutes

**Midterm 2 (25%)**
**Date:** Thu, Nov 8, 1:00 PM, WMEM
duration 60 minutes

**Final Exam (50%)**
**Date:** Wed, Dec 5, 2:30 PM - 4:30 PM, TBA on Webadvisor

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# 7 Course Statements

## 7.1 Course Grading Policies

**Missed Assessments**: If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic Consideration: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

**Accommodation of Religious Obligations**: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor at the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations:

http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

**Missed midterm tests**: If you miss a test due to grounds for granting academic consideration or religious accommodation, the weight of the missed test will be added to the final exam. There will be no makeup midterm tests.

**Passing grade**: In order to pass the course, you must obtain a grade of 50% or higher in the course.

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# 8 School of Engineering Statements

## 8.1 Instructor's Role and Responsibility to Students

The instructor's role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on Courselink but these are not intended to be stand-alone course notes. Some written lecture notes will be presented only in class. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for tests and labs.

## 8.2 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and lab sessions. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

## 8.3 Lab Safety

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

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# 9 University Statements

## 9.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

## 9.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The regulations and procedures for Academic Consideration are detailed in the Undergraduate Calendar.

## 9.3 Drop Date

Courses that are one semester long must be dropped by the end of the fortieth class day; two-semester courses must be dropped by the last day of the add period in the second semester. The regulations and procedures for Dropping Courses are available in the Undergraduate Calendar.

## 9.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

## 9.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required, however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance, and not later than the 40th Class Day.

More information: www.uoguelph.ca/sas

## 9.6 Academic Misconduct

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy is detailed in the Undergraduate Calendar.

## 9.7 Recording of Materials

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

## 9.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.