ENGG*3700 - Optimization for Engineers

Fall 2024 Course Outline
Section: 01
Credits: 0.50

Land Acknowledgement: Guelph

The University of Guelph resides on the ancestral lands of the Attawandaron people and the treaty lands and territory of the Mississaugas of the Credit. We recognize the significance of the Dish with One Spoon Covenant to this land and offer respect to our Anishinaabe, Haudenosaunee and Métis neighbours. Today, this gathering place is home to many First Nations, Inuit, and Métis peoples and acknowledging them reminds us of our important connection to this land where we work and learn.

Calendar Description

This course serves as an introduction to optimization. Topics to be covered include but are not limited to: linear programming, sensitivity analysis, linear integer programming technique, dynamic programming, Markov chains, transportation method, decision analysis, and queuing theory.
Prerequisite(s): MATH*2130, MATH*2270, (1 of CIS*1300, CIS*1500, ENGG*1410)
Restriction(s): Non-BENG students may take a maximum of 4.00 ENGG credits.
Department(s): School of Engineering

Course Description

The main goal of this course is to help you learn how to determine the best choice among a set of alternatives.

Lecture Schedule

TuTh 11:30am-12:50pm in MCLN*102 (9/5 to 12/13)

Tutorial Timetable

Day	Time	Location	Sections
Wednesday	9:30 - 11:20 AM	ALEX 218	103
Wednesday	2:30 - 4:20 PM	MCLN 107	102
Friday	2:30 - 4:20 PM	ALEX 218	101

Instructor Information

Jhantu Kumar Saha, Ph.D., P.Eng.
Email: jsaha@uoguelph.ca
Office: RICH 1517A
Office Phone: 519-824-4120 Ext.53085

Additional Support

<Optional content block - title and content block fully editable>: Instructors may add additional content if necessary. This content block can be removed by clicking the 'eye' icon.

Teaching Assistant (GTA)	Email	Office Hours

Cora Rose Dickie-Wilson	cdickiew@uoguelph.ca	TBA on CourseLink or By Appointment
Dean DiFiore	ddifiore@uoguelph.ca	TBA on CourseLink or By Appointment

Textbooks

Group	Title	Author	ISBN
Recommended	Operations Research An Introduction, 11th ed	Hamdy A. Taha, Pearson Education Incorporated, 2022	

Learning Resources

Required Resources

Course Website (Website) (http://courselink.uoguelph.ca)
Course material, news, announcements, and grades will be regularly posted to the ENGG*3700 Courselink site. You are responsible for checking the site regularly.

Webcam (Equipment)
Assessments may be administered using the Respondus invigilation system which requires students to have a webcam.

Course Resources

Lecture Information (Notes)
All the lecture notes will be posted on the web page (week #1 - #12).

Suggested Problem Sets (Other)
Suggested problem sets to be discussed in the tutorials will be posted on CourseLink.

Miscellaneous Information (Other)
Other information may be posted on the web page.

Campus Resources

If you are concerned about any aspect of your academic program: Make an appointment with a Program Counsellor (https://www.uoguelph.ca/uaic/programcounsellors/) in your degree program. If you are struggling to succeed academically: There are numerous academic resources offered by the Learning Commons (https://www.lib.uoguelph.ca/using-library/spaces/learning-commons/) including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills.

Communication & Email Policy

Please use lectures and lab help sessions as your main opportunity to ask questions about the course. Major announcements will be posted to the course website. **It is your responsibility to check the course website regularly**. 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.

Course Learning Outcomes

1. Utilize the Simplex Algorithm to solve Linear Programming Problems.
2. Utilize Branch and Bound technique to solve Integer Programming Problems.
3. Formulate a solution method and solve Dynamic Programming Problems.
4. Apply the appropriate optimization technique to optimize a system.
5. Concisely and articulately communicate the results of an optimization solution procedure.

Teaching and Learning Activities

Lectures

Topic	Learning Objectives
What is Operations Research?	1, 4, 5
Modeling with Linear Programming	1, 4, 5
The Simplex Method and Sensitivity Analysis	1, 4, 5

Duality and Post-Optimal Analysis	1, 4, 5
Integer Linear Programming	2, 4, 5
Dynamic Programming	3, 4, 5
Transportation Method	4, 5
Other topics	4, 5

Tutorials

Tutorial Sessions will be used to discuss/explain solution methods of the Suggested Problem Sets. Students are encouraged to attempt to solve the problems prior to their tutorial session and come prepared with questions related to challenges faced.

Assessment Breakdown

Name	Scheme A (%)
Assignment	10%
Quizzes	40%
Final Exam	50%
Total	**100%**

Assessment Details

Assignment

IN CLASS PRACTICE PROBLEMS **10%**

Lectures will contain in-class practice problems. Students will be responsible for attempting the problems and submitting them to Dropbox to be assessed. The goal of the assignments is to allow students to obtain feedback and assistance in the application of the method taught. They will not be graded for content but will be used to personalize feedback to students and assist with learning. These assignments will be due by 11:59 pm on the Sunday following the class in which they were started. There are approximately 10 submissions worth about 1% each, total up to a maximum of 10%.

Course Learning Outcomes Assessed: 1, 2, 3, 4, 5

Quizzes

Quizzes **40%**

Quiz 1, Linear Programming/Simplex Method, Oct. 3

Quiz 2, Sensitivity Analysis/Duality, Oct. 24

Quiz 3, Integer Programming, Oct. 31

Quiz 4, Dynamic Programming/Transportation Models, Nov. 14

Quiz 5, Markov Models, Nov. 21

Five quizzes will be provided with the best four quizzes counting towards the final grade. Each quiz will be worth 10% of the total mark in the course. Quizzes will cover material covered in the topic listed. Each quiz may consist of problems that you will have to solve, true/false questions, and/or multiple choice/multi-select questions. The questions will be generated randomly for each student but will cover the same content. Students will get feedback on each quiz. All quizzes will be open book/notes in class. No collaboration or communication with others of any type is allowed. The quizzes are to be done alone.

Course Learning Outcomes Assessed: 1, 2, 3, 4, 5

Exam

Final Exam **50%**

Date: See "Final Exam" Section Below

You must pass the final exam to pass the course. If you don't pass the final exam, your assignments and quizzes marks will not be added to your final grade.

Course Learning Outcomes Assessed: 1, 2, 3, 4, 5

Final Exam

Date: Dec 5

Time: Th 11:30am-1:30pm

Location: TBA *Please see Web Advisor closer to the date of scheduled final for location.*

To understand rules and regulations regarding Examinations students are encouraged to read Student's Responsibilities (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/examinations/)

If the student is unable to meet the final exam requirements due to medical, psychological or compassionate circumstances they are encouraged to review Student's Responsibilities in the Academic Consideration, Appeals and Petitions (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-consideration-appeals-petitions/) section of the Academic Calendar.

Last Day to Drop Course

The final day to drop Fall 2024 courses without academic penalty is the last day of classes: November 29

After this date, a mark will be recorded, whether course work is completed or not (a zero is assigned for missed tests/assignments). This mark will show on the student's transcript and will be calculated into their average.

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 (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulationsprocedures/academic-misconduct/) for information on regulations and procedures for Academic Consideration.

"If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester or as soon as you are aware of the conflict to make alternate arrangements."

Missed Quizzes

If you miss more than two quizzes due to grounds for granting academic consideration, the weight of the missed quizzes in excess of two will be added to the weight of the final exam. There will be no makeup quiz.

Passing grade

In order to pass the course, you **must obtain a grade of 50% or higher on the final exam**. In other words, if you don't obtain 25 out of 50 in the final exam, your assignments & quizzes marks will not be added to your final grade and your assignments & quizzes marks will be zero.

Course Standard Statements

Relationships with other Courses & Labs Previous Courses:

- **CIS*1500:** Introduction to Programming
- **MATH*2130:** Numerical Methods
- **MATH*2270:** Applied Differential Equations

Follow-on Courses:

N/A

School of Engineering Statements

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.

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.

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

Standard Statements for Undergraduate Courses

Academic Integrity

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 (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-misconduct/) is outlined in the Undergraduate Calendar.

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 make a booking at least 10 days in advance, and no later than the first business day in November, March or July as appropriate for the semester. Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time. For students at the Guelph campus, information can be found on the SAS website. (https://www.uoguelph.ca/sas/)

Accommodation of Religious Obligations

If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements.

See the Academic calendar for information on regulations and procedures for Academic Accommodations of Religious Obligations (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-accommodation-religious-obligations/).

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.

Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all undergraduate students except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in the Undergraduate Calendar - Dropping Courses (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/dropping-courses/).

Email Communication

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.

Health and Wellbeing

The University of Guelph provides a wide range of health and wellbeing services at the Vaccarino Centre for Student Wellness (https://wellness.uoguelph.ca/). If you are concerned about your mental health and not sure where to start, connect with a Student Wellness Navigator (https://wellness.uoguelph.ca/navigators/) who can help develop a plan to manage and support your mental health or check out our mental wellbeing resources (https://wellness.uoguelph.ca/shine-this-year/). The Student Wellness team are here to help and welcome the opportunity to connect with you.

Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g., final exam or major assignment).

Recording of Materials

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

Resources

The Academic Calendars (http://www.uoguelph.ca/registrar/calendars/?index) are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.

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. See the Undergraduate Calendar for information on regulations and procedures for Academic Consideration. (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-consideration-appeals-petitions/)

Professional Accreditation Outcomes

Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

1. Knowledge Base

	Graduate Attribute Indicator	Instructional Level	Data Collection for Accreditation
1.3	Recall, describe and apply fundamental engineering principles and concepts	Advanced	No

2. Problem Analysis

	Graduate Attribute Indicator	Instructional Level	Data Collection for Accreditation
2.1	Formulate a problem statement in engineering and non-engineering terminology	Advanced	No
2.2	Identify, organize and justify appropriate information, including assumptions	Advanced	No
2.3	Construct a conceptual framework and select an appropriate solution approach	Advanced	No
2.4	Execute an engineering solution	Advanced	No
2.5	Critique and appraise solution approach and results	Advanced	No

5. Use of Engineering Tools

	Graduate Attribute Indicator	Instructional Level	Data Collection for Accreditation
5.1	Select appropriate engineering tools from various alternatives	Advanced	No
5.2	Demonstrate proficiency in the application of selected engineering tools	Advanced	No
5.3	Recognize limitations of selected engineering tools	Advanced	No