



UNIVERSITY OF ALBERTA
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING
Construction Engineering and Management

CIV E 606: Design and Analysis of Construction Operations

Course Outline and Syllabus (Winter 2026)

COURSE DESCRIPTION:

*3 (fi 6) (either term, 3-0-0) Overview of production management in construction. Techniques for modelling construction operations, design of efficient processes, measurement and improvement of productivity. Computer simulation techniques for modeling and analysis.

Upon successful completion of this course, students should have the knowledge and skills to:

- Design simulation models to abstract and represent construction processes
- Use discrete event and continuous simulation concepts for modeling construction processes
- Implement and run experiments on models using the Symphony simulation environment
- Test, validate, and evaluate developed models using different techniques including statistical methods

LECTURES:

Wednesday 11:00PM – 1:50PM (NRE 2-122)

TEACHING TEAM:

Lecture Instructors:

Dr. Yasser Mohamed
Office: 7-269 DICE

Email: yaly@ualberta.ca
Office hours: TBD

Teaching Assistant:

TBD

Email to the address above is the preferred method of communication. Responses to email outside normal working hours are not promised, or to be expected. In your email, please indicate CIVE 606 in the subject line and sign your full name and ID#. Strive for clear, concise and complete communication.

HYBRID DELIVERY RULES AND TIMING:

The course will be delivered in person with online material available through U of A Canvas site.

Lecture materials will be **posted ahead** of the scheduled lecture time. These materials may include video recordings, documents, and/or required activities. Materials will be available by Friday prior to the lecture at 1600 hours.

At the scheduled time of the lectures, the meeting will be used for answering questions, discussion, clarifying any parts of the material that is scheduled for that week, and for applications on term project cases. Please make sure that you go through the material required for the week as there will be **no repetition** of the posted material during the lecture session.

MARKING SCHEME:

The course mark will be calculated based on the following breakdown:

Online participation (weekly activities): (15%)

Online course materials will include some activities that you need to complete every week such as polls, posting of questions, participation in online forum, and/or quizzes. 5% of the overall mark is based on the completion of these weekly activities.

Homework Assignments: (40%)

Each homework assignment is designed to cover one of the four main topics in the course and the weight on each assignment is proportional to the material covered. More details are listed in following sections.

Group Project (presentation and report, each group is 2 or 3 students): (45%)

Projects should be related to an application of the modeling and simulation topics covered in the course a real construction process. You should choose your project team during the first month of the course. Shortly after, a project proposal is due (tentatively halfway through the course). More details are listed in following sections.

The weighted average of all grades will result in a final percentage mark and converted into your final letter grade. Percentage scores, not a standard distribution, will determine grades. The final grade distribution will be assessed based on a combination of the class distribution and absolute percentage results. There is no fixed distribution of grades.

ASSIGNMENTS:

-
- All assignments must be submitted on time. While they will be graded, **late assignments will receive a grade of zero.**
 - Each assignment must be prepared and submitted in a legible, well-organized, and professional manner.
 - A soft copy of your report and model(s) must be sent via eClass.
 - Label your assignments with you name and student ID number.

COURSE PROJECT

Select a real-world application, system, or operation(s) in which an identifiable problem that would benefit from a simulation-based solution exists. Develop a simulation model for this problem, and demonstrate how the model is used to support enhanced decision-making processes for those involved in this application.

Students are to write their projects in the Winter Simulation Conference: Case Studies Track format. Timeline for deliverables are as follows (times subject to changes if necessary):

- **Wednesday, February 11:** Abstract for selected project.
- **Wednesday, March 25:** Draft paper and draft simulation model(s) for project.
- **Wednesday, April 8:** Project presentations, Final paper and final simulation model(s) for project. This is a tentative date and can be revised towards the end of the term.

The course project and submissions related to the project must:

- Be completed in teams made of two or three members.
- Include an abstract, a draft report and draft model(s), and a final report and final model(s).
- Be presented by the team on the same day of project submission.

REFERENCES:**Textbook:**

AbouRizk, S., Hague, S., and Ekyalimpa, R. (2016). *Construction Simulation: An Introduction Using Symphony*. Edmonton, Alberta: University of Alberta. ISBN: 978-1-55195-357-1

Lecture notes, assignments, required readings, and Symphony simulation software will be made available on eClass.

POLICIES:

Policy about course outlines can be found in § 23.4(2) of the University Calendar

1- General Requirements:

- Observe professional courtesies and be on time. Lecture and lab sessions will start and finish on time.
- Turn off cell phones and other noisy devices during lectures and labs.
- Learn actively during lecture and lab sessions by asking questions and participating in discussions; we are here to help you get the most out of this course, but we cannot read your mind.

- d. Be a team player and acknowledge your study partners. Contribute your best effort to your group in the problem-solving labs and in your final project.

2- Course website:

Log in to eClass on the University of Alberta home page to access the course website. All notes and handouts for both lecture and lab sessions, assignments and solutions will be posted on the eClass website.

3- Academic Integrity:

The University of Alberta is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Code of Student Behaviour (online at www.governance.ualberta.ca) and avoid any behaviour, which could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

4- Recording Course Material:

Audio or video recording, digital or otherwise, of lectures, labs, seminars or any other teaching environment by students is allowed only with the prior written consent of the instructor or as a part of an approved accommodation plan. Student or instructor content, digital or otherwise, created and/or used within the context of the course is to be used solely for personal study, and is not to be used or distributed for any other purpose without prior written consent from the content author(s).

5- Material during Exam:

Only those items specifically authorized by the instructor may be used during an exam. The use of unauthorized personal listening, communication, recording, photographic and/or computational devices is strictly prohibited. Students should refrain from bringing any unauthorized electronic device into an examination room, including cell phones, high tech watches, high tech glasses or other such devices.

6- Students with Disabilities:

Students who require accommodation in this course due to a disability are advised to discuss their needs with Specialized Support & Disability Services (2-800 Students' Union Building).

7- Academic Support Centre:

Students who require additional help in developing strategies for better time management, study skills or examination skills should contact the Student Success Centre (2-300 Students' Union Building).

8- Protection of Privacy:

Personal information is collected under the authority of Section 33(c) of the Freedom of Information and Protection of Privacy Act (Alberta) directly by the University or by an authorized service provider on behalf of the University, and will be protected under Part 2 of that Act. Recordings of this course will be used for the purposes of student learning and will be disclosed to other students enrolled in this section of the class and to Teaching Assistants and other instructors and in accordance with section 40 of the FOIP Act. Recordings will be made available until the end of term. Please direct any questions about this collection to the professor of this course [Yasser Mohamed, yaly@ualberta.ca].

9- Expectations for AI use

In this course, we commit to AI use guided by ethical and transparent principles. While students are allowed to use advanced automated tools (such as ChatGPT or Dall-E 2) for certain written assignments, it is crucial to adhere to the following guidelines:

- Seek prior approval from the instructor for AI use in specific assignments.
- When allowed, clearly attribute and cite any AI-generated content in your work, including prompts and AI outputs as part of your academic record. Include an additional reflection component in your assessments, discussing how AI tools contributed to your learning process.

IMPORTANT: Please note that AI use is strictly prohibited in assessments and assignments not approved by the instructor. Failure to abide by this guideline may be considered an act of cheating and a violation as outlined in the relevant sections of University of Alberta (November 2022) [Code of Student Behaviour](#).

Disclaimer: Any typographical errors in this Course Outline are subject to change and will be announced during class.

PRE-REQUISITES:

Students enrolled in CIV E 606 should have completed CIV E 603 (Construction Informatics) or equivalent, as programming knowledge is an asset. Students should also command a reasonable understanding of construction operations.

COURSE OUTLINE:

No	Topic	Material Covered
1	Introduction to Simulation	<p>Introduction to computer simulation:</p> <ul style="list-style-type: none"> Simulation definitions An overview of the types of simulation models/methods: <ul style="list-style-type: none"> Dynamic vs. static models Deterministic vs. stochastic models DES/ABM/SD/CS/Combined Application areas for simulation: <p>Introduction to the Symphony simulation modelling environment:</p> <ul style="list-style-type: none"> Software installation Symphony UI and details regarding templates, properties, traces, model, and scenarios Running simulation models and viewing results
2	Introduction to Statistical Aspects of Simulation	<p>Monte Carlo simulation:</p> <ul style="list-style-type: none"> History and some simple examples <p>Probably distributions:</p> <ul style="list-style-type: none"> Discrete vs. continuous statistical distribution types Characteristics of these, including parameters and shapes, distribution types preferred in certain cases <p>Input modelling:</p> <ul style="list-style-type: none"> Fitting methods and goodness of fit tests <p>Generating random deviates:</p> <ul style="list-style-type: none"> Techniques for sampling continuous statistical distributions <p>Output analysis:</p> <ul style="list-style-type: none"> Statistical output analysis Modelling equipment breakdown in a mining operation
3	Introduction to Discrete Event Simulation	<p>Modelling features in Symphony's General Purpose Templates (GPT):</p> <ul style="list-style-type: none"> Introduction to the basics of computer programming General entity Attributes in Symphony: <ul style="list-style-type: none"> Local attributes Global attributes Setting attributes in Symphony: <ul style="list-style-type: none"> Scenario initialization Set attribute modelling element (create, task, destroy) Directional arrows An overview of tracing/debug features in Symphony: <ul style="list-style-type: none"> Trace/debug/error windows Trace properties (debug category) of modelling elements Trace modelling element
4	Modelling Resources	<p>Resource/File/Capture/Release/Preempt modelling elements:</p> <ul style="list-style-type: none"> Setup for single resource capture and release File – IsBlocking property and fulfillment of requirement behaviors Single and Multiple Resource Requirements without code (Resource(s)File configurations, plus properties for Capture and Release Elements) Resource requirements with varying priorities [priorities at file(s) vs. priorities defined at the Capture element]

		<ul style="list-style-type: none"> Resource capture vs. preemption and the influence of priorities Using Resource Elements to model emissions Modelling strategies with resources – Cloning/batching/unbatching entities that have been assigned resources <p>Task Modelling Element:</p> <ul style="list-style-type: none"> Duration types Constrained/Unconstrained/Resource Dependent
5	Decision Structures and Statistic Collection	<ul style="list-style-type: none"> Batch/Unbatch Modelling Elements Generate/Consolidate Modelling Elements Valves and Activators Statistic/Statistic Collect Chart/Chart Collect Cost/Cost Collect
6	Adding User Written Code to Models	<p>User written code for simple formulas in Symphony:</p> <ul style="list-style-type: none"> Setting or getting local/global attributes Querying the simulation engine Tracing information Sampling statistical distributions <p>User written code with complex formulas in Symphony:</p> <ul style="list-style-type: none"> Getting modelling elements within a scenario and manipulating them Scheduling events and transferring entities within model with code Making custom resource requirements Collecting statistics
7	Continuous Simulation in Symphony	<p>Introduction to continuous and combined simulation (DES-CS) modelling:</p> <ul style="list-style-type: none"> Basic concepts of continuous simulation Stocks, Source, Sink, Flow and Watch elements in Symphony.NET Strategies for developing combined continuous-DES models Using Symphony formulae for manipulating continuous modelling elements
8	Verification and Validation	<ul style="list-style-type: none"> Verification and validation of simulation models
9	Other Modelling Techniques	<ul style="list-style-type: none"> Markov Modelling System Dynamics Agent-Based Modelling Bayesian Techniques

LECTURE SESSIONS SCHEDULE:

No	Date	Topics
1	Jan 7, 2023	Introduction to computer simulation Introduction to Simphony simulation modeling Environment
2	Jan 14, 2023	Monte Carlo simulation Probability distributions
3	Jan 21, 2023	Input modeling Generating random deviates
4	Jan 28, 2023	Output analysis Validation and Verification
5	Feb 5, 2023	Introduction to Simphony's General Purpose Template Hand Simulation
6	Feb 11, 2023	Modeling resources in Simphony
Winter Term Reading Week (February 17-20)		
7	Feb 25, 2023	Decision structures and statistic collection
8	Mar 4, 2023	Adding user-written code to models
9	Mar 11, 2023	Continuous simulation
10	Mar 18, 2023	Validation and Verification
11	Mar 25, 2023	Markov Modeling System Dynamics
12	Apr 1, 2023	TBD
13	Apr 8, 2023	Term Project presentations