CIV E 645 Water Resources Planning and Management

Fall 2024 - September 03 to December 09

Class time: Wednesday, Friday 12:30-13:50 Location: NRE 2-122

Instructor:

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Donadeo Innovation Centre For Engineering 7-261
Office Hours:

Course Description:

*3.5 (fi) (either term, 3-0-1) Systems concept on the planning and management of water resources systems. Engineering economics and economic theories. Evaluate and optimize the design and operations of water resources systems using Linear Programming, chance-constrained Linear Programming, Dynamic Programming, Stochastic Dynamic Programming, constrained and unconstrained nonlinear programming. Optimal sizing and operations of reservoir systems and hydropower using HEC5 and urban stormwater management system

Course synchronous and asynchronous content delivery schedule:

The course will be delivered synchronously, through in-person lectures. Assignments will be completed outside lecture periods (asynchronously).

Land Acknowledgment:

The University of Alberta respectfully acknowledges that we are located on Treaty 6 territory, a traditional gathering place for diverse Indigenous peoples including the Cree, Blackfoot, Métis, Nakota Sioux, Iroquois, Dene, Ojibway/ Saulteaux/Anishinaabe, Inuit, and many others whose histories, languages, and cultures continue to influence our vibrant community.

Course Objectives & General Content:

The course material applies economics, operations research, management science, systems modelling and analysis, and statistics to hydrology, hydraulics and water resources problems for the design, analysis, operation and management of various types of water projects. The tools used are meant for water quantity management. The design and operations of hydro systems are optimized in a framework of risk & reliability, using operation research techniques such as linear programming, dynamic programming, nonlinear programming and simulation modelling.

Learning Outcomes:

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

1. Formulate and solve linear programming (LP) problems
2. Apply dynamic programming methods to water resources problems
3. Formulate and solve nonlinear programming (NLP) problems
4. Explain the principles of river basin management models, apply a commercial basin model, and analyze its output
5. Apply system dynamics methods to water management problems

Marking Scheme:

Activity	(A)Synchronous	Due/Scheduled	Weight
Homework Assignments	Asynchronous	Questions provided at least one week before deadline	35%
Reservoir optimization project	Asynchronous	Dec 6, 2024	15%
Final Examination	Synchronous	Set by registrar	50%

The Faculty recommended grade point average for a 600 level course is 3.3. Instructors have the leeway to deviate from this average and can assign grades based on their own scheme. All grades are approved by the department chair (or delegate). The office of the Dean has final oversight on all grades.

Term Work

All term work solutions will be posted no later than the last day of classes. All term work will be returned to students by the final day of classes, with the exception of major term work due in the last week of classes. The latter will be returned by the day of the final examination or the last day of the examination period if there is no final examination in the course as per university policy; instructors will make accommodations to return these term work. It is the responsibility of the student to pick up all their term work at the specified time and place. Any unreturned term work, shall be retained and then shredded six months after the deadline for reappraisal and grade appeals. Final examinations will be kept for one year as required by university guidelines and the Government of Alberta's Freedom of Information and Protection of Privacy Act.

Calculator Policy

Only approved non-programmable calculators are permitted in examinations. Any calculator taken into an examination must have a sticker identifying it as an acceptable non-programmable calculator (gold sticker). Students can purchase calculators at the University Bookstore with the stickers already affixed. Calculators purchased elsewhere can be brought to the Student Services where the appropriate sticker will be affixed to the calculator.

Text and References (Mandatory):

Mays, L. W. and Tung, Y.K. (2002). Hydrosystems Engineering and Management. Water Resources Publications LLC, Highlands Ranch, CO, 530 pages.
Available for short loan from library. Call number TD 353 M474 2002

Text and References (Recommended):

Loucks, D. P. et al. (2005). Water Resources Systems Planning and Management: An Introduction to

Methods, Models and Applications. UNESCO, Paris. Available for free download from: http://ecommons.cornell.edu/handle/1813/2804.

Website:

eClass

Did you know that the University of Alberta has various low-to-no-cost services to help students succeed? Visit http://www.deanofstudents.ualberta.ca/ for information about the academic, wellness, and various other support services available to U of A students. It's never too early or too late to seek help!

Civ E 645: Water Resources Planning and Management

Course Outline

Dr. Evan Davies, Sept. 4, 2024

Course Aims

- Tools for design, analysis, and management of water systems
  - These tools are from many areas:
    - Economics
    - Management science
    - Operations research
    - Systems thinking and analysis
- Key topics:
  - Economics
  - Linear programming
  - Dynamic programming
  - Nonlinear programming
  - Simulation modelling
  - Applications

Course Outline

Course Topic	Approx. No. of Weeks
I. Introduction and Course Context Course Content Systems concepts, optimization, uncertainties, and models	0.5
II. Engineering Economics Benefit-cost analysis	0.5
III. Evaluation and Optimization of Water Resources Systems using, Linear Programming Dynamic Programming Nonlinear Programming Application of WEB.BM model	 3 1 3 1.5
IV. Evaluation and Simulation of Water Resources Systems System Dynamics	3
V. Additional Course Components Course Summary	0.5

Course Evaluation

Homework Assignments	35%
Reservoir Management Project	15%
Final Examination	50%

Homework Assignments

- Five assignments, for the following topics:
  - Economics
  - Linear programming (2)
  - Dynamic programming and Calculus
  - Nonlinear programming
  - System Dynamics (*not marked*)
- Assignments will be calculation-based, but some may have a written aspect as well
  - Due approx. one week after assigned

Course Project

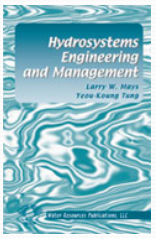
- Application of River Basin Management model
  - We will use an optimization model (LP) called WEB.BM
  - You will solve problems with the model and write a report on your findings. Detailed instructions will be provided

Final Examination

- Scheduled during the final exam period
  - Dec 18, 1 pm (*subject to change)*
- Problem Solving: Calculations
  - Application of course methodologies
- Written Solutions
  - Key concepts, problem formulation, systems methods

Readings

- **Textbook** is available at library
  - Mays, L. W. and Tung, Y.-K. (2002). *Hydrosystems Engineering and Management*. Water Resources Publications, LLC.
  - Call number **TD 353 M474 2002**



- **Readings** will be assigned weekly
  - *From text and sometimes journals…*
  - Some will be *mandatory*
  - Others will be *optional*

eClass

- To be posted on eClass:
  - Presentation slides
  - Readings
  - Assignments
  - *Other course material*

Required Software

- Spreadsheet program (**Excel**)
- River basin management model (**WEB.BM**)
- System dynamics software: **Vensim PLE**
  - Available for **free** from

    http://www.vensim.com

- Word processor: **MS Word** or equivalent

Academic Honesty

*"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.ualberta.ca/secretariat/appeals.htm) and avoid any behaviour which could potentially result in suspicions of **cheating**, **plagiarism**, **misrepresentations of facts** and/or **participation in an offence**.*

Academic dishonesty is a serious offence and can result in suspension or expulsion from the University."

Extra material on citation requirements and reference formatting on eClass page

Use of Generative AI

- According to NSERC, "a blanket ban on the use of generative AI in [writing] is impractical and ultimately unenforceable. Our recommendations here are framed with the highest respect accorded to the [student], and the [student's] judgement and honesty; **with this autonomy comes accountability**"
- Key points (adapted from NSERC's recommendations):
  - **The student is personally accountable for the complete contents of their work. In practical terms, this means that if the AI has cheated, you have cheated too!**
  - The student should "think through the core research problem themselves." This includes the development of the primary questions and methods.
  - **The student must disclose the usage of generative AI, if they have used it.** Students must simply declare (yes/no) if generative AI was used, for any purpose, in their writing. If the work (ideas, research, arguments) is their own, there is no concern about using AI for grammar and style editing.

Adapted from https://science.gc.ca/site/science/en/interagency-research-funding/policies-and-guidelines/use-generative-artificial-intelligence-development-and-review-research-proposals/advice-ad-hoc-generative-ai-panel-external-experts

University and faculty policies

Respect and professionalism

The Faculty of Engineering is committed to fostering and protecting an equitable, inclusive, and respectful work and study environment in line with University of Alberta policies and professional engineering industry standards.

The faculty prepares students to uphold industry standards to become a Professional Engineer (P.Eng). Therefore, respect, professionalism, and accountability must be upheld within the Faculty of Engineering and the University of Alberta.

Academic integrity

All students are expected to follow the University of Alberta's Student Code of Behaviour and Student Conduct Policy. The faculty expects an environment free of harassment, discrimination, and bullying. We encourage you to talk to the Office of Safe Disclosure and Human Rights about experiences, questions, or concerns. Additional resources and support for students are attached below.

Engineering students studying in the province of Alberta must also follow the Code of Ethics set by the Association of Professional Engineers and Geoscientists of Alberta (APEGA).

Course outline policies, course requirements, evaluation and grading information can be found in the University Calendar.

Safety during learning activities

In all Faculty of Engineering courses, labs, seminars or other learning activities, safety is of paramount importance. In some cases, laboratory work in a program requires high standards for risk management to keep potential hazards safely under control.

Anyone found to be unable to function safely in the class, lab, seminar or other learning activity may be asked to leave or be removed for their and the safety of other participants and instructors in alignment with the Student Code of Behaviour and Student Conduct Policy. As members, or prospective members, of the engineering profession, it is your responsibility to identify and inform the proper authorities of unsafe work.

Audio and video recording

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).

Only those items specifically authorized by the instructor may be brought into the exam facility. Students must not bring any unauthorized electronic device into an examination room, including cell phones or other devices.

Student services and support

Health & Wellness Support

Counselling and Clinical Services

Free, short-term, appointment-based counselling and psychiatric services. Also offers drop-in workshops. Book an initial consultation. Visit uab.ca/CCS to learn more.

Wellness Supports Social Workers

Free one-on-one support for students in the areas of housing, finances, academics, personal wellness, life skill development, family dynamics, system navigation, and any area of life where there is a desire to invite change. Visit uab.ca/wellness to learn more.

Sexual Assault Centre

Free, anonymous, and confidential drop-in counselling. Visit uab.ca/UASAC to learn more.

The Office of Safe Disclosure & Human Rights (OSDHR)

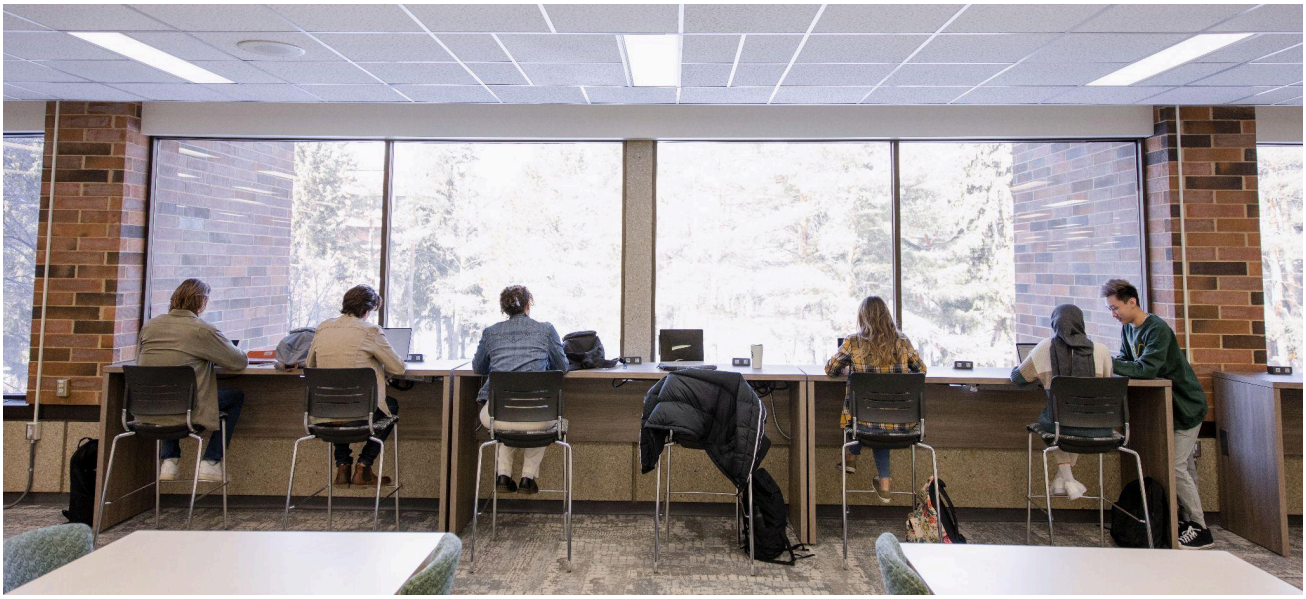
The OSDHR advises confidentially on sensitive issues you may not feel comfortable solving on your own. Contact the OSDHR if you want to get help or to make a report while keeping your privacy. Visit uab.ca/OSDHR to learn more.

HIAR (Helping Individuals at Risk)

If you're worried about someone, contact HIAR, who can help assess risk and connect individuals to support. Learn more at uab.ca/HIAR.

Immediate External Supports

Health Link Alberta: 811
Suicide Crisis Helpline: 988



Academic support

Academic Success Centre
Access to a variety of services to maximize your academic success. Learn more at uab.ca/ASC.

Accessibility Resources
Connects students with disabilities to accommodations. Learn more at uab.ca/Access under accommodations + accessibility.

Decima Robinson Support Centre
Academic support for 100- or 200-level introductory calculus, linear algebra and statistics courses. Visit uab.ca/DSC to learn more.

Engineering Student Success Centre
The Faculty of Engineering provides drop-in tutoring for first-year courses. Visit uab.ca/ESSC to learn more.

Office of the Student Ombuds
Call for complex problems and conflict mediation. Learn more at uab.ca/ombuds.

Financial support

Student Service Centre

For awards and other funding support. Learn more at uab.ca/ask.

Campus Food Bank

The Campus Food Bank Society is an independent charity supporting University of Alberta students, faculty, staff, and alumni for up to five years. For additional information visit their website at campusfoodbank.com.