

Pathways to study Waterpower at the University of Toronto

University of Toronto offers a number of courses on waterpower:

- **APS1410: Waterpower Essentials**

This course presents an overview of the waterpower industry, beginning with its ecological and historical context, how power stations work, and their major components. After a site tour, students will consider the major decision making factors in the design of a waterpower facility: policy and planning considerations, the business case, commercial markets, and risk management. With this, the finer details of power station design are introduced: turbine selection, electrical and control components, as well as how these components work. Further, students are introduced to operations and maintenance considerations, contract models, and dam safety. A course project will mirror these topics, as students evaluate the feasibility of a greenfield waterpower facility. With the support of industry professionals, students will work through the complexity and ambiguity of a development project.

Fall 2022 Schedule: Sept 14 - Dec 8, Thursdays 3-6pm in HA403

- **APS1411: Renewal of Waterpower Facilities**

Waterpower infrastructure is both ageing and being repurposed. This course looks at how the design of waterpower dams, structures and equipment has been shaped by technological change over time. Students will learn to analyze the upgrade potential of an existing plant; review the tools and data available to understand site condition and to be aware of modernization scope for structures and equipment.

Winter 2023 Schedule: Jan 11 - April 5, Wed 3-6pm, Online course, Synchronous delivery

- **CIV550: Water Resources Engineering (Fall, 2022)**

This course covers global, national and regional water issues, law and legislation; Hydraulic structures; Reservoir analysis; Urban drainage and runoff control: meteorological data analysis, deterministic and stochastic modeling techniques; Flood control: structural and nonstructural alternatives; Power generation: hydro and thermal power generation. Low flow augmentation; Economics and decision making.

How to enroll

There are three distinct pathways to enrol in the waterpower courses.

- (1) Enrolling in a full Masters of Engineering, comprising of 10 one-semester courses. By enrolling in the above waterpower courses, students can work toward an Emphasis in Waterpower
- (2) Enrolling as a non-degree student in selected courses of interest. Receive academic credit that can contribute to a future Masters degree.
- (3) Auditing the courses: no academic credit, but can contribute to professional development requirements.

If you have specific questions about the application process for the above, please contact the admissions officer and Pauline Martini (pauline.martini@utoronto.ca)

For other inquiries about the waterpower courses, please contact Sharon Mandair (sharon.mandair@gmail.com)

Learn more about the OWA's partnership with the University of Toronto.

Renewal of Waterpower Facilities - Overview

Emphasis in Waterpower

As the world strives for decarbonization, the energy supply is in transition and waterpower is in a unique position to support this change. As the oldest form of low carbon energy, waterpower's role is becoming even more important. The energy transition is demanding more flexibility to support other renewable technologies. Through upgrading of aging infrastructure waterpower not only supports the electricity grid, but also plays a role in integrated water management around flood and drought mitigation, navigation and recreations. The challenges are many, but waterpower stations are uniquely suited to tackle these challenges, embedded in communities and ecosystems all across Canada and the world. They are long term assets, in a world of short-term investment. An emphasis focused on waterpower aims to prepare students with a basic understanding of this technology and its growing opportunities in the industry, drawing on its long history and the many lessons learnt.

Renewal of Waterpower Facilities

Waterpower infrastructure is both ageing and being repurposed. This course looks at how the design of waterpower dams, structures and equipment has been shaped by technological change over time. Students will learn to analyze the upgrade potential of an existing plant; review the tools and data available to understand site condition and to be aware of modernization scope for structures and equipment in the context of environmental, social, technical and economic decision making.

Learning Outcomes

Student will be able to:

- appreciate profile of existing hydro fleet
- understand design considerations for hydro dams, structures and equipment as they evolved over time
- analyze upgrade potential of an existing plant
- be aware of modernization scope for structures and equipment

Course Instructor

Michael Morgenroth, Dipl.Ing., Ph.D., P.Eng.
Email: michael.morgenroth@stantec.com

Course Modules

Week	Title
1	Course Introduction and Dam Safety
2	Overview & Dams
3	Conveyances and Spillways
4	Flow Control Equipment (Gates & Valves)
5	Penstocks & Surgetanks
6	Turbines & Performance Testing
7	Generators, Transformers & Switchgear
8	Governor, SCADA, Protection & Controls
9	Financial Analysis
10	Environmental and Permitting
11	Prioritization process
12	Funding/Approvals

Course Evaluation

Percent of Mark	Task
10%	Safety Moment (Individual): Prepare a safety moment that is relevant to waterpower facilities and present to class with ~ 5 Minutes
15%	Homework Presentation (Individual): Prepare a 15-Minute topical presentation (topic assigned at end of each session) and answer peer questions
50%	Course Project Report (Group): Written report that covers the Work Breakdown Structure (WBS) required for the Group Project to be submitted at last session
25%	Course Project Presentation (Individual): Executive Summary of Group Project where each group member takes up to 3 minutes to present an aspect of the findings
100%	Total

Group project will be a written report and presentation covering the critical options analysis and preferred renewal option recommended for an existing hydropower facility.