Course Name:	Water & Waste-water Treatment
Language of Instruction:	English
Course Dates:	July 12 to August 18, 2022
English Tutoring Time:	Tuesday/Thursday, 7:00-7:30am, EDT
Course Meeting Time:	Tuesday/Thursday, 7:30-9:30am, EDT
Course Meeting Place:	Zoom
Course Instructor:	Dr. Mahipal Jadeja

约克大学

约克大学位于加拿大的商业、技术和文化中心多伦多，是加拿大一所著名的综合性大学。作为加拿大的第三大高等学府，约克大学每年有约 55,000 名在校生，其中国际生约占 20%，来自一百七十多个国家，以其文化和知识的多元化而闻名。

约克大学的教育注重各学科知识的融会贯通与灵活运用，为学生提供了丰富多彩的学习机会，不仅仅考核学生的学习与答辩成绩，更是鼓励学生发现与分析问题。此外，为了进一步促进学生的跨学科综合思考能力，学校还允许学生参与完全不同领域专业的学习。

约克大学现与世界上一百五十多所大学签有合作协议，包括中国的北京大学、北京航空航天大学、中国社会科学院、复旦大学、中欧国际工商管理学院、四川大学等，进行广泛的交流与合作。

课程简介

饮用水对于维持地球上的生命至关重要。联合国估计，目前全球 79 亿人口中有 20 多亿人无法获得安全的饮用水。这意味着生活在这个星球上的每 4 个人中就有 1 个无法获得没有被微生物和化学（无机和有机）污染的可靠饮用水源。预计世界一些地区的气候变化和人口增长肯定会加剧这一问题。这就迫切需要在社区中加大处理水和废水的努力，以便可以重复使用。

本课程旨在向学生介绍水和废水处理的原理，并介绍一些案例研究，展示用于提高水和废水质量以实现可持续再利用的创造性和创新策略。改善供水和卫生条件可以促进经济增长，提高全球社区的生活水平，同时对环境的影响最小或没有影响。

Potable water is essential for sustaining life on earth. The United Nations (UN) estimates that over 2 billion of the current global population of 7.9 billion do not have access to safe, potable water. This translates into 1 out of every 4 people living on this planet not having access to reliable sources of drinking water free of microbial and chemical (inorganic and organic) contamination. It is anticipated that climate change and population growth in some regions of the world will certainly exacerbate this problem. This calls for an urgent need to ramp up efforts in communities to treat water and waste-water, so that it can be reused.

This course aims to give the students an introduction to the principles of water and waste-water treatment and introduce some case studies that showcase the creative and innovative strategies employed to enhance the quality of water and waste-water for its sustainable reuse. Improved water supplies and sanitation can boost economic growth and raise the standard of living in communities across the globe, with minimal or no environmental impact.

Learning Outcomes

The learning outcomes of this course are as follows:

- A broad understanding of the principles of water and waste-water treatment
- The various phases of water treatment based on physical, chemical and biological treatment methods
- The various phases of waste-water treatment based on primary, secondary and tertiary treatment methods
- Applications of water treatment methods in rural and urban communities
- Applications of waste-water treatment methods in rural and urban communities
- Application of innovative and sustainable solutions for water and waste-water treatment methods

Course Design

The format of instruction is a combination of lectures and class discussion. Each class will start with a brief lecture to introduce the concepts and terminology associated with water treatment (and waste-water treatment where applicable), then start an in-class

discussion on the applications of the concepts using specific examples from different locations around the globe. In some cases, specific examples will be given highlighting some changes in the methods employed based on rural, suburban and urban applications of water and waste-water treatment.

Students in this course will be split into groups (4-5 students per group) to review examples of applications of water treatment systems provided during class and spend some time outside regular class time to do some research on water treatment plants in either China or elsewhere, which employ generic and innovative solutions to address water treatment in communities ranging from rural (i.e., populations < 10,000) to suburban towns/cities (i.e., populations 10,000 < x < 1,000,000) to megacities (i.e., populations 1,000,000 < x < 10,000,000), and present in class at the end of the second week of this course (i.e., middle of the accelerated term). Additional information on this presentation will be provided during course overview on the first day of class.

Similar research will have to be done during the second half of this course by the same student groups (4-5 students per group) on waste-water treatment plants in either China or elsewhere, which employ generic and innovative solutions to address sewage treatment in communities ranging from rural (i.e., populations < 10,000) to suburban towns/cities (i.e., populations 10,000 < x < 1,000,000) to megacities (i.e., populations 1,000,000 < x < 10,000,000), and present in class on the last day of class for this course at the end of the fourth week. will have to present in class on the last day for this course Additional information regarding this presentation will be provided during course overview on the first day of class. The Mid-term presentation (middle of the accelerated term) and the final presentation (end of the accelerated term) will be weighted heavily to contribute to mid-term and final grades for this course, respectively.

In a partially flipped format, students are expected to have read the assigned material and reviewed the lecture slides in advance, and come prepared to discuss the subject matter and raise questions on parts they wish to have a better understanding of the content. The time spent in class discussion is a critical component of the in-class learning process. The aim of this hybrid model is to prepare students for real-world problems while providing them with a strong theoretical background in water and waste-water treatment.

* Lecture attendance is mandatory. All teaching materials and assignments will be posted on eClass. All communications will be conducted via eClass and/or e-mail.

Outline of the Topics in the Course

The following topics will be covered in this course:

Week 1: Introduction to Water Treatment

Tuesday – Jul 12, 2022

- Course Overview
- Water Chemistry – inorganics & organic matter

Thursday – Jul 14, 2022

- Water Treatment
  - Screening
  - Mixing & Flocculation
  - Sedimentation
  - Flocculator-Clarifiers
  - Filtration
  - Chemical feeders
  - Turbidity removal
  - Taste & odour control

Week 2: Introduction to Water Treatment (continued from Week 1)

Tuesday – Jul 19, 2022

- Water Treatment (continued)
  - Synthetic organic chemical removal
  - Iron & Manganese removal
  - Precipitation softening
  - Water stabilization

- Fluoridation
- Chlorination
- Disinfection by-products
- Ozone

Thursday – Jul 21, 2022

- Water Treatment
  - Disinfection
  - Ion exchange softening & Nitrate removal
  - Removal of dissolved salts
  - Sources of wastes in water treatment
  - Dewatering & disposal of wastes from water treatment plants

Week 3: Introduction to Water Treatment (continued from Week 2)

Tuesday – Jul 26, 2022

- Issues with Water treatment
  - Walkerton, Ontario – *e-coli*
  - Flint, Michigan – Pb
- Innovative solutions associated with water treatment
  - Natural & Engineered wetland systems
  - Desalination – thermal vs. Reverse Osmosis (RO)
  - Michael Pritchard – TED Talks

Thursday – Jul 28, 2022

- **Mid-Term Group Presentations**
- Waste-water Flows & Characteristics
  - Domestic waste-water
  - Industrial waste-waters
  - Infiltration & Inflow
  - Municipal waste-water
  - Composite sampling
  - Evaluation of waste-water

Week 4: Introduction to Waste-water Treatment

Tuesday – Aug 2, 2022

- Waste-water Treatment
  - Considerations in plant design
  - Preliminary treatment
  - Pumping stations
  - Sedimentation
  - Biological filtration

- Rotating biological contactors
- Biological aeration
- Stabilization ponds

Thursday – Aug 4, 2022

- Waste-water Treatment (continued)
  - Effluent disinfection
  - Individual Household disposal systems
  - Characteristics of waste sludges
  - Selection and arrangement of sludge processes
  - Anaerobic digestion
  - Aerobic digestion
  - Pressure filtration & Centrifugation
  - Agricultural land application
  - Landfilling
  - Incineration
  - Odour control

Week 5: Introduction to Waste-water Treatment (continued from Week 4)

Tuesday – Aug 9, 2022

- Advanced Waste-water Treatment
  - Limitations of conventional treatment
  - Suspended solids removal
  - Pathogen removal
  - Phosphorus in waste-waters
  - Chemical – Biological Phosphorus removal
  - Nitrogen in waste-waters
  - Biological Nitrification & Denitrification

Thursday – Aug 11, 2022

- Water Reuse
  - Water Quality & Regulations
  - Agricultural Irrigation
  - Urban Irrigation & Reuse
  - Grey water & Industrial reuse
  - Construction & other reuse applications
  - Groundwater recharge & potable supply
  - Design of Urban Distribution Systems

Week 6: Water Reuse

Tuesday – Aug 16, 2022

- Issues with Waste-water treatment

- London, UK – fatberg
- Sydney, Australia – Biodegradable wet wipes
- Innovative solutions associated with waste-water treatment
  - *INNOQUA* – nature-based sanitation solution
  - Using algae in waste-water treatment to remove phosphates & nitrates

Thursday – Aug 18, 2022
- **Final Project Presentations**

Evaluation Method

- Attendance is mandatory and student participation in class discussions will be considered in the final grade.

- Midterm Group Presentations will be based on research of water treatment plants in China or elsewhere, which employ generic and innovative solutions to address water treatment in communities ranging from rural (i.e., populations $< 10,000$) to suburban towns/cities (i.e., populations $10,000 < x < 1,000,000$) to megacities (i.e., populations $1,000,000 < x < 10,000,000$).

- Final Group Presentations will be based on research of waste-water treatment plants in China or elsewhere, which employ generic and innovative solutions to address sewage treatment in communities ranging from rural (i.e., populations $< 10,000$) to suburban towns/cities (i.e., populations $10,000 < x < 1,000,000$) to megacities (i.e., populations $1,000,000 < x < 10,000,000$).

Midterm Presentations: 40% (Week 3)
Final Presentations: 40% (Week 6)
Class Participation: 20% (10% - weeks 1-2 & 10% - weeks 3-4, respectively)

Rubric for Mid-Term & Final Presentations:

Criteria	Poor (1-2 points)	Fair (3 points),	Good (4 points)	Great (5 points)
Example of Water/Waste-water Treatment System	A graphic that may/may not include a map showing only the geographic location	A graphic that includes a map showing only the geographic location	A graphic that includes one map showing both, the geographic location	A graphic that includes two maps (one **clearly** showing the geographic location & country in

Selection based on either rural (i.e., populations < 10,000) OR suburban towns/cities (i.e., populations 10,000 < x < 1,000,000) OR megacities (i.e., populations 1,000,000 < x < 10,000,000).	and/or the country in which the water/waste-water treatment facility is located in. Also, **a couple of** pertinent statistics about the water/waste-water treatment facility are provided in a tabular format	and country in which the water/waste-water treatment facility is located in. Also, **some** pertinent statistics about the water/waste-water treatment facility are provided in a tabular format	and country in which the water/waste-water treatment facility is located in. Also, **most** pertinent statistics about the water/waste-water treatment facility are provided in a tabular format	which it is located, while the other map shows country and continent in which the water/waste-water treatment facility is located in. Also, **all** pertinent statistics about the water/waste-water treatment facility are provided in a tabular format.
Water/Waste-water Treatment Process Flow Sheet (x2)	A schematic that shows **a couple** of the physical, chemical and biological treatment of water/primary, secondary and tertiary phases of waste-water treatment at the water/waste-water treatment facility	A schematic that shows **some** of the physical, chemical and biological treatment of water/primary, secondary and tertiary phases of waste-water treatment at the water/waste-water treatment facility	A schematic that shows **most** of the physical, chemical and biological treatment of water/primary, secondary and tertiary phases of waste-water treatment at the water/waste-water treatment facility	A schematic that clearly shows **all** the physical, chemical and biological treatment of water/primary, secondary and tertiary phases of waste-water treatment at the water/waste-water treatment facility
Integration of any sustainable, innovative technology/technologies into the standard/generic water waste-water system (x2)	**May/May not** outline the integration of the innovative technology/technologies on the water/waste-water treatment process flow sheet. Also, it identifies **a couple** of the benefits (environmental, social and economic) of integrating the innovative technology/technologies to the standard/generic water waste-water	**Partly** outlines the integration of the innovative technology/technologies on the water/waste-water treatment process flow sheet. Also, it identifies **some** of the benefits (environmental, social and economic) of integrating the innovative technology/technologies to the standard/generic water waste-water systems	**Mostly** outlines the integration of the innovative technology/technologies on the water/waste-water treatment process flow sheet. Also, it identifies **most** of the benefits (environmental, social and economic) of integrating the innovative technology/technologies to the standard/generic water waste-water systems	**Clearly** outlines the integration of the innovative technology/technologies on the water/waste-water treatment process flow sheet. Also, it **clearly** identifies the benefits (environmental, social and economic) of integrating the innovative technology/technologies to the standard/generic water waste-water systems

YORK UNIVERSITÉ UNIVERSITY

Course Instructor

Mahipal Jadeja, PhD

Dr. Jadeja has twenty-two years of teaching experience in environmental geosciences in higher education and has been an author or co-author of several scientific papers, reports, oral and poster presentations. He has developed and taught numerous courses in the environmental geosciences in the context of urban & environmental sustainability. Additionally, he has considerable knowledge and experience in contaminant fate and transport in Groundwater and environmental/geotechnical modeling.

Currently, Mahipal Jadeja is a professor at the School of Environmental & Civil Engineering Technology (SECET) at Seneca College, affiliated with York University. He currently teaches in the Civil Engineering Technology, Environmental Technician and the Environmental Technology Programs and has previously taught in the Environmental Site Remediation (ESR) Applied Degree Program. In the last decade, he has been instrumental in developing pathways for York University and Seneca College students between the two institutions.

He earned his Doctorate in Environmental Science and Engineering from the University of Texas at Arlington.