This course introduces the basic engineering and science framework needed to understand and predict environmental processes and to appreciate the link between human activity and environmental sustainability. The course emphasizes the role of the engineer in protecting human health and the environment. The course discusses pressing environmental issues and innovative solutions including the role of engineers to effect positive change. The course provides an introduction to a career in environmental engineering, but also provides concepts that are relevant to all civil engineering careers. The general objectives are for the student to become able to:

- Identify key components of the physical environment and how they are influenced by human activity.
- Recognize how culture, societal factors and economics frame environmental issues.
- Apply the mathematics of growth to better understand population growth and sustainability at various scales.
- Use the mass balance approach to estimate pollutant concentrations in simple open and closed environmental systems.
- Apply fundamental principles of chemistry and physics to model the fate of pollutants in the environment (air and water).
- Understand the central role of protecting public health and safety in the engineering profession.
- Understand the concepts of sustainable development and design and environmental stewardship.
- Demonstrates knowledge of professional ethics and is able to identify and provide reasoned arguments on ethical issues in environmental engineering.
- Improve communication and teamwork skills through undertaking individual written assignments, working on a group project, and delivering a group presentation.
- Appreciate the need for life-long learning to keep abreast of emerging environmental issues and policies.

**Calendar Copy:**
A course introducing the application of chemistry and engineering principles to an understanding of environmental issues associated with human activity. Topics include mass and energy transfer, environmental chemistry, water and air pollution, pollutant transport modeling, pollution management, and risk assessment.

**Antirequisite(s):** [Chemistry 2210A/B](#).

**Prerequisite(s):** [Chemistry 1302A/B](#) or the former Chemistry 1024A/B.

Note: It is the student's responsibility to ensure that all Prerequisite and Corequisite conditions are met or that special permission to waive these requirements has been granted by the Faculty. It is also the student's responsibility to ensure that they have not taken a course listed as an
Antirequisite. The student may be dropped from the course or not given credit for the course towards their degree if they violate the Prerequisite, Corequisite or Antirequisite conditions.

**Contact Hours:**

3 lecture hours/week;
Lectures will be delivered asynchronously through pre-recorded videos posted to the course OWL site. Lectures will be organized into weekly learning modules which students should review in the week they are posted, and be prepared to review and discuss in the tutorial on the following week. Review of lecture material and self-study should take approximately 6 hours per week.

1 tutorial hour/week.
A 1-hour tutorial session will be delivered synchronously through Zoom each week. Students will be divided into three groups and each group will be assigned one tutorial hour that will occur on a regular basis during the scheduled lecture hours for the course:

- **Tutorial Group A:** Tuesdays 10:30 – 11:20
- **Tutorial Group B:** Tuesdays 11:30 – 12:20
- **Tutorial Group C:** Wednesdays 2:30 – 3:20

You will be notified of which group you are in via OWL. Attendance at tutorials is required in order to support the learning objectives, discuss the course in a live and interactive manner, and gain participation marks. Tutorials will also discuss current environmental issues linked to the course material, present examples of calculations introduced in the lectures, discuss the assignments, and answer questions about all of these topics. Tutorials will actively engage students by using iClicker in real time. Tutorials will not be recorded to allow free and open discussion and to not inhibit any questions or opinions. If you are unable to attend on a regular basis for a specific reason, please contact the instructor at the beginning of the term to explain and discuss possible alternative arrangements in exceptional circumstances.

**Instructor:**
Dr. Jason I. Gerhard, SEB3029, e-mail: jgerhard@uwo.ca
Office hours: Wednesdays 3:30 – 4:30 pm via Zoom (link can be found on course OWL site).

Administrative Assistant: Sandra McKay (smckay@uwo.ca)

**Textbook:**
Course notes (with gaps) will be provided. These should be downloaded from the course website in advance of watching the lecture. The gaps will be filled in during the lectures and should be done by the student in their own set of notes while watching the lecture; this will promote active learning. Solutions to some example problems will be provided in the tutorials and these, as well as the gap-filled notes, will not be posted on the course website.

**Units:**
SI unit systems will be adopted in assignments, test, and examination.
Specific Learning Objectives:

I. Growth in Human Systems and Sustainability (6 lecture hours)
At the end of this section, the student should be able to
   (a) Understand, differentiate and manipulate equations for linear, exponential, and logistic growth and apply to environmental problems including population growth.
   (b) Manipulate the mathematics of growth as a product of factors and apply to environmental problems including growth of greenhouse gas emissions.
   (c) Explain in context and calculate (where appropriate) the concepts of IPAT, environmental resistance, total fertility rate, demographic transition, tragedy of the commons, market failure, sustainable development, environmental footprint, human development index, sustainability of human society.

II. Pollutants in the Environment: Water (12 lecture hours)
At the end of this section, the student should be able to:
   (a) Identify the basic physical and chemical properties of water.
   (b) Recognize the major parts of the hydrologic cycle.
   (c) Articulate the social and geopolitical dimensions of water pollution, water shortages and water disparity.
   (d) Understand the major classes of pollutants in environmental water systems, such as pathogens, nutrients, heavy metals and pesticides.
   (e) Calculate and employ the criteria used to describe water quality.
   (f) Describe and differentiate drinking water and wastewater treatment systems.

III. Materials Balances (8 lecture hours)
At the end of this section, the student should be able to:
   (a) Use appropriate units in calculating or measuring environmental quantities for liquids, gases and solids.
   (b) Differentiate between conservative and non-conservative pollutants.
   (c) Apply the principles of mass conservation to materials balances in simple steady-state and transient environmental systems, including pollutant decay.

III. Pollutants in the Environment: Air (8 lecture hours)
At the end of this section, the student should be able to:
   (a) Identify the basic physical and chemical properties of air and common primary and secondary air pollutants, including VOCs, ozone, photochemical smog, and particulate matter.
   (b) Understand the trends and social and economic factors that influence the management of local, national and global air pollution.
   (c) Recognize the basic mechanisms that lead to ozone depletion and smog.
   (d) Appreciate the Montreal Protocol as an example of successful global partnership to reduce a targeted environmental threat.
   (e) Demonstrate an appreciation for the science of climate change, its drivers and predicted trajectories, as well as the environmental, social, and economic impacts.
   (f) Understand the Professional Code of Ethics and be able to apply it to the responsibilities of engineers in an environmental context.
The instructor may expand or revise material presented in the course as appropriate.

**General Learning Objectives:**

E=Evaluate, T=Teach, I=Introduce; (I) = Introduction, (D) = Developing, (A) = Advanced level

<table>
<thead>
<tr>
<th>Knowledge Base</th>
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<th>Engineering Tools</th>
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<tr>
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<td>Professionalism</td>
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<td>Life-Long Learning</td>
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**Evaluation:**
The final mark will be determined as follows:

- Participation: 10 %
- Assignments: 15 %
- Midterm Test: 15 %
- Project: 15 %
- Written Final Examination: 35 %
- Oral Final Examination: 10 %
- Total: 100 %

1. **Midterm Test and Exam:**

A two-hour written midterm test will be held during tutorial hours. This is tentatively scheduled for 2:30 – 4:30 pm, Wednesday, October 21. This will be a take-home (download from OWL, upload to OWL when done) exam. However, no collaboration is allowed, you must complete this on your own.

A three-hour written final examination will be held during the regular examination period. This will be a take-home (download from OWL, upload to OWL when done) exam. However, no collaboration is allowed, you must complete this on your own.

After the written final exam has been marked (i.e., approximately one week later), a 15-minute oral examination will be conducted between the professor and the student in which the written examination as well as follow-up questions will be reviewed and discussed.

Both the midterm test and final examination will be open book exams. They must be completed by the individual student without any external help or collaboration. Online proctoring via Zoom may be used to monitor student activity during the midterm test and exam (if used, this will be clearly indicated prior to the exam). Also, the uploaded answers to both the midterm test and final examination will be submitted via Turnitin to ensure no copying or plagiarism.

2. **Weekly Assignments:**

Assignments will be given on a bi-weekly basis. They are long assignments, covering 2 weeks worth of material, so do not put off starting them and ensure you dedicate adequate time to completing them. You can discuss the assignments with colleagues, but ensure the answer you submit are yours alone. All written submissions will be passed through Turnitin to ensure no
copying or plagiarism. Assignments are to be submitted prior to the due date to OWL. Late assignments will be assessed a penalty of 10% per day, to a maximum of 4 days, after which they will receive a mark of zero. Extensions are to be negotiated with the course instructor, not the teaching assistants. The maximum number of missed assignments for each student will be one; if more than one assignment is missed a student may be barred from writing the final exam. Only a selection of questions will be marked in each assignment, but the questions to be marked will not be determined or announced in advance. The intention is for students to complete the entire assignment in order to maximize learning the course material.

3. **Tutorials:**

The tutorials will be synchronous (live, in real time, using Zoom) in a regular slot each week with a subset of the class. The tutorials have multiple objectives:
- Provide opportunity to directly interact with TAs and Professor
- Discussion of current environmental issues in the news and in the course notes
- Answer your questions on course material, lectures, and assignments
- Provide examples to further supplement the course notes
- Test-your-learning quizzes on the most recent course notes (correct/incorrect does not count)
- Provide opportunities for participation via live interaction and via iClicker

If you are unable to attend on a regular basis for a specific reason, please contact the instructor at the beginning of the term to explain and discuss possible alternative arrangements in exceptional circumstances.

4. **Project**

A group research project will be assigned. Groups will be randomly assigned. The project runs throughout the course with a succession of written and oral deliverables. A component of peer review is included to ensure equal contribution from all group members. Full details provided in a separate document and lecture.

5. **Participation**

Participation is an important component of this course. It will be assessed in primarily three ways:

a) Attendance at tutorials, live participation in tutorials, and participation in the test-your-learning quizzes using iClicker.

b) Posting to the online discussion forums on the class. Each student is required to post two original forum items per month (Sept, Oct, Nov) and two forum replies per month (Sept, Oct, Nov). Posts must include relevant, original, constructive material with well-written summaries and opinions and appropriate links. Examples will be provided.

c) Viewing and participating in Group Project presentations. This may include asking questions in real-time, or asking and answering questions asynchronously (e.g., via Forum or VoiceThread).
If you are unable to participate in any of these methods on a regular basis for a specific reason, please contact the instructor at the beginning of the term to explain and discuss possible alternative arrangements in exceptional circumstances.

6. Use of English:

In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for improper use of English. Additionally poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Cheating:
University policy states that cheating is a scholastic offence. The commission of a scholastic offence is attended by academic penalties that might include expulsion from the program. If you are caught cheating, there will be no second warning.
For more information on scholastic offenses, please see:
http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_undergrad.pdf

Attendance:
Any student who, in the opinion of the instructor, has not engaged sufficiently in class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

Accommodation:
Students with disabilities work with Accessible Education (formerly SSD) which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The accommodation policy can be found here: Academic Accommodation for Students with Disabilities.

Academic Consideration for Student Absence
Students will have up to two (2) opportunities during the regular academic year to use an on-line portal to self-report an absence during the term, provided the following conditions are met: the absence is no more than 48 hours in duration, and the assessment for which consideration is being sought is worth 30% or less of the student’s final grade. Students are expected to contact their instructors within 24 hours of the end of the period of the self-reported absence, unless noted on the syllabus. Students are not able to use the self-reporting option in the following circumstances:

- for exams scheduled by the Office of the Registrar (e.g., December and April exams)
- absence of a duration greater than 48 hours,
- assessments worth more than 30% of the student’s final grade,
- if a student has already used the self-reporting portal twice during the academic year

If the conditions for a Self-Reported Absence are not met, students will need to provide a Student Medical Certificate if the absence is medical, or provide appropriate documentation if there are compassionate grounds for the absence in question. Students are encouraged to contact their Faculty academic counselling office to obtain more information about the relevant documentation.
Students should also note that individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds, or for other
reasons. **All documentation required for absences that are not covered by the Self-Reported Absence Policy must be submitted to the Academic Counselling office of a student's Home Faculty.**

For Western University policy on Consideration for Student Absence, see Policy on Academic Consideration for Student Absences - Undergraduate Students in First Entry Programs and for the Student Medical Certificate (SMC), see: [http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf).

**Religious Accommodation**

Students should consult the University's list of recognized religious holidays, and should give reasonable notice in writing, prior to the holiday, to the Instructor and an Academic Counsellor if their course requirements will be affected by a religious observance. Additional information is given in the Western Multicultural Calendar.

**Use of Recordings:**

All of the remote learning sessions for this course will be recorded. The data captured during these recordings may include your image, voice recordings, chat logs and personal identifiers (name displayed on the screen). The recordings will be used for educational purposes related to this course, including evaluations. The recordings may be disclosed to other individuals under special circumstances. Please contact the instructor if you have any concerns related to session recordings.

Participants in this course are not permitted to record the sessions, except where recording is an approved accommodation, or the participant has the prior written permission of the instructor. The lecture notes and online lecture videos and tutorial sessions are copyrighted to the instructor and legally protected. Do not post these videos and lecture notes on any other website or online forums. The recording of the live/synchronous sessions of the course without the permission from the instructor is prohibited. The illegal posting and sharing of the copyrighted course content could be subjected to legal actions.

**Conduct:**

Some components of this course will involve online interactions. To ensure the best experience for both you and your classmates, please honour the following rules of etiquette:

- please “arrive” to class on time
- please use your computer and/or laptop if possible (as opposed to a cell phone or tablet)
- ensure that you are in a private location to protect the confidentiality of discussions in the event that a class discussion deals with sensitive or personal material
- to minimize background noise, kindly mute your microphone for the entire class until you are invited to speak, unless directed otherwise
- [suggested for classes larger than 30 students] In order to give us optimum bandwidth and web quality, please turn off your video camera for the entire class unless you are invited to speak
- [suggested for cases where video is used] please be prepared to turn your video camera off at the instructor’s request if the internet connection becomes unstable
- unless invited by your instructor, do **not** share your screen in the meeting

The course instructor will act as moderator for the class and will deal with any questions from participants. To participate please consider the following:

- if you wish to speak, use the “raise hand” function and wait for the instructor to acknowledge you before beginning your comment or question
- remember to unmute your microphone and turn on your video camera before speaking
• self-identify when speaking.
• remember to mute your mic and turn off your video camera after speaking (unless directed otherwise)

General considerations of “netiquette”:
• Keep in mind the different cultural and linguistic backgrounds of the students in the course.
• Be courteous toward the instructor, your colleagues, and authors whose work you are discussing.
• Be respectful of the diversity of viewpoints that you will encounter in the class and in your readings. The exchange of diverse ideas and opinions is part of the scholarly environment. “Flaming” is never appropriate.
• Be professional and scholarly in all online postings. Cite the ideas of others appropriately.

Note that disruptive behaviour of any type during online classes, including inappropriate use of the chat function, is unacceptable. Students found guilty of Zoom-bombing a class or of other serious online offenses may be subject to disciplinary measures under the Code of Student Conduct.

**Online Proctoring Notice:**

Tests and examinations in this course will be conducted using Zoom. You will be required to keep your camera on for the entire session, hold up your student card for identification purposes, and share your screen with the invigilator if asked to do so at any time during the exam. The exam session will not be recorded.*

More information about the use of Zoom for exam invigilation is available in the Online Proctoring Guidelines at the following link: https://www.uwo.ca/univsec/pdf/onlinelproctoringguidelines.pdf.

Completion of this course will require you to have a reliable internet connection and a device that meets the system requirements for Zoom. Information about the system requirements are available at the following link: https://support.zoom.us/hc/en-us.

* Please note that Zoom servers are located outside Canada. If you would prefer to use only your first name or a nickname to login to Zoom, please discuss this with your instructor in advance of the test or examination.

**Notice:**

Students are responsible for regularly checking their email, course website (https://owl.uwo.ca) and notices posted outside the Civil and Environmental Engineering Department Office.

**Consultation:**

Students are encouraged to discuss problems with their teaching assistant and/or the Instructor in tutorial sessions. Office hours will be arranged for the students to meet with the Instructor and teaching assistants. Other individual consultation can be arranged by appointment with the instructor.

The document “INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED” is part of this course outline.