# ENV 237H1S/238H1S – PHYSICS OF THE CHANGING ENVIRONMENT

#### Department of Physics, University of Toronto Course Syllabus: WINTER 2024

This course will cover basic physics of environmental processes and of measurement techniques in the atmosphere, the ocean, terrestrial biosphere systems, and other biological systems. It will place its work in the context of climate change and other aspects of environmental change.

#### **COURSE INFORMATION:**

**INSTRUCTOR:** Prof. Kaley Walker (she/her)

#### **COURSE MEETING SCHEDULE:**

- Meetings: 2 hours/week; Tuesdays and Thursdays 2 3 PM in MP
  - Starting on Tuesday 9 January; typically, Tuesdays will be *Office Hours/Problem Solving* and Thursdays will be *Tutorial/Discussions*.
  - Any exceptions will be announced in class and on the course website.
- Practicals: 2 hours/week; Mondays 2 4 PM in MP starting 15 January 2024)

## **COURSE WEBSITE:**

Quercus will be used for the course website. The home page of the website will be used for all class announcements. It is your responsibility to check regularly to keep up on course announcements and assignment due dates!

# **CONTACT INFORMATION:**

#### For Prof. Walker

Office: Department of Physics

kaley.walker@utoronto.ca

- E-mail: I will try to reply to email inquiries from students within 2 business days (i.e.
  Policy: excluding weekends). I will not answer detailed questions about physics problems by e-mail, as these are best addressed by coming to see me (or your tutor) during our office hours or by appointment.
- Office Hours: Mondays: 12-1 PM (TBC) and I will hold office hours during one lecture session per week (see website for exceptions). In addition to these hours, you can contact me by phone or e-mail to arrange an appointment. You may also drop by my office - if I have time, I will be happy to answer your questions.

Telephone: 416 978 8218

#### For Practicals Tutors and Marker:

Tutor:	Liz Cunningham (they/them)	E-mail: <u>ecunning@physics.utoronto.ca</u>
Tutor:	Sabrina Madsen (she/her)	E-mail: smadsen@physics.utoronto.ca
Marker:	Jon-Paul Mastrogiacomo (he/him)	E-mail: jp.mastrogiacomo@mail.utoronto.ca

#### **COURSE OBJECTIVES:**

In this course, we will be considering the physical concepts, processes and phenomena that are relevant to understanding our changing environment. We will be investigating the physical principles through practicals, tutorial/discussions, and demonstrations. We will be covering topics in areas of thermodynamics, fluid mechanics and interaction of electromagnetic radiation with matter. There will be a focus on how we measure environmental parameters in the latter part of the course. The primary goal of the course is to describe our environment and its changes quantitatively using physical concepts and models through calculations, error analysis and written descriptions. The secondary goal is to develop physics skills and intuition by making quantitative measurements, analyzing data and determining physical parameters. The balance between these goals will differ for ENV 237 and 238.

At the end of the course, you will be able to:

- 1. Demonstrate a solid foundational understanding of the physical environment, including buoyancy, forces, thermodynamics, and electromagnetism. Mastery of these concepts will be demonstrated and evaluated as part of the Problem Sets, Practicals, Midterm Test, and Exam.
- 2. Solve quantitative problems by applying the physical concepts developed in class. Distinguish important from extraneous information in a word problem, and solve the problem using physical concepts developed in class. This will be demonstrated and evaluated as part of the Problem Sets, Midterm Test and Exam.
- 3. Critically evaluate and interpret datasets in order to answer questions about the physical environment. Plot digital data such that they can be usefully interpreted to describe physical phenomena. This will be demonstrated and evaluated as part of the Problem Sets, Practicals, and the Formal Report, where you will collect and analyse your own dataset.
- 4. Develop a hypothesis about an environmental property, and design and implement a measurement scheme to address that hypothesis. This will be demonstrated and evaluated as part of the Formal Report. This assignment will be a group assignment, so you will also work productively as part of a team.

#### **PRACTICALS OBJECTIVES:**

These are an integral part of the course and attendance at all the Practicals is expected. Throughout the term, the Practicals will be used to divide the class into smaller groups (~4 students) for a different mode of learning. During these Practicals, you will have the opportunity to perform hands-on experiments, work on problems like those that will be included on assignments and to discuss course topics in a different environment. As part of the Practicals, you will design and conduct an experiment to measure solar irradiance.

#### **COURSE TEXTS:**

This course will use one main text for the course in combination with supplementary readings (all linked on the course website). The main text is *Environmental Physics by Clare Smith, copyright 2001 (2005 electronic) by Taylor and Francis.* There are copies of the textbook at the U of T bookstore, and the text is also available in hard copy and online through the library. Please note that the page numbers differ between the online version and the print version. Section titles will be provided for readings to avoid confusion. Additional readings will be provided from *Environmental physics: Sustainable Energy and Climate Change by Boeker and van Grondelle, copyright 2011, Third edition by Wiley* and other texts and articles.

#### **COURSE EVALUATION (differs by course):**

Assessment	Value for	Value for	Dates
	ENV237	<b>ENV238</b>	
Problem Sets (5 in total)	20 %	15 %	#1: Friday 19 January 2024
			#2: Friday 2 February 2024
			#3: Friday 16 February 2024
			#4: Friday 15 March 2024
			#5: Saturday 30 March 2024
Midterm Test (~2 hours)	15 %	15 %	Monday 4 March 2024
			(during Practicals 2:10 – 4 PM)
Practicals	15 %	15 %	Each Monday during term starting on
			Monday 15 January
Solar Irradiance Project	20 %	25 %	Outline due Friday 9 February
			Final Report due Friday 5 April
Post-Lecture Quizzes	7%	7%	23 throughout the term $\sim$ 2 per week
Peer Review Participation	3%	3%	Monday 1 April
Final Exam (3 hours)	20 %	20 %	Scheduled by the Office of the
			Faculty Registrar in the Final Exam
			Period

- Practicals mark is calculated from individual and group work and contributions.
  - Calculated from marked assignments for 8 Practicals during the term. The group mark contributes 75% and the individual mark 25% to the total for each Practical.
- Solar Irradiance Project mark is calculated from two components:
  - Outline group assignment worth 5% of Project total
  - Formal Report individual assignment worth 95% of Project total
- You will receive 0.3% for each Post-Lecture Quiz you complete and submit on-time prior to our Tutorial/Discussion sessions.
- Peer Review Participation mark requires two components to be completed:
  - Submission of a complete draft (all sections) of your Formal Report
  - Completion of constructive and helpful peer reviews of two Formal Reports

# **DETAILS FOR COURSE COMPONENTS:**

# LECTURES AND TUTORIAL/DISCUSSIONS:

The course is broken into four sections (approximately 3 weeks for each) covering:

- Energy and Thermodynamics
- Fluid Mechanics and Circulation
- Radiation and Interactions with Matter
- Remote Sensing using Satellites

Pages are provided on Quercus for each lecture containing the video and readings for that lecture. A transcript and blank lecture slides provided to facilitate your note taking. Following each tutorial/discussion, I will post my lecture notes. A listing of topics for each lecture is given below and these are subject to change as the term proceeds.

Week	Topic(s) Covered	
1	Introduction	
	Energy Exchange and Radiation	
2	Heat Transfer and Energy Exchange	
	Diffusion and Heat	
3	Electrical Energy and Engines	
	Renewable Energy	
4	Pressure and Buoyancy	
	Fluids and Flow	
5	Gases and Atmospheric Stability	
	Balloon-Based Atmospheric Measurements	
6	Atmospheric Structure and Circulation	
	Ocean Circulation	
7	Hydrology and Hydrogeology	
	Absorption, Emission, and Scattering of Light	
8	Refraction and Diffraction of Light	
	Polarization in the Atmosphere	
9	Radiation in the Atmosphere	
	Absorption of Radiation and Biological Effects	
10	Remote Sensing from Space	
	Satellites in Orbit	
11	Case Study: Remote Sensing of the Earth's Surface	
	Case Study: Measuring Vegetation from Space	
12	Case Study: Remote Sensing of the Atmosphere	
	Course Review	

#### PLANNED LECTURE TOPIC SCHEDULE:

#### **PROBLEM SETS:**

- Five Problem Sets will be due during the term (approximately every two weeks). The problem sets will be posted on the course website approximately a week prior to the due date. No paper copies of the problem sets will be distributed in class. Due dates for the problem sets are as follows:
  - o Friday 19 January 2024
  - Friday 2 February 2024
  - o Friday 16 February 2024
  - Friday 15 March 2024
  - Saturday 28 March 2024 (this is because Friday is a statutory holiday)
- In preparing your answers for the problem sets, you may use your textbook and other resources and discuss the problems with your classmates. However, each student <u>must</u> prepare their final answers to the problem sets individually and <u>must</u> provide all answers and explanations using their own words. Copying from a source is plagiarism (see section on Academic Integrity)!
- Problem sets will be due through Quercus by 9:59 PM on the announced due date, with a grace period until 11:59 PM that day. A late penalty will be applied to Problem sets submitted after 11:59 PM on the announced due date.

#### **PRACTICALS:**

- Your mark for the Practicals will be based on participation in experiments and activities during the sessions and correct completion of assigned work. This work will be done in groups of 3-4 students.
- Each group is responsible for recording their work in their lab notebook and submitting it for marking at the end of the practical period. Details on marking of work will be provided in Practicals and on the course website.
- A Pre-Practical assignment to be completed by each student individually, worth 1/8 of the Practical mark, will be due at the beginning of each Practicals period. Pre-Practical assignments will be submitted through Quercus.
- The Practicals begin on Monday 15 January and continue each week during the term.

# MIDTERM TEST AND FINAL EXAM:

The Midterm Test and Final Exam will both be timed, written, closed-book tests and will consist of calculation, definition, explanation questions. The Midterm Test will be held during your Practicals session on Monday 4 March and the Final Exam will be held during the Finals period.

- You will be provided with an equation sheet and a table of constants for the Midterm Test and Final Exam. The equation sheet will be provided prior to the test or examination to aid in your studying.
- You must bring your non-programmable scientific calculator for the Midterm Test and Final Exam. You will not be able to borrow one during the test or examination!

#### SOLAR IRRADIANCE MEASUREMENT PROJECT:

In the latter part of the course, you will be designing and conducting your own experiment to investigate solar irradiance. You will be working with a group of classmates to formulate your hypothesis and collect your data in February and March. There will be two components submitted for this project:

- An outline for your project stating your hypothesis, measurement plan and other parameters for your project will be due on **Friday 9 February**. This will be developed by you and your group and <u>one</u> outline will be created. This outline will be submitted via Quercus by <u>each</u> member of the group.
- A formal lab report on your results and analyses will be due on the last day of term (**Friday 5 April**). This will be completed by you individually and must show your own work and comprehension of the project.
- Both your outline and your formal report will be due on Quercus by the time stated on the instruction sheet. You must also provide your own calculation spreadsheet at the same time. Both must be submitted by the due date and time for your formal report to be marked on time.
- Marking rubrics and assignment expectations will be provided for both the Outline and Formal Report as part of these assignment sheets.
- There will be a peer-review process that will contribute 3% to your grade. The peer reviews of the formal reports will occur during the Practicals session on Monday 1 April. Your draft formal reports are due through Quercus **before 2:00 pm on Monday 1 April**. To obtain the 3% participation grade, your formal report draft must be submitted on time and complete (i.e., all sections attempted), and you must read and provide helpful and encouraging comments on two other formal reports.

#### **POST-LECTURE QUIZZES:**

Post-lecture quizzes allow you to let me know if there is a problem with the lecture video or audio quality, to let me know if there are physics concepts about which you are still unclear, or to ask for additional information on a topic of particular interest. To receive credit, you submit your quiz by the due date. Typically, we will cover two video lectures each tutorial, so you will need to complete two post-lecture quizzes per week. Any variations will be announced.

#### **USE OF GENERATIVE AI:**

The use of generative artificial intelligence tools and apps is strongly discouraged in all course assignments as it defeats the purpose of achieving course outcomes, especially those related to written scientific communication. Students should not copy or paraphrase from any generative artificial intelligence applications for the purpose of completing assignments in APL. Representing AI generated content as one's idea or an expression of an idea may be considered an academic offense.

## WRITING AT THE UNIVERSITY OF TORONTO:

There are a number of College Writing Centres at the University of Toronto (http://www.writing.utoronto.ca/writing-centres/arts-and-science) that you can use as resources to assist you in organizing and writing your formal report and other assignments. The main Writing at the University of Toronto website can be found via the web (http://www.writing.utoronto.ca/). They provide a lot of useful information under the FAQs and Advice sections of their website and you are encouraged to consult them for assistance with your written assignments. They also offer a series of workshops entitles "Writing Plus". These are detailed at <a href="http://www.writing.utoronto.ca/writing-plus">http://www.writing.utoronto.ca/writing-plus</a>. Finally, the English Language Learning program (ELL) offers different skills development programs that may be of benefit (http://www.artsci.utoronto.ca/current/advising/ell).

#### **TECHNICAL REQUIREMENTS:**

For this course, you will need a non-programmable scientific calculator (for both course work and test/exams), access to a computer with data graphing and analysis capability (such as a spreadsheet/graphing program or scientific programming suite) and internet access to retrieve the course readings and view additional materials (from electronic resources at the Library and other websites).

#### PHYSICS ACADEMIC ADVISING:

For academic advising or any undergraduate inquiries, please consult with the Physics Undergraduate Coordinator, Hala Larizza-Ali (<u>ugcoord@physics.utoronto.ca</u>; 416-978-7057; MP301).

#### **ACADEMIC INTEGRITY:**

All suspected cases of academic dishonesty will be investigated following procedures outlined in the <u>Code of Behaviour on Academic Matters</u> (<u>https://governingcouncil.utoronto.ca/secretariat/</u> policies/code-behaviour-academic-matters-july-1-2019</u>. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods,

please reach out to me. Note that you are expected to seek out additional information on academic integrity from me or from other institutional resources. For example, to learn more about how to cite and use source material appropriately and for other writing support, see the U of T writing support website at <u>http://www.writing.utoronto.ca</u>. Consult the Code of Behaviour on Academic Matters for a complete outline of the University's policy and expectations. For more information, please see <u>A&S Student Academic Integrity</u> (<u>https://www.artsci.utoronto.</u> ca/current/academic-advising-and-support/student-academic-integrity) and <u>the University of Toronto Website on Academic Integrity</u> (<u>https://www.academicintegrity.utoronto.ca</u>)

## LATE/MISSED ASSIGNMENTS:

The late penalty for assignments is a reduction in your mark of 5% per day of lateness. After one week, solutions will be posted and late assignments will not be accepted. <u>Some, but not all, assignments will have grace periods included for the due date</u>. No exceptions will be made for incorrectly assuming a grace period is given for any due date.

#### MAKE-UP QUIZZES/TESTS:

We have one Midterm Test during the Practicals period. If you are unable to attend, please talk to your instructor as soon as possible.

#### SPECIFIC MEDICAL CIRCUMSTANCES:

If you become ill and it affects your ability to do your academic work, consult me right away. Normally, I will ask you for documentation in support of your specific medical circumstances. This documentation can be an Absence Declaration (via ACORN) or the University's Verification of Student Illness or Injury (VOI) form. The VOI indicates the impact and severity of the illness, while protecting your privacy about the details of the nature of the illness. If you cannot submit a VOI due to limits on terms of use, you can submit a different form (like a letter from a doctor), as long as it is an original document, and it contains the same information as the VOI (including dates, academic impact, practitioner's signature, phone and registration number). For more information on the VOI, please see http://www.illnessverification.utoronto.ca. For Absence Declaration Tool information on for A&S students. please see https://www.artsci.utoronto.ca/absence. If you get a concussion, break your hand, or suffer some other acute injury, you should register with Accessibility Services as soon as possible.

#### **RELIGIOUS ACCOMMODATIONS:**

As a student at the University of Toronto, you are part of a diverse community that welcomes and includes students and faculty from a wide range of cultural and religious traditions. For my part, I will make every reasonable effort to avoid scheduling tests, examinations, or other compulsory activities on religious holy days not captured by statutory holidays. Further to University Policy, if you anticipate being absent from class or missing a major course activity (such as a test or in-class assignment) due to a religious observance, please let me know as early in the course as possible, and with sufficient notice (at least two to three weeks), so that we can work together to make alternate arrangements.

## **STUDENTS WITH DISABILITIES OR ACCOMMODATION REQUIREMENTS:**

Students with diverse learning styles and needs are welcome in this course. If you have an acute or ongoing disability issue or accommodation need, you should register with Accessibility beginning of the academic Services (AS) at the vear by visiting https://studentlife.utoronto.ca/service/accessibility-services-registration-and-documentationrequirements/. Without registration, you will not be able to verify your situation with your instructors, and instructors will not be advised about your accommodation needs. AS will assess your situation, develop an accommodation plan with you, and support you in requesting accommodation for your course work. Remember that the process of accommodation is private: AS will not share details of your needs or condition with any instructor, and your instructors will not reveal that you are registered with AS.

## **ACCOMMODATION FOR PERSONAL REASONS:**

There may be times when you are unable to complete course work on time due to non-medical reasons. If you have concerns, speak to me or to an advisor in your College Registrar's office; they can help you to decide if you want to request an extension or other forms of academic consideration. They may be able to email your instructors directly to provide a College Registrar's letter of support and connect you with other helpful resources on campus.

## **QUERCUS INFO:**

This course uses the University's learning management system, Quercus, to post information about the course. This includes posting readings and other materials required to complete class activities and course assignments, as well as sharing important announcements and updates. New information and resources will be posted regularly as we move through the term. To access the course website, go to the U of T Quercus log-in page at <a href="https://q.utoronto.ca">https://q.utoronto.ca</a>. Once you have logged in to Quercus using your UTORid and password, you should see the link or "card" for ENV237. Note, that ENV238 students will also use the ENV237 link. SPECIAL NOTE ABOUT GRADES POSTED ONLINE: Please also note that any grades posted are for your information only, so you can view and track your progress through the course. No grades are considered official, including any posted in Quercus at any point in the term, until they have been formally approved and posted on ACORN at the end of the course. Please contact me as soon as possible if you think there is an error in any grade posted on Quercus.

# **ATTENDANCE:**

Attendance at all Practicals sessions is required. Attendance at Tutorial/Discussions is strongly recommended, and attendance at Office Hours/Problem Solving is encouraged.

#### **ASSIGNMENT SUBMISSION METHOD:**

All assignments, including Problem Sets, Pre-Practical assignments, and Formal Report assignment components, should be submitted via Quercus. Practicals notebooks should be submitted to your tutor at the end of each Practicals session.

#### **ONLINE COMMUNICATION:**

Please use your mail.utoronto.ca email address for all course-related communications.

# **CELL PHONES AND LAPTOP USAGE:**

Technology can support student learning, but it can also become a distraction. Research indicates that multi-tasking during class time can have a negative impact on learning. Out of respect for your fellow students in this class, please refrain from using laptops or mobile phones for purposes unrelated to the class. Do not display any material on a laptop which may be distracting or offensive to your fellow students. Laptops may be used only for legitimate classroom purposes, such as taking notes, downloading course information from Quercus, or working on an assigned in-class exercise.

# PRIVACY/FIPPA STATEMENT:

Personal information is collected pursuant to section 2(14) of the University of Toronto Act, 1971 and at all times it will be protected in accordance with the Freedom of Information and Protection of Privacy Act. Please note that this course requires presentations of one's work to the group. For more information, please refer to <u>http://www.utoronto.ca/privacy</u>.

# MENTAL HEALTH AND WELL-BEING:

As a student, you may experience challenges that can interfere with learning, such as strained relationships, increased anxiety, substance use, feeling down, difficulty concentrating and/or lack of motivation, financial concerns, family worries and so forth. These factors may affect your academic performance and/or reduce your ability to participate fully in daily activities. Everyone feels stressed now and then - it is a normal part of university life. Some days are better than others, and there is no wrong time to reach out. There are resources for every situation and every level of stress.

There are many helpful resources available through your College Registrar or through Student Life (<u>http://studentlife.utoronto.ca</u> and <u>http://www.studentlife.utoronto.ca/feeling-distressed</u>). An important part of the University experience is learning how and when to ask for help. Please take the time to inform yourself of available resources.

# **COURSE MATERIALS, INCLUDING LECTURE NOTES:**

Course materials are provided for the exclusive use of enrolled students. These materials must not be reposted, shared, put in the public domain, or otherwise distributed without the explicit permission of the instructor. These materials belong to your instructor, the University, and/or other sources depending on the specific facts of each situation and are protected by copyright. Students violating these policies will be subject to disciplinary actions under the Code of Student Conduct. This includes selling my materials, or giving my materials to a person or company that is using them to earn money.

# <u>VIDEO RECORDING AND SHARING (DOWNLOAD PERMISSIBLE; RE-USE</u> <u>PROHIBITED):</u>

This course, including your participation, may be recorded on video and, if recorded, will be available to students in the course for viewing remotely and after each session. If lecture recordings are provided (for reasons such as lecturer illness or travel), they are only for the exclusive use of enrolled students, for their personal learning. Lecture recordings are not to be shared in any way beyond enrolled students.

Course videos and materials belong to your instructor, the University, and/or other sources depending on the specific facts of each situation and are protected by copyright. In this course, you are permitted to download session videos and materials for your own academic use, but you should not copy, share, or use them for any other purpose without the explicit permission of the instructor.

For questions about the recording and use of videos in which you appear, please contact your instructor.

# **EQUITY, DIVERSITY AND INCLUSION:**

The University of Toronto is committed to equity, human rights, and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. U of T does not condone discrimination or harassment against any persons or communities.