PHY 2505S
ATMOSPHERIC RADIATIVE TRANSFER AND REMOTE SOUNDING
Spring Term, 2020
GENERAL INFORMATION – REVISED (March 24)

LECTURER:
Prof. Kimberly Strong
Office: MP323 and MP710A, Department of Physics
Email: strong@atmosp.physics.utoronto.ca, Phone: 416-978-5205 (MP323)

LECTURES: 10:10 – 12:00 PM, Tuesday, Room MP606 (Online/Zoom for Lectures 10-12)

OFFICE HOURS: These will vary from week to week, all in MP323 or Zoom*.
3:00 – 4:00 PM, Tuesday, Jan 7, Jan 21, Feb 18, Feb 25, March 3, March 10, March 31*, April 7*, April 14*
2:00 – 3:00 PM, Thursday, Jan 16, Jan 30, Feb 13
4:00 – 5:00 PM, Wednesday, March 18
3:00 – 4:00 PM, Thursday, March 26*
Also, feel free to drop by or make an appointment.

WEBSITE: Lectures and supplementary material will be posted on the course homepage. https://www.atmosp.physics.utoronto.ca/people/strong/phy2505/phy2505.html.

REFERENCES: There is no required textbook for this course. In addition to the lecture notes, the following texts and other works on atmospheric physics and radiation may be useful references. These books are available on short-term loan or electronic form from UofT libraries:

- An Introduction to Atmospheric Radiation (Second Edition), K.N. Liou (Academic Press, 2002) – online, Physics and Gerstein libraries
- A First Course in Atmospheric Radiation, (Second Edition), G.W. Petty (Sundog Publishing, 2004) – Physics and Gerstein libraries
- Spectroscopy and Radiative Transfer of Planetary Atmospheres, (First Edition), K.V. Chance and R.V. Martin (Oxford University Press, 2017) – Physics library
- Atmospheric Science, An Introductory Survey (Second Edition), J. Wallace and P. Hobbs (Academic Press, 2006) – Physics library
- C.N. Banwell, Fundamentals of Molecular Spectroscopy (McGraw-Hill, several editions available) – Physics and Gerstein libraries

MARKING:

30% Problem sets:
#1 will be handed out on Jan 21 and due in class on Feb 4
#2 will be handed out on March 10 and due March 31 (by email)

15% Journal club presentation/discussion facilitation (2-4 PM, April 8)

55% Term paper: discuss topic with instructor by Feb 14, outline and bibliography due March 10, paper due April 21 (by email), and presentation 3-5 PM, April 15:
10% Outline/bibliography for term paper
30% Term paper 15% Presentation for term paper

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COURSE OUTLINE

This course will provide a survey of the interaction of electromagnetic radiation fields with the Earth's atmosphere. Emphasis will be on the physical basis of interactions and calculations. The goal is to develop an understanding of atmospheric radiative transfer, the physics responsible for atmospheric spectra, the information content of these spectra, and how atmospheric properties can be derived using remote sounding methods. Topics to be covered include:

- Review of radiative transfer
- Radiative absorption and emission in general
- Solar variability and determination of the solar constant
- The spectrum of the atmosphere
- The role of minor constituents and the greenhouse effect
- Introduction to molecular spectroscopy (rotational and ro-vibrational)
- Spectral line shapes; approximations and modeling
- Techniques and methodologies for atmospheric remote sounding
- Uses of satellite instrumentation for atmospheric remote sensing
- Scattering of radiation; applications to the atmosphere (as time permits)

COURSE ASSIGNMENTS

PROBLEM SETS: There will be two problems sets, due two weeks after they are assigned. While you may discuss the assignment with your classmates, you must prepare your answers to the problems independently. Marks will be given for showing workings as well as for final answers. Further information will be provided with each problem set.

TERM PAPER, OUTLINE/BIBILIOGRAPHY AND SEMINAR PRESENTATION:
The theme/topic for your paper/presentation will be a recent remote sounding mission/instrument and examples of atmospheric phenomena that it has been used to study. There are four deadlines for this assignment: By Feb 14, before Reading Week, you must discuss the topic with the instructor. An outline for the paper (including an "annotated" bibliography) is due on March 10. The paper is due on April 21, and the presentations will be arranged soon after that. Guidelines for the outline, term paper, and presentation will be provided later in the term.

"JOURNAL CLUB" PRESENTATION/DISCUSSION FACILIATION:
You will be responsible for presenting a journal article related to the course material (chosen by your lecturer) and leading a class discussion of this paper. Guidelines on the format of the presentation and expectations for the discussion will be provided later in the term.

PENALTIES FOR LATE WORK: Unless otherwise stated, there will be a late penalty of 5% per day, up to seven days, after which material will not be accepted. Requests for exemptions have to be made at least 24 hours before the deadline and may or may not be granted.

SUBMISSION OF WORK: Paper copies of work must be handed to the instructor in person. Work put in the instructor's mailbox, slid under the office door, or submitted by e-mail will not be accepted. Accommodations will be made for students who are in the field and COVID-19.

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ADDITIONAL INFORMATION FROM UofT

Academic Integrity

Academic integrity is fundamental to learning and scholarship at the University of Toronto. Participating honestly, respectfully, responsibly, and fairly in this academic community ensures that the U of T degree that you earn will be valued as a true indication of your individual academic achievement, and will continue to receive the respect and recognition it deserves. Familiarize yourself with the University of Toronto's Code of Behaviour on Academic Matters (http://www.governingcouncil.utoronto.ca/policies/behaveac.htm). It is the rule book for academic behaviour at the U of T, and you are expected to know the rules.

Problem Sets: The point of you working on the problem sets is to prepare yourself for the tests and exam. When you are stuck and find you cannot progress with something, it makes sense to seek out a friend in the class to see if they have any helpful hints. But the work you submit in the end should be your own work, and you should understand everything you submit and be prepared to explain why you submitted it.

Tests and Exam: The mid-term test and the final exam must be done individually, involving no communication at all with your peers. It is strongly advised not to engage in any behaviour that might be construed by the invigilators for the tests/exam as an attempt to obtain information from another candidate or from another test/exam paper.

The University of Toronto treats cases of academic misconduct very seriously. All suspected cases of academic dishonesty will be investigated following the procedures outlined in the Code. The consequences for academic misconduct can be severe, including a failure in the course and a notation on your transcript. If you have any questions about what is or is not permitted in this course, please do not hesitate to contact me. If you are experiencing personal challenges that are having an impact on your academic work, please speak to me or seek the advice of your college registrar.

Please review the the attached UofT guidelines on "HOW NOT TO PLAGIARIZE".

Accommodations

If you have a learning need requiring an accommodation the University of Toronto recommends that students immediately register at Accessibility Services at
http://www.studentlife.utoronto.ca/as.

Location: 4th floor of 455 Spadina Avenue, Suite 400
Voice: 416-978-8060
Fax: 416-978-5729
Email: accessibility.services@utoronto.ca

The University of Toronto supports accommodations of students with special learning needs, which may be associated with learning disabilities, mobility impairments, functional/fine motor disabilities, acquired brain injuries, blindness and low vision, chronic health conditions, addictions, deafness and hearing loss, psychiatric disabilities, communication disorders and/or temporary disabilities, such as fractures and severe sprains, recovery from an operation, serious infections or pregnancy complications.

As the instructor of this course, you are also invited to communicate with me at any time about your learning needs. Confidentiality of learning needs is respectfully and strictly maintained.

Equity, Diversity and Excellence

At the University of Toronto, we strive to be an equitable and inclusive community, rich with diversity, protecting the human rights of all persons, and based upon understanding and mutual respect for the dignity and worth of every person. We seek to ensure to the greatest extent possible that all students enjoy the opportunity to participate as they see fit in the full range of activities that the University offers, and to achieve their full potential as members of the University community.

Our support for equity is grounded in an institution-wide commitment to achieving a working, teaching, and learning environment that is free of discrimination and harassment as defined in the Ontario Human Rights Code. In striving to become an equitable community, we will also work to eliminate, reduce or mitigate the adverse effects of any barriers to full participation in University life that we find, including physical, environmental, attitudinal, communication or technological.

Our teaching, scholarship and other activities take place in the context of a highly diverse society. Reflecting this diversity in our own community is uniquely valuable to the University as it contributes to the diversification of ideas and perspectives and thereby enriches our scholarship, teaching and other activities. We will proactively seek to increase diversity among our community members, and it is our aim to have a student body and teaching and administrative staffs that mirror the diversity of the pool of potential qualified applicants for those positions.

We believe that excellence flourishes in an environment that embraces the broadest range of people, that helps them to achieve their full potential, that facilitates the free expression of their diverse perspectives through respectful discourse, and in which high standards are maintained for students and staff alike. An equitable and inclusive learning environment creates the conditions for our student body to maximize their creativity and their contributions, thereby supporting excellence in all dimensions of the institution. For more information please see http://about.hrandequity.utoronto.ca/.