

# **GGR337 Environmental Remote Sensing**

**University of Toronto, Fall 2020**

Lecture: Monday, 10–12 am, every week, online

Lab: Tuesday, 1–3 pm, selected weeks, online

## **Instructor**

Prof. Jane Liu

E-Mail: [janejj.liu@utoronto.ca](mailto:janejj.liu@utoronto.ca)

Office hours:

Monday, 1–2 pm, Thursday, 1–2 pm, to be offered online.

## **Teaching Assistants**

Mr. Yihong Liu

E-Mail: [yhong.liu@mail.utoronto.ca](mailto:yhong.liu@mail.utoronto.ca)

Office hours:

Tuesday, 3–4 pm, Friday, 3–4 pm, to be offered online.

Mr. Jiye Leng

E-Mail: [jiye.leng@mail.utoronto.ca](mailto:jiye.leng@mail.utoronto.ca)

Office hours: TBA

Wednesday, 10–11 am, to be offered online.

## **Course Description**

Environmental remote sensing has been an increasingly exciting subject as many new satellite sensors have recently been successfully launched and many are still forthcoming. The unprecedented abundance of earth observation data will allow us to address many pressing environmental issues. This course will cover the basics of using remote sensing data for environmental studies. In addition to learning the basic concepts, terminology, and theories of remote sensing science and applications, students will have the opportunity to acquire hand-on experience in digital image processing using the image analysis system ArcGIS. A series of laboratory works are designed with detailed instructions to lead the students through the key steps in

processing satellite images and in extracting quantitative information about the Earth's surface.

## Learning Outcomes

After successfully completing GGR337H, students will be able to:

- Understand fundamental principles of electromagnetic radiation as applied to remote sensing;
- Appropriately use basic concepts related to remote sensing observations;
- Acquire the basic knowledge on the characteristics of the main existing spaceborne and airborne remote sensing systems;
- Have the ability to conduct applications of remote sensing techniques to real-world environmental issues;
- Use an image processing tool to implement basic operations with remote sensing images and conduct quantitative analysis.

## Evaluation

	<u>Weight</u>	<u>Due Date</u>
Assignment 1	5%	Oct. 5, 2020
Assignment 2	10%	Oct. 19, 2020
Midterm	15%	Oct. 26, 2020
Assignment 3	10%	Nov. 2, 2020
Assignment 4	10%	Nov. 23, 2020
Assignment 5	10%	Dec. 7, 2020
Final assessment	40%	Final assessment period

## Tutorials/Practicals

Lab 1	Sep. 22, 2020	Radiation
Lab 2	Oct. 6, 2020	Introduction to Image processing
Lab 3	Oct. 20, 2020	Registration of images
Lab 4	Nov. 3, 2020	Image enhancement and modeling
Lab 5	Nov. 24, 2020	Image classification

## Submissions

All assignments should be submitted electronically on Quercus by 8 pm on the due days.

## Delivery method

All lectures and labs will be offered online. Lectures will be offered every Monday, 10–12. Labs will be offered on selected Tuesday, 1–3 pm (see Course Schedule). Pre-recorded lectures and lab demonstrations will be posted on Quercus before the scheduled time. Students can watch these recordings at the scheduled or a later time.

## Access to Course Materials & Readings

Course materials and readings will be posted on Quercus, accessible to students.

## Access to Computer Software ArcGIS

The lab sessions of this course require usage of ArcGIS. If students are able to install ArcGIS on their own computers, that would be the best option. Otherwise, they will be able to remotely access to IIT computers via Remote Desktop at the Geography Department Lab at St. George campus. A detailed guide will be provided in Quercus.

## Recording/electronics Usage

Students can access the course materials in Quercus from a electronic device, e.g., a computer.

## Communication

The instructor and teaching assistants are available in online lectures, labs, office hours. Students are encouraged to ask questions during these times, also through emails (see Instructor and Teaching Assistants). Extra office hours can be arranged. One to one appointment can also be arranged. If you feel that you are having difficulty keeping up with assignments or understanding the material we are covering, please contact the instructor as soon as possible.

## Course Policies

**Assignments:** Late assignments will be subject to a late penalty of 10% per day (including weekends) of the total marks for the assignment. Assignments submitted five calendar days beyond the due date will be assigned a grade of zero.

**Missed Quiz/Test:** There will be no re-writes or make-ups for term tests/quizzes missed for University-accepted reasons. Instead the final assessment will be re-weighted by the value of the missed term test/quiz.

**Informing Your Instructor and Submitting Appropriate Documentation:** Students must submit a self-declaration of illness within **one week** of a missed assignment due date or test date. Failure to submit appropriate documentation will result in a grade of zero.

## Required Text

Campbell, J. B., 2011, *Introduction to Remote Sensing*, Fifth edition, Guilford Press.  
ISBN: 978-1-59385-319-8.

## Reference Books

Verbyla, D. L., 1995, *Satellite Remote Sensing of Natural Resources*, Lewis Publishers, New York. ISBN:1-56670-107-4.

## Additional Readings

To be provided in Quercus.

## Course Schedule

<b>Week</b>	<b>Lecture (Monday, 10–12 )</b>	<b>Lecture Topic</b>	<b>Lab (Tuesday,1–3)</b>
1	Sep 14	Introduction to remote sensing principles	No lab
2	Sep 21	Electromagnetic radiation and remote sensing terminology	Lab 1, Radiation, 5%. Due: Oct. 5
3	Sep 28	Spectral characteristics of ground targets	No lab
4	Oct 5	Digital data handling and image enhancement	Lab 2, Introduction to image processing, 10%. Due: Oct. 19
5	Oct 12	Thanksgiving holiday, no classes	No lab
6	Oct 19	Geometric corrections	Lab 3: Registration of images, 10%. Due: Nov. 2
7	Oct 26	Midterm, 15%, Color display	No Lab
8	Nov 2	Radiometric corrections	Lab 4: Image enhancement and modeling, 10%. Due: Nov. 23
9	Nov 9	Reading week, no classes	No lab
10	Nov 16	Clustering and unsupervised classification	No lab
11	Nov 23	Supervised classification techniques and accuracy	Lab 5: Image classification, 10%. Due: Dec. 7
12	Nov 30	Satellite orbits and sensors	No lab
13	Dec 7	Multispectral transformations of image data and vegetation indices	No lab
14	Dec 10 (Note: Thursday, 10–12)	Applications of remote sensing Review	Make-up for the Thanksgiving.

## Readings

1. Lecture notes.

2. Campbell:

<b>Week</b>	<b>Lecture</b>	<b>Lecture Topic</b>	<b>Campbell (v5, Chap.Section)</b>	<b>Campbell (v4, Chap.Section)</b>
1	Sep 14	Introduction to remote sensing principles	1.1-1.2,1.4-1.6	1.1-1.2,1.4-1.6
2	Sep 21	Electromagnetic radiation and remote sensing terminology	2.1-2.7	2.1-2.7
3	Sep 28	Spectral characteristics of ground targets	6.6,9.8-9.9, 17.3,18.6,19.2	6.6,9.8-9.9, 17.3,18.6,19.2
4	Oct 5	Digital data handling and image enhancement	4.1,4.4-4.5	4.1,4.4-4.5, 5.15
5	Oct 12	Thanksgiving holiday, no classes	No chapters assigned	No chapters assigned
6	Oct 19	Geometric corrections	11.9	11.5-6
7	Oct 26	Midterm, 15%, Color display	4.7	No chapters assigned
8	Nov 2	Radiometric corrections	11.2	11.4
9	Nov 9	Reading week, no classes	No chapters assigned	No chapters assigned
10	Nov 16	Clustering and unsupervised classification	12.3	12.3
11	Nov 23	Supervised classification techniques and accuracy	12.4,14.4,14.5	12.4, 14.4, 14.5
12	Nov 30	Satellite orbits and sensors	6.1-6.3,6.8	6.1-6.3
13	Dec 7	Multispectral transformations of image data and vegetation indices	17.3,17.6,17.7	17.1-17.7, 17.9
14	Dec 10 (Note: Thursday, 10-12)	Applications of remote sensing Review	17.1	No chapters assigned

## Accessibility Services

The University of Toronto is committed to accessibility. If you require accommodations or have any accessibility concerns, please visit Accessibility Services at <http://www.accessibility.utoronto.ca/> as soon as possible.

For more information please contact Accessibility Services at

Robarts Library

1st Floor (ground entrance off St. George St.)

130 St. George Street, Toronto, ON M5S 3H1

Voice: 416-978-8060

Fax: 416-978-8246

TTY: 416-978-1902

Email: [accessibility.services@utoronto.ca](mailto:accessibility.services@utoronto.ca)

Web: [www.accessibility.utoronto.ca](http://www.accessibility.utoronto.ca)

## Academic Integrity

It is your responsibility as a student at the University of Toronto to familiarize yourself with, and adhere to, both the Code of Student Conduct and the Code of Behaviour on Academic Matters.

This means, first and foremost, that you should read them carefully.

- The [Code of Student Conduct](#) is available from the U of T website:
- The [Code of Behaviour on Academic Matters](#) is available from the U of T website:

See also the [University's website on Academic integrity](#).

## Services

### **Geography Math Help Centre**

A resource for this course is the department's Math Help Centre. Geography TAs will be available to help refresh and explain math concepts and techniques that may come up in your Geography courses. This includes working with formulas, graphing data, completing calculations, and so forth. It does not matter how basic your questions are! No appointment is required, just drop by. There will also be table space available in the room, allowing students to get math help as they work through assignments. Details on location and TA times will be posted here:

<http://geography.utoronto.ca/undergraduate/math-help/>