Georgia Institute of Technology/School of Earth and Atmospheric Sciences

LAND REMOTE SENSING
(3 credit hours)

Instructor - Professor James Wray

E-mail jwray@gatech.edu; Office – Ford ES&T building 2234
Office hours - Wed 12-1 PM, or by appointment
Class days/time/place – M/W/F 11:15-12:05 PM (Room L1116 Ford ES&T building)

Recommended Textbooks:

Rees W. G. (2013) Physical Principles of Remote Sensing, 3rd edition (Cambridge University Press).
Howell S. B. (2006) Handbook of CCD Astronomy, 2nd edition (Cambridge University Press).
Campbell J. B. & Wynne R. H. (2011) Introduction to Remote Sensing, 5th edition (Guilford Press).
Drury S. A. (2004) Image Interpretation in Geology, 3rd edition (Routledge).
Lillesand T., Kiefer R. W., & Chipman J. (2007) Remote Sensing and Image Interpretation, 6th edition (Wiley).

Additional sources:

Clark, R. N., Chapter 1: Spectroscopy of Rocks and Minerals, and Principles of Spectroscopy, in *Manual of Remote Sensing, Volume 3, Remote Sensing for the Earth Sciences*, (A.N. Rencz, ed.) John Wiley and Sons, New York, p 3- 58, 1999. (https://speclab.cr.usgs.gov/PAPERS.refl-mrs/refl4.html)

Grading:

Exams (one midterm and one final exam, equally weighted) – 35%

Homeworks and lab exercises – 35%
Graduate students will complete an additional assignment involving critical review and oral presentation of a peer-reviewed paper from the recent remote sensing literature. Most assignments will contain a final question exclusively for graduate students that involves scientific interpretation of the dataset analyzed within the broader context of their Earth science knowledge.

Final project (research term paper and final presentation – 25%
Graduate students will be expected to demonstrate how the technique(s) explored in their term project constitute a viable potential extension of their thesis research.

Class participation – 5%

Attendance:

Although the slides prompting each day's discussion will generally be posted online afterward, this is not a substitute for attending lectures, asking and answering questions,

all of which will be factored into each student's class participation score. The Institute Absence policy is available at: www.catalog.gatech.edu/rules/4/

Goal:
This course will cover the broad spectrum of techniques for making remote measurements of the composition, morphology, and thermophysical properties of solid surfaces on Earth and other planetary bodies.

Learning Objectives:
Upon completion of this course, students will be able to:

1. Access, process and interpret a range of different types of remote sensing data.
2. Understand the physics underlying how remote measurements are made across the electromagnetic spectrum (and beyond).
3. Assess and describe which techniques and data sets are most useful for answering particular scientific questions about a range of land environments.
4. Develop skills that are necessary for scientific discussion and for the analysis of current scientific literature.

Overview:
Electromagnetic spectrum; radiative transfer; photometry; imaging systems and processing; visible/NIR reflectance spectroscopy; Raman spectroscopy; thermal IR spectroscopy; thermal inertia; radar, lidar; laser-induced breakdown spectroscopy; X-ray, γ-ray spectroscopy; neutron spectroscopy

Academic Integrity:
Academic dishonesty will not be tolerated. This includes cheating, lying about course matters, plagiarism, or helping others commit a violation of the Honor Code. No support materials (textbooks, notes, internet searches) are allowed during the in-class exams. Plagiarism includes reproducing the words of others without both the use of quotation marks and citation. Students are reminded of the obligations and expectations associated with the Georgia Tech Academic Honor Code and Student Code of Conduct, available online at www.honor.gatech.edu.

Learning Accommodations:
If needed, we will make classroom accommodations for students with documented disabilities. These accommodations must be arranged in advance and in accordance with the Office of Disability Services (http://disabilityservices.gatech.edu).

Schedule of Topics:

Week 1:	Introduction to remote sensing
	Earth and planetary surface remote sensing examples
Week 2:	Electromagnetic waves in free space, photon energy, spectral windows
	Blackbody radiation, emissivity, Kirchhoff's law
	Dielectric constants, dispersion, refraction
Week 3:	Fresnel's law, scattering, Beer's law
	Camera performance specs, imaging modes, detectors, field of view
Week 4:	Camera spec case study
	CCD imaging I

Week 5:	CCD imaging II
	Intro to visible/near-infrared reflectance spectroscopy
Week 6:	Electronic absorptions
	Vibrational absorptions (H_2O, sulfate/carbonate/organics)
	Spectrometer demo
Week 7:	Spectral identification/mapping of vegetation
	Diffraction gratings, other dispersive elements for spectroscopy
	Data analysis sequence, atmospheric correction, spectral "polishing"
Week 8:	FALL BREAK
	Continuous spectral mapping vs. spectral classification
	Principal components analysis, decorrelation stretches
Week 9:	MIDTERM EXAM (covers weeks 1-8)
	Thermal (mid) infrared emission spectroscopy
Week 10:	Temperature and emissivity from thermal radiance
	Thermal inertia, albedo
Week 11:	Introduction to radar
	Radar effects of slopes, roughness, dielectric properties
	Radar polarimetry
Week 12:	Planetary examples of radar and lidar
	Raman spectroscopy
Week 13:	Laser-induced breakdown spectroscopy
	Raman spectroscopy
	Gamma spectroscopy
Week 14:	Neutron spectroscopy
	THANKSGIVING BREAK
Week 15:	X-ray spectroscopy
	Review & discussion
Week 16:	TERM PROJECT PRESENTATIONS
Finals week:	FINAL EXAM (covers weeks 9-16)

Participation Grade:

Student participation will be an important contributor to actively learning and learning from each other. Participation grades will be posted monthly. Class participation will be evaluated as follows:

- 90-100%: always attend, participating often by asking questions or actively working with classmates on in class exercises.
- 80-90%: Less than two unexcused absences, participating often
- 70-80%: 2 to 4 unexcused absences, participating in class activities
- < 70%: More than 4 unexcused absences. Likely irregular participation.