**University of Maryland, College Park**

**GEOG372: Remote Sensing**

Spring Semester 2019 (January 29 – May 9)

**Syllabus**

(Last updated: January 23, 2019)

**Room:** LeFrak Rm 2166

Room is subject to change due to departmental needs.

**Lectures:** 9:30am to 10:45am

Jan 29 to May 9: Tuesday and Thursday

**Laboratory classes:** LeFrak Rm 1136. Assigned times cannot be changed owing to limited space in the lab.

**Section 0101:** Thursday 11:00am – 1:00pm (required lab session);

1:00pm-2:00pm (optional lab time for independent work)

**Section 0102:** Friday 11:00am – 1:00pm (required lab session);

The lab may also be used during open hours as needed. Please check the open labs hours on the doors outside the labs.

Lab times & dates: (Sect 0101 Th 11am-1pm; Section 0102 Fr 11am-1pm)

25/26 January – 19/20 April

**Instructor:** Dr. Belen Franch

befranch@umd.edu

Office Hours: Room 410, 4321 Hartwick Rd., Tue-Thu 12-1pm

**TA:** Matthew Cooper

mattcoop@terpmail.umd.edu

**GENERAL INFORMATION**

**Course Overview:** This course is intended to provide an introduction to remote sensing of the environment, with particular attention to the role of electromagnetic energy and specifically focusing on systems that are used to monitor the earth’s land surfaces and oceans. It will introduce the basic principles of image interpretation, remote sensing, and digital data processing in relation to optical, thermal and microwave remote sensing systems. Examples of remote sensing applications will be presented along with methods for obtaining quantitative information from remotely sensed images. The lab sessions will focus on introduction of techniques used in the analysis of remotely sensed data (e.g., digital image processing), with an emphasis on the study of spatial and environmental relationships.

**Learning outcomes for the course**

Upon a successful completion of the course, the students will be able to:

- Understand the general principles of electromagnetic energy interaction with the Earth’s surface and atmosphere which enable and limit successful applications of remote sensing methods.
- Understand the basis of operations for active and passive air- and satellite-born instruments within the optical, thermal, and microwave range of the electromagnetic spectrum.

- Describe the major properties of remotely sensed imagery including resolution(s), instruments and platform-dependent distortions and data limitations.

- Perform qualitative and quantitative analysis of remotely sensed data, extract spectral information, and perform image classification using standard and emerging techniques.

- Acquire publicly available satellite imagery and competently handle simple image processing routines using commercial (PCI Geomatica) and open source (Quantum GIS) image analysis software.

**Target Audience:**

This course is intended for those who want to learn more about remote sensing either as a termination for a more general program or as a gateway to 400 level classes in Geography, especially GEOG 472 (“Remote Sensing: Digital Image Processing”). Please, keep in mind that it is a 300 level course. Thus, basic knowledge of physics and statistics is encouraged. See Geography advisers in LeFrak Rm. 2108 (Tel. 301-405-4073) for further information on your academic program and course selection. Non-Geography students or undeclared majors are welcome.

**Overlaps:**

This course has no overlaps with other classes in the Department of Geographical Sciences.

**Prerequisites:**

This course has as prerequisites GEOG201 and GEOG306.

**Geography Major Program Information:** GEOG372 counts as a gateway course for Geography majors. For further information on course selection, see GEOG advisers in Rm. 2181M LeFrak Hall (geog-advise@umd.edu).

**Course Structure:** This class will consist of 17 x 1hr 15 min lecture/discussions and 10 x 2hr labs. The course is divided into 2 modules. At the end of each module there will be a 1hr test. The tests will only include material studied in the preceding lectures or provided in ELMS. See Course schedule information on the Home page for more information about the course materials.

**Instructor & TA Communication:** Please allow 24 hours (excluding weekends and holidays) for a response from the instructor or TA before sending a follow-up email. In addition, when sending an email please include **GEOG 372** in your subject heading. Please read the syllabus in its entirety before sending an email.

**Enrollment limit:** 40 Students

There is usually a long waiting list for this class and so, to avoid depriving others, only committed students, fully intending to complete the course should enroll.

**COURSE MATERIALS**

**Course on-line materials.** The ELMS course site is at <https://elms.umd.edu>, where all announcements, class materials, exams and grades will be posted.

**Text Books:** In this course text books are used as **reference material**. A list of books is provided, so the student can select the one that adapts better to their needs.

* Campbell, J.B. and Wynne, R. H. 2011. Introduction to Remote Sensing. Guildford Press, New York. 5th Edition. ISBN 978-1-60918-176-5
* Jensen, J.R., Remote Sensing of the Environment - An Earth Resource Perspective, 592 pp., Prentice Hall, Upper Saddle River, NJ, 2007. ISBN: 0131889508, Second Edition
* Richards, J. A. 2013. Remote Sensing Digital Image Analysis. An Introduction. Springer-Verlag, Berlin, Heidelberg. Fifth Edition. ISBN 978-3-642-30061-5
* Chuvieco, E. and Huete, A. 2010. Fundamentals of Remote Sensing. CRC Press (Taylor & Francis Group), Boca Raton (Florida). ISBN 978-0-415-31084-0

Other required and recommended readings for this course will be available for download on the ELMS webpage.

**Computer Labs:** LeFrak rooms 1136 and 1138 will be availablefor the students during free hours following the schedule posted on <http://geog.umd.edu/content/lab-conduct-policy>.

**Note on course material copyright:** All course material copyrights belong to the University of Maryland unless otherwise noted. Materials, including lectures, assignments, quizzes and exams, are not to be distributed outside of the University of Maryland without permission.

**Schedule** **of classes:**

See calendar on the Home page

This course has a more complex organization than many. Check the calendar before each class since important information and schedule changes are posted there.

**Course organization.**

There are four Topics, each covering an important aspect of remote sensing:

* **Study materials** will be provided. These will consist of sections of the textbook to study, additional texts and materials authored by the Instructor. We encourage the students to prepare these materials before each lecture.
* **17 lectures/discussions.** The lectures have 2 purposes: 1) to provide a framework for your study of each Topic and, 2) to present any particularly difficult concepts. The class time will be only partly a lecture. The rest is for discussion of the assigned Study materials contents. In addition, topics that arise from your private studies can be brought up in the discussions. Participation of the students during the lectures will count in the final evaluation.
* **A test following each module**. Tests will be taken at the end of each module. They are multiple choice exams with factual and conceptual questions. Test will include also short answering questions about factual and conceptual issues.
* **Research paper analysis**. The article presentation will be group work. Each group of 2 students will find a remote sensing article in a topical area provided at the beginning of the course by the Instructors. Selection of the articles needs to be approved by the instructor by **March 14**. Each group must submit a one page summary of the paper selected by **April 4**. Each group is expected to give a presentation on that paper in front of the class during the last two weeks of the course. The presentation will be followed by a discussion during which students from other groups are expected to ask questions and engage. Each student will be required to read every summary before the day during which it is presented. The presentations will be limited to 8 minutes and Q&A will be limited to 5 minutes. Students will be graded both as presenters and for participation in discussion.
* **10 Labs.** 2 hour lab sessions (11am-1pm, Thursday/Friday). Lab sessions will be supervised by a Teaching Assistant, with written guides and software instruction manuals posted on the R: drive of the lab computers before each section. The lab classes are an essential part of this course, so attendance at all lab classes is mandatory.

**GRADING**

**Assessment & Grading:**

This course will be assessed by:

* 2 tests: each 25% of the total grade (50% grade).
* 10 lab exercise reports – individual lab reports each worth 4% of total grade (labs worth 40% grade overall). Each lab is assessed at 10 point scale: 8 for report, 2 for attendance, and 1 extra. Lab reports must be submitted on ELMS as .pdf files by the start of the lab in the week following the class. The labs’ extra credits will be limited to 2 extra credits.
* Research paper presentation (10% grade: 4% summary, 4% presentation and 2% Q&A)
* Participation in class and forums (2% extra).
* Seminar sessions (2% extra: 1% per seminar).

**Attendance**

* **Lecture/discussions:** Following Campus policy, attendance at lectures is not mandatory BUT important information (in some cases including up-coming exam questions) will be presented. The discussion component will be in the form of tutorials, which students will be asked individually to respond to questions on the current Topic.
* **Labs:** The lab classes are an essential part of this course, so attendance at all lab classes is mandatory. Absences excused according to the Senate policy statement given in Official Notices (below). During the lab exercises the students will work individually to produce a lab report which will be graded by the TA. All deliverables as described in each lab assignment should be submitted to Canvas/ELMS. Each completed lab report is worth 10 points max, from which two points are given for attendance. Reports must be submitted within one week after the lab. Delayed reports will be downgraded by 50%. Reports will not be graded if submitted three weeks or more after the lab class.
* **Exam make-up** policy. Make-up will only be given for absences according to Campus policies. Explained and signed by the Health Center or other medical doctor or, in the case of an emergency, by a responsible person.

**Grading Scale:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Letter Grade**  | **Range (%)**  | **Letter Grade**  | **Range (%)**  |
| A+  | 100 – 97  | C+  | 79.99 – 77  |
| A  | 96.99 – 93  | C  | 76.99 – 73  |
| A-  | 92.99 – 90  | C-  | 72.99 – 70  |
| B+  | 89.99 – 87  | D+  | 69.99 – 67  |
| B  | 86.99 - 83  | D  | 66.99 – 63  |
| B-  | 82.99 - 80  | D-  | 62.99 – 60  |
|  | F | < 59.99  |

**Due Dates and Late Policy:** Lab due dates are explicitly stated. Reports must be submitted within one week after the lab. Delayed reports will be downgraded by 50%. Reports will not be graded if submitted three weeks or more after the lab class. If you are ill or physically indisposed and cannot submit your assignment on time, you must notify the instructor before class and provide a written doctor’s note when you return for you to have a chance to make up the assignment. Any non-verifiable excuses may be denied. This policy may seem strict, but this class will move rapidly and it is in your best interest to turn in everything on time to avoid falling irrecoverably behind. If you cannot complete the assignment on time, it is better to turn in partially completed work than nothing at all!

**Test attendance:** Attendance to the 2 tests is mandatory to pass the course. We require the students to be in class on time. Students that arrive later than 10 minutes will not be able to take the test.

**Keys to Success:** This course is challenging for many students because of the quantitative nature of remote sensing and the computer processing using complex software. While extensive explanations will be given, always ask if anything is not clear. At the beginning of each lecture, the teachers will offer the opportunity for questions from the previous lecture.

* Attend all lectures and labs – each is a critical component of this class. Doing well on the lab assignments will significantly improve your final grade. Attending lecture will make the difference of an entire letter grade.
* Read the assigned text chapters/sections/study materials before coming to class.
* During lectures, focus on listening to the material being presented and synthesizing this information by taking notes that summarize the key points. Additionally, always ask questions if needed. Participation in the class will be positively considered.
* At the end of each week, review your class notes and assigned readings to be sure that you understand the key terms and concepts introduced in the lectures that week. You might consider forming a study group with some of your classmates to assist in this activity.
* Ask questions. Use Office Hours and email the Instructor or TA with questions.

**Lectures, Seminars, and Exams**

Lecture 0. Syllabus

Lecture 1. History and basic concepts

Lecture 2. Sensors

Lecture 3. Discussion session. Interpreting Remote Sensing products

Lecture 4. Principles of the electromagnetic radiation. Solar spectral range

Lecture 5. Interaction of the radiation with the atmosphere

Lecture 6. Thermal remote sensing

Lecture 7. Lidar

Lecture 8. Synthetic aperture radar (SAR)

Summary and doubts

**March 5th.** Test

Lecture 9. Analysis of RS data: spatial, spectral and temporal domains.

Lecture 10. Remote sensing image classification

Lecture 11. Advanced methods for remote sensing image classification

Lecture 12. Accuracy assessment of classification maps

Lecture 13. Discussion session. Applications of Remote Sensing

Lecture 14. Agricultural applications

Lecture 15. Climate Change and remote sensing

Lecture 16. Vegetation monitoring

Lecture 17. Natural hazards monitoring & risk assessment

Summary and doubts

**April 18th.** Test

**April 23rd to May 2nd**. Research paper analysis presentations

**Labs**

Lab 1. Introduction to data visualization and analysis (Jan 31st and Feb 1st)

Lab 2. Satellite data from different sensors (Feb 7th and 8th)

Lab 3. Landsat 8 data analysis and interpretation (Feb 14th and 15th)

Lab 4. Thermal remote sensing (Feb 28th and March 1st)

Lab 5. Analyzing Images in QGIS (March 7th and 8th)

Lab 6. Spectral indices and spatial filters (March 14th and 15th)

Lab 7. Supervised and unsupervised image classification (April 4th and 5th)

Lab 8. Decision tree supervised classification and accuracy assessment (April 11th and 12th)

Lab 9. Change detection (April 25th and 26th)

Lab 10. Working with Remote Sensing Data Catalogues (May 2nd and 3rd)

**ADMINISTRATIVE**

**Attendance**: You are strongly advised to attend all lectures since this will provide a basic understanding of the subject matter of the course. The course grade is dependent upon successful completion of 2 Quizzes and 10 Lab Reports. The Campus Senate policy <http://www.umd.edu/catalog/0405/chapter4.pdf>) requires students who are absent due to illness/injury to furnish **documentary support** to the instructor (see below). In this class the policy applies to the lab classes only. You are required to contact the Instructor by email, where possible, prior to lab sessions for which they are unable to attend owing to an illness or an injury. No later than on return to class, you must provide written and, where appropriate (determined by the Instructor) signed documentation verifying that your illness/injury is such that you cannot attend the Lab session. You will not be allowed to turn in missed assignments or make up quizzes and lab classes if you have not provided this documentation. If you do not present documentation of illness or emergency, zero points will be given. In addition, if it is found that you have falsified the documentation provided, you will be referred to the University’s Student Conduct Office.

**Religious Observance**: **By the 2nd week of the course**, students must provide the Instructor, in writing, any request for absence from lab classes due to a named religious observance on a specified date. Please refer to the Online Undergraduate Catalog Policy on Religious Observance.

**Disabilities**: If you have a documented disability and wish to discuss academic accommodations, please contact the Instructor as early as possible. Every effort will be made to accommodate students who are registered with the Disability Support Services (DSS) Office and who provide me with a University of Maryland DSS Accommodation form which has been updated for the 2012 Spring semester. This form must be presented to **me no later than the 2nd week of the course**. I am not able to accommodate students who are not registered with DSS or who do not provide me with documentation which has been reviewed by DSS.

**CourseEvalUM**.  Your **participation in the evaluation of courses through CourseEvalUM is a responsibility you hold as a student member of our academic community**.  Your feedback is confidential and important to the improvement of teaching and learning at the University as well as to Faculty tenure and promotion procedures.  The date from which CourseEvalUM is open for you to complete your evaluations will be announced by the University. Please go directly to the website ([www.courseevalum.umd.edu](https://www.courseevalum.umd.edu)) to complete your evaluations by the published date.

**Policy on phones**: Outgoing calls are not permitted during lectures. Phones must be set to a silent mode. More than one occurrence of phones making an audible sound will result in the owner being asked to leave the lecture room.

**Policy on computers**: Students may use computers to take notes, but other uses are not permitted. Class materials on the Web should be downloaded before the class. Anyone found using their computer for purposes other than note-taking will be asked to leave.

**Academic Integrity Expectations**:  The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit: <http://www.studenthonorcouncil.umd.edu/whatis.html>
By registering for this course you indicate your acceptance of these provisions for academic integrity.

**Student conduct**. Students are expected to treat each other with respect. Disruptive behavior of any kind will not be tolerated. Students who are unable to show civility with one another, or myself will be subject to being referred to the Office of Student Conduct or to Campus Police. You are expected to adhere to the Code of Student Conduct.

**Copyright policy**. The lectures delivered in this class and the course materials are protected by federal copyright law as the Instructor’s original works. You are permitted to use course materials for your use. You may not record, reproduce, or distribute my lectures/notes for any commercial purpose without written consent. Persons who sell or distribute copies or modified copies of course materials, possess commercial copies of notes (i.e., Terpnotes), or assist another person or entity in selling or distributing those materials may be considered in violation of the University Code of Student Conduct, part 9(k).

***From the University Registration, Academic Requirements, and Regulations (Chapter 4), Sect Academic Records and Regulations***

*(https://catalogundergraduate.umd.edu/files/2017-2018-UGCatalog.pdf)*

*“Students are expected to take full responsibility for their own academic work and progress. Students, to progress satisfactorily, must meet all of the requirements of each course for which they are registered. Students are expected to attend classes regularly. Consistent attendance offers students the most effective opportunity to gain command of course concepts and materials.*

*In-class participation may be an ongoing requirement and an integral part of the work of some courses. In-class assessments may occur, sometimes without advance notice. The syllabus will specify expectations about in-class participation and its relationship to the final course grade.*

*Except in cases where in-class participation forms a significant part of the work of the course, attendance should not be used in the computation of grades; assignment of a course grade on some basis other than performance in the course is prohibited by University policy. Recording student attendance is not required of the faculty.*

*Absences from courses in which in-class participation forms a significant part of the work of the course (such as lab or discussion courses) shall be handled by instructors in accordance with the general policies of their academic units.*

*An excused absence is an absence for which the student has the right to receive, and the instructor has the responsibility to provide, academic accommodation.*

*Excused absences must be requested promptly and must be supported by appropriate documentation. Excused absences do not alter the academic requirements for the course. Students are responsible for information and material missed on the day of absence. Students are within reason entitled to receive any materials provided to the class during the absence. Students are responsible for determining what course material they have missed and for completing required exercises in a timely manner.”*