GGS579 Syllabus: Spring 2023	
Course Information	GGS579: Remote Sensing Location: Exploratory Hall Times: Tuesday and Thursdays 1:30-2:45pm
Instructor	Dr. Konrad Wessels About Konrad Wessels COS (https://science.gmu.edu/directory/konrad-wessels). Office Hours: by appointment – email me
Course Description	The world is currently experiencing a proliferation in image data from satellites, aircraft and UAV's. These images have to be processed to produce geospatial information to inform natural resource management, urban planning, defense intelligence and business decisions. This course will introduce the foundations of remote sensing, as well as the processing and analyses of imagery for diverse applications using ENVI. The course will introduce key concepts in electromagnetic radiation, passive (multi-spectral) and active (Lidar) sensor systems, and methods for image processing, classification and geospatial information extraction.
Course Objectives	Upon completion of the course, students will be able to: 1. Understand and explain the key theories of remote sensing and image analysis. 2. Use advanced image processing tools to process imagery to geospatial products. 3. Gain advanced insight into the use of remote sensing for multiple, real-world applications.
Course Methodology	The course will be taught as a combination of in-person and on-line lectures, on-line ENVI tutorials, hands-on image processing, class discussion and weekly assignments. Students will also present papers on selected remote sensing applications in class and undertake a mini-project.
Required textbook(s) and/or materials	Required Textbook: **Relevant chapters are available as pdf under " Textbook" at the bottom of the main menu of this course's Blackboard page** "Remote Sensing and Image Interpretation" by Lillesand, Kiefer and Chipman (7th edition, John Wiley & Sons). https://www.wiley.com/en-us/Remote+Sensing+and+Image+Interpretation%2C+7th+Edition-p-9781118919477.

	Additional Textbook: In the lecture presentations I also use figures and Examples from "Introductory Digital Image Processing: A Remote Sensing Perspective, 4th Edition" by J.R. Jensen. (4th edition, Pearson). https://www.pearson.com/us/higher-education/program/Jensen-Introductory-Digital-Image-Processing-A-Remote-Sensing-Perspective-4th-Edition/PGM30020.html
Computer Requirements	**Hardware:** You will need access to a Windows or Macintosh computer with at least 2 GB of RAM and access to a fast and reliable broadband internet connection (e.g., cable, DSL). A larger screen is recommended for better visibility of course material. You will need speakers or headphones to hear recorded content and a headset with a microphone is recommended for the best experience. For the amount of Hard Disk Space required taking a distance education course, consider and allow for: 1. the storage amount needed to install any additional software and 2. space to store work that you will do for the course. **Course-specific Hardware/Software** You will have to install **ENVI** on your own computer. You can purchase a student license, or a **temporary student license may be provided by Harris Geospatial under a special arrangement following COVID**. Home **installation instructions** will be provided on BlackBoard page /Start Here/Welcome.
Participation	Learning can only happen when you are playing an active role. It is important to place more emphasis on developing your insights and skills, rather than transmitting information. Knowledge is more important than facts and definitions. It is a way of looking at the world, an ability to interpret and organize future information. An active learning approach will more likely result in long-term retention and better understanding because you make the content of what you are learning concrete and real in your mind.
Cheating Policy	Any form of cheating on an activity, project, or exam will result in zero points earned. "Cheating" includes, but is not limited to, the following: reviewing others' exam papers, having ANY resources utilized when not allowed, collaborating with another student during an individual assignment or exams. Consulting internet resources during an exam constitutes cheating.
Individuals with Disabilities	Students with documented disabilities should contact the Office of Disability Services (703) 993-2474) to learn more about accommodations that may be available to them.

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<tr><td>Course Grading & Evaluation</td><td>
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<tr><td>Assignments</td><td>40%</td></tr>
<tr><td>Midterm exam</td><td>15%</td></tr>
<tr><td>Quizzes</td><td>10%</td></tr>
<tr><td>Mini-project</td><td>15%</td></tr>
<tr><td>Final exam</td><td>20%</td></tr>
<tr><td>Total:</td><td>100%</td></tr>
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Grades will be assigned as follows:
<table>
<tr><th>Weighted average range</th><th>Letter grade</th></tr>
<tr><td>□ 98.0</td><td>A+</td></tr>
<tr><td>97.9 – 93.0</td><td>A</td></tr>
<tr><td>92.9 – 90.0</td><td>A</td></tr>
<tr><td>89.9 – 87.0</td><td>A-</td></tr>
<tr><td>86.9 – 83.0</td><td>B+</td></tr>
<tr><td>82.9 – 80.0</td><td>B+</td></tr>
<tr><td>79.9 – 77.0</td><td>B</td></tr>
<tr><td>76.9 – 73.0</td><td>B-</td></tr>
<tr><td>72.9 – 70.0</td><td>C</td></tr>
<tr><td>69.9 – 60.0</td><td>D</td></tr>
<tr><td>□ 59.9</td><td>F</td></tr>
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a)
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<tr><td>Discussion board</td><td>We will use Discussion board mainly for trouble shooting during Assignments and for discussing possible exam questions.</td></tr>
<tr><td>Assignments – 40%</td><td>Each week’s assignment has to be uploaded to Blackboard by the due date and time. Assignments are due by Sunday, 11:59 PM, ET unless otherwise stated. Refer to the course schedule and weekly overviews for details. Each Assignment will have a demo video which explains all the steps you need to follow in ENVI - be sure the watch the video. ENVI’s website also has outstanding instructions and additional information for each function in the software. If you have a specific question, email the TA for help. If the question and answer is potentially useful to other students, the TA will post it on Discussion Board. See further information on Assignments below.
DO NOT FALL BEHIND ON ASSIGNMENTS. Late assignments will incur a 5-10 points penalty.</td></tr>
<tr><td>Exams – 35%</td><td>Mid-term Exam 15%
Final Exam 20%.
Exams are taken on BlackBoard. Open book, open notes.</td></tr>
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Assignment Details:

- Expect to work 2-3 hours per week on assignments for this course.
- Submission of assignment report should be done only **through the Blackboard course website**. Reports should be neat and clearly indicate question number and answer. Insert cropped screen shots of processed satellite imagery at appropriate zoom level to respond to the question.
- Submit **pdf files** of assignment to Blackboard, not Word documents.

- Unless otherwise stated, all assignments are due by the end of the week in which they are assigned.
- Feedback will be provided on Assignments and if you address the issues and resubmit, you can improve your points
- For the purposes of this course, a week is defined as **beginning at 12:01 am each Monday EST**, and **ending at 11:59 pm on the following Sunday EST. Late assignments will incur penalties.**

To help you manage your schedule and time to complete the assignments in this course, please follow the recommended timeline below. If you have a question or concern or encounter a problem about an assignment, please contact me immediately so we can discuss and work out a resolution. **Dates below in Course Calendar indicate the Monday of each week.**

Course Calendar

Weeks (Monday)	Lessons	Assignments
Week 1 23 Jan	**Lesson 1:** Introduction. Overview of Remote Sensing applications, Remote Sensing process, Electromagnetic Waves and Spectrum, Spectral signature, Energy Sources and Radiation	• Watch all videos • Start Reading textbook Chapter 1: **Concepts and foundations of Remote Sensing** • Review lecture notes • Set up ENVI license • Do ENVI tutorials: https://www.harrisgeospatial.com/docs/DisplayTools.html • https://www.harrisgeospatial.com/docs/OpeningLocalFiles.html
Week 2 30 Jan	**Lesson 2:** Energy Sources and Radiation, Energy Interactions, Atmospheric Scattering and Absorption, Interaction with earth surface (vegetation and water)	• Watch videos • Read textbook Chapter 1: **Concepts and foundations of Remote Sensing** (Page 1-30, 45-59) • Do Practical Exercise ENVI: Getting started • Start Assignment 1 in ENVI: Interpretation of WorldView image of GMU campus
Week 3 6 Feb	**Lesson 3:**	• Watch videos • Read Textbook 25-35

	Geometric influence on spectral response, Digital image acquisition, Four digital image resolutions: Radiometric resolution	• Complete Assignment 1 in ENVI. • Study for Quiz 1 on Lessons 2&3.
Week 4 13 Feb	**Lesson 4:** Spatial resolution, Types of multispectral sensors, Spectral resolution, Satellite orbits, Temporal resolution	• Take Quiz 1 (on Lesson 2&3) • Watch lecture videos • Watch External videos (they are awesome!!) • Class exercise / Discussion: Fill in Google Sheets on 4 resolutions of selected satellite sensors • Textbook: 72-75, 290-293, 218-229, 219-224, 140-143, 286-290, 309-318, 359-367, 290-321 • Download Data for Assignment 2 • Complete Assignment 2: WorldView image interpretation of Washington DC.
Week 5 20 Feb	**Lesson 5:** Processing digital numbers to surface reflectance	• Watch lecture videos • Watch External videos • Read textbook: p 491-495 • Study for Quiz 2 (on Lesson 5)
Week 6 27 Feb	**Lesson 6:** Geometric correction, Image enhancement, spatial filters	• Take Quiz 2 (on Lesson 5) • Watch lecture videos • Watch ENVI Demo video on Image enhancement: Contrast stretch • Watch External video • Read text book: 495-499, 500-06, 507-512, 147-148 • Complete and submit Assignment 3
Week 7 6 March	**Lesson 7:** Spectral Indices, Vegetation indices time series	• View lecture videos • View external videos • Read text book: 517-522 • Contribute 2 anticipated Midterm exam questions to Discussion Board • Complete Lesson 7, Assignment 4
13 March	**Spring Break**	• No Class

Week 8 **20 March**	**Lesson 8:** Midterm Exam	• Contribute 2 anticipated Midterm exam questions to Discussion Board • Take **Midterm exam** date TBD - on Bb • There are two parts to this exam. Complete both. • Instructions: • Use symbols and formatting in answer text box where required. Enable the full toolbar of answer text box. • Be comprehensive in your answers - explain yourself well.
Week 9 **27 March**	**Lesson 9:** Data transforms, Image Classification - Supervised and Unsupervised	• View lecture videos • View external videos • Read text book: p529-530, 537-556 • Complete Lesson 9, Assignment 5 by Sunday
Week 10 **3 April**	**Lesson 10:** Land Cover classification, Accuracy Assessment	• Review lecture video • View external videos • Complete and submit lesson 10, Assignment 6 by Sunday 11:59pm • Read textbook: 575-580, 611-618
Week 11 **10 April**	**Lesson 11:** Sub-pixel classification, Object-based Classification,	• Review lecture video • Read Textbook: 562-567, 568-570, 570-573. • Study for Quiz 3 (Lesson 9-11)
Week 12 **17 April**	**Lesson 12:** Change Detection	• Take Quiz 3 (on Lesson 9-11). • Watch lecture videos • Complete and submit Assignment 7 by Sunday • Read textbook: 582-587
Week 13 **24 April**	**Lesson 13:** LiDAR remote sensing	• View lecture videos and external video • Read textbook sections: 471-482 • View demo video on LiDAR processing • Complete Assignment 8 by Sunday • Review lecture presentation
Week 14 **1 May**	**Lesson 14:** Hyperspectral and Thermal remote sensing and applications	• View lecture videos and external video • Read textbook sections: 271-281, 598-602, 245 – 269, • Complete all late Assignments • Review lecture presentation • In preparation for Final Exam, post 2 example questions and on discussion board. • Review questions on discussion board

Week 15 10-17 May	**Lesson 15:** Final exam period	• Instructions for Final 379 • **Final Exam date TBD** • Go to BlackBoard / Assessments / Final Exam Part1 and 2 • Part 1 and Part 1 of the final exam is in 2 separate Assessments / tests. Complete both. • Time available? Part 1 120 min; Part 2 90 min • This is an "open-book" and "open-notes" exam. • You may NOT Google information from other websites. • You may NOT communicate with other students or anybody during the exam. • Do NOT Copy/Paste from notes • Email me if you have any problems with the on-line test or questions. kwessels4@gmu.edu. • **Read questions carefully and answer all parts of the questions.**