Syllabus: Fall 2022	
Course Information	GGS379: Remote Sensing Location: Exploratory Hall 2103 /Blackboard
Instructor	Dr. Konrad Wessels About Konrad Wessels COS (https://science.gmu.edu/directory/konrad-wessels) Please refer to your online course: https://mymasonportal.gmu.edu/ Office Hours by appointment.
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 image processing tools to process imagery to geospatial products. 3. Gain fundamental insight into the use of remote sensing for multiple, real-world applications.
Course Methodology	**This will be a hybrid course that will provide on-line material, but meet in person weekly for crucial interaction and required participation.** The class format will combine reading, lectures, in-class presentations, and hands-on processing of satellite imagery. The class will be interactive and require every student to be engaged in the material and assignments. In addition to the lectures, timely completion of assignments, **every student will be expected to be an active participant in class.**
Required textbook(s) and/or materials	Required Textbook: (Relevant chapters are available as pdf under "e-Reserve Textbook" in 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. If you consider the purchase of a new computer, please go to Patriot Tech to see recommendations. **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 during COVID. Pls wait for instructions before purchasing any software: https://www.harrisgeospatial.com/Industry-Solutions/Academic. Home installation instructions will be provided.
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. **You will be required to prepare and explain specific assigned concepts in class and will be graded on these brief presentations. Topics will be assigned weekly via email and announcements on Bb.**
Cheating Policy	Any form of cheating on an activity, project, or exam will result in zero points earned.

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<tr><td></td><td>“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.

If you have questions about when the contributions of others to your work must be acknowledged and appropriate ways to cite those contributions, please talk with the professor or utilize the GMU writing center.</td></tr>
<tr><td>Individuals with Disabilities</td><td>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.
(From the 2019-2020 Catalog – catalog.gmu.edu)</td></tr>
<tr><td>Course Grading & Evaluation</td><td>
<table>
<tr><td>Assignments</td><td>45%</td></tr>
<tr><td>Midterm exam</td><td>20%</td></tr>
<tr><td>Quizzes and class participation</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 listing common theoretical questions.</td></tr>
<tr><td>Assignments – 45%</td><td>Each week assignment reports are required to be uploaded to Blackboard. 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.</td></tr>
<tr><td>Exams – 40%</td><td>Mid-term Exam 20%</td></tr>
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	Final Exam 20%
Need Help? Utilize the "Course Q&A" discussion forum or email your instructor directly.	

Assignments:

- Expect to work 3-4 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.
- 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.**

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 22 Aug	**Lesson 1:** Introduction. Overview of Remote Sensing applications, Remote Sensing process, History, 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 **29 Aug**	**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 Sensin**g (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 **5 Sept**	**Lesson 3:** Geometric influence on spectral response, Digital image acquisition, Four digital image resolutions: Radiometric resolution	• Watch videos • Read Textbook 25-35 • Complete Assignment 1 in ENVI. • Study for Quiz 1 on Lessons 2&3.
Week 4 **12 Sept**	**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 **19 Sept**	**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 **26 Sept**	**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 **3 Oct**	**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
10 Oct	**Fall Break**	• No Class
Week 8 **17 Oct**	**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 **24 Oct**	**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 **31 Oct**	**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 **7 Nov**	**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 **14 Nov**	**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 **21 Nov**	**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 15 **28 Nov**	**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 16 **7-14 Dec**	**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.**