University of Hawaii Maui College
ETRO 440 - Remote Sensing

1. **Course Alpha. Please click on the ? to the right for help.**

   ETRO

2. **Course Number. Please click on the ? to the right for help.**

   440

3. **Course Title/Catalog Title. Please click on the ? to the right for help.**

   Remote Sensing

4. **Number of Credits. Please click on the ? to the right for help.**

   4

5. **Contact Hours/Type. Please click on the ? to the right for help.**

   - Hour lecture/lab (6)

6. **Course Description. Please click on the ? to the right for help.**

   Applies radiometric and photometric measurement concepts: propagation, irradiance, radiance, radiant intensity, luminance, radiant exittance. Calibrates and characterizes remote sensing data and data analysis techniques. Covers the interaction between electromagnetic radiation and matter. Investigates the effects of the atmosphere on light propagation and remote sensing experiments. Includes laboratory exercises and inquiries to build teamwork, presentation skills and practical experiences of the technical workplace. Utilizes technologies and analysis techniques relevant to the Hawai`i high-tech industry.

7. **Pre-Requisites. Please click on the ? to the right for help.**

   ETRO 450 Signal Processing (with grade C or better); OR consent

   ETRO 450 with grade C or better, or consent.

8. **Co-requisites.**

   None

9. **Recommended Preparation.**

   None

10. **Is this a cross-listed course? Please click on the ? to the right for help.**

    NO

11. **Reason for Proposal. Why is this course being proposed or modified? This question requires specific information as part of the explanation. Please click on the ? to the right for help.**

    The pre-requisites, credits, and contact hours are modified to reflect the changes brought to the ENGT program map.

12. **Effective Semester and Year. For new or modified courses, the effective year is one year from the semester proposed. For example, if proposed in Spring 2012, the effective semester is Spring 2013. Please click on the ? to the right for help.**

    Fall 2015

13. **Grading Method. What grading methods may be used for this course? Please click on the ? to the right for help.**

    - Standard (Letter,Cr/NCr,Audit) (0)

14. **Is this course repeatable for credit? How often can this course be counted toward a degree or certificate? Please click on the ? to the right for help.**

    NO

15. **Course Student Learning Outcomes (SLOs). DO NOT ENTER TEXT IN THE TEXT BOX BELOW. Click on the yellow button "COURSE LEARNING OUTCOMES" and enter in that screen. Please click on the ? to the right for help.**

Course SLO/Competency	Apply calibrations to digital image data.	Estimate measurement precision or instrument capabilities from data analysis.	Describe how propagation effects (seeing, transparency, etc) influence observations and analysis.	Demonstrate technologist-level proficiency of data characterization, processing.	Analyze data to identify signals or signal constituents.	Collaborate on writing technical reports for publication.	Use software to demonstrate propagation & data analysis concepts (IDL, Zemax, ArcGIS)	Collaboratively solve remote sensing problems.	Present remote sensing analysis using modern graphical tools.	Utilize computational methods and algorithms to solve problems.	Develop specifications for a remote sensing system matched to signal requirements and needs.
Conduct, analyze and interpret	☑	☑	☑	☑							

radiometric experiments using laboratory instruments and tools, including data collection, calibration and characterization.												
Evaluate instrument capabilities through data analysis and application of remote sensing and propagation concepts.		☑	☑	☑	☑							
Communicate problems, solutions, and experimental results by applying illumination, propagation, radiation-matter interaction and measurements concepts, and using both technical and everyday norms of communication.					☑	☑	☑	☑				
Identiy, analyze, and solve radiometric problems, working collaboratively and integrating diverse perspectives and problem-solving processes.					☑	☑	☑	☑	☑	☑		
Develop a professional development and career plan that matches personal interests and values to local remote sensing infrastructure, and considers societal impact of remote sensing technology.									☑	☑	☑	

Course SLO/PSLO	analyze, design, and implement electro-optic systems, control systems, instrumentation systems, communication systems, computer systems, or power systems	utilize integral and differential calculus, or other appropriate mathematics above the level of algebra and trigonometry to solve technical problems	demonstrate critical engineering technology skills and experiences such as: making existing technology operate, creating/selecting new technology, troubleshooting, calibrating, characterizing, and optimizing;	demonstrate engineer's way of thinking, analyzing technology as systems;
Conduct, analyze and interpret radiometric experiments using laboratory instruments and tools, including data collection, calibration and characterization.	☑	☑		
Evaluate instrument capabilities through data analysis and application of remote sensing and propagation concepts.		☑	☑	
Communicate problems, solutions, and experimental results by applying illumination, propagation, radiation-matter interaction and measurements concepts, and using both technical and everyday norms of communication.		☑	☑	
Identiy, analyze, and solve radiometric problems, working collaboratively and integrating diverse perspectives and problem-solving processes.		☑	☑	
Develop a professional development and career plan that matches personal interests and values to local remote sensing infrastructure, and considers societal impact of remote sensing technology.			☑	☑

16. Course Competencies. DO NOT ENTER TEXT IN THE TEXT BOX BELOW. Click on the yellow button "COURSE COMPETENCIES/ISSUES/SKILLS" and enter text in that screen. Course competencies are smaller, simpler tasks that connect to and facilitate the SLOs.

Competency
Apply calibrations to digital image data.

Estimate measurement precision or instrument capabilities from data analysis.
Describe how propagation effects (seeing, transparency, etc) influence observations and analysis.
Demonstrate technologist-level proficiency of data characterization, processing.
Analyze data to identify signals or signal constituents.
Collaborate on writing technical reports for publication.
Use software to demonstrate propagation & data analysis concepts (IDL, Zemax, ArcGIS)
Collaboratlvely solve remote sensing problems.
Present remote sensing analysis using modern graphical tools.
Utilize computational methods and algorithms to solve problems.
Develop specifications for a remote sensing system matched to signal requirements and needs.

17. Recommended Course Content and Timeline. The course content facilitates the course competencies. Course content may be organized by weeks, units, topics or the like.

Content
1-2 Weeks: Data characterization and sources of error
2-3 Weeks: Detection and processing software tools and analysis.
2-3 Weeks: Data Analysis: Photometry / Intensity / Polarimetry / Spectroscopy
1-2 Weeks: High-Tech Workforce Remote Sensing Applications
1-2 Weeks: Technical Presentations of Remote Sensing Projects

18. Program Learning Outcomes. DO NOT ENTER TEXT IN THE TEXT BOX BELOW. Click on the yellow button "PLOs" and enter text in that screen. Program Student Learning Outcomes (PLOs) supported by this course. If you are not a "program" use the Liberal Arts PLOs, view them by clicking on ? icon to the right.

Program SLO
analyze, design, and implement electro-optic systems, control systems, instrumentation systems, communication systems, computer systems, or power systems
utilize integral and differential calculus, or other appropriate mathematics above the level of algebra and trigonometry to solve technical problems
demonstrate critical engineering technology skills and experiences such as: making existing technology operate, creating/selecting new technology, troubleshooting, calibrating, characterizing, and optimizing;
demonstrate engineer's way of thinking, analyzing technology as systems;

19. College-wide Academic Student Learning Outcomes (CASLOs). FIRST, fill out the CASLO grid located in the UHMC tab above. Click on the HELP icon for tips on determining support for the CASLOs and indicate your choices below by clicking on the box in front of each supported CASLO. NOTE: Our campus does not use the Preparatory Level, Level 1 and Level 2 designations in the chart below.

☑	**Creativity** - Able to express originality through a variety of forms. ☑ Preparatory Level
☑	**Critical Thinking** - Apply critical thinking skills to effectively address the challenges and solve problems. ☑ Preparatory Level
	Information Retrieval and Technology - Access, evaluate, and utilize information effectively, ethically, and responsibly.
	Oral Communication - Practice ethical and responsible oral communications appropriately to a variety of audiences and purposes.
☑	**Quantitative Reasoning** - Synthesize and articulate information using appropriate mathematical methods to solve problems of quantative reasoning accurately and appropriately. ☑ Preparatory Level
	Written Communication - Write effectively to convey ideas that meet the needs of specific audiences and purposes.

GenED SLO
Creativity - Able to express originality through a variety of forms.

Critical Thinking - Apply critical thinking skills to effectively address the challenges and solve problems.
Quantitative Reasoning - Synthesize and articulate information using appropriate mathematical methods to solve problems of quantative reasoning accurately and appropriately.

20. Linking. CLICK ON CHAIN LINK ICON IN UPPER RIGHT HAND CORNER TO BEGIN LINKING. Please click on the ? to the right for help.

21. Method(s) of delivery appropriate for this course. Please click on the ? to the right for help.

- Classroom/Lab (0)

22. Text and Materials, Reference Materials, and Auxiliary Materials. Please click on the ? to the right for help.

Materials, examples, and/or exercises will be handed out by the instructor.

Reference materials:
Open-source text books: Optics, E&M, Conceptual physics and more
http://www.lightandmatter.com/

Online tutorials such as:
http://www.opticsforkids.org/tutorials/

NASA Goddard Remote Sensing Tutorial
http://rst.gsfc.nasa.gov/

Online Handbooks such as the Ocean Optics Web Book:
http://www.oceanopticsbook.info

Online Reference books for software tools:
Oslo - Optical ray tracing software & reference guide
http://www.lambdares.com/education/oslo_edu/

Auxilliary materials:
Software such as IDL, Zemax, ArcGIS, and MODTRAN
IDL Handbook
"Remote sensing: models and methods for image processing" by Schowengerdt
"Handbook of CCD Astronomy" by Howell
"Optics" by Hecht .

23. Maximum enrollment. Please click on the ? to the right for help.

24

24. Particular room type requirement. Is this course restricted to particular room type? Please click on the ? to the right for help.

YES
Laboratory with computers

25. Special scheduling considerations. Are there special scheduling considerations for this course? Please click on the ? to the right for help.

YES
This course must fit the BAS ENGT course scheduling.

26. Are special or additional resources needed for this course? Please click on the ? to the right for help.

No

27. Does this course require special fees to be paid for by students? Please click on the ? to the right for help.

NO

28. Does this course change the number of required credit hours in a degree or certificate? Please click on the ? to the right for help.

No

29. Course designation(s) for the Liberal Arts A.A. degree and/or for the college's other associate degrees. Please click on the ? to the right for help.

Degree	Program	Category
Associate in Arts:		LE - Elective LE - Elective
AS:		PE - Program Elective
AAS:		
BAS:	ET	CR - Core Course/Requirement - BAS
Developmental/ Remedial:		

30. Course designation(s) for other colleges in the UH system.

This course transfers as an elective.

31. Indicate the year and page # of UHMC catalog referred to. For new or modified courses, please indicate the catalog pages that need to be modified and provide a sheet outlining those changes.

Page 114 in general catalog 2014-2015.

32. College-wide Academic Student Learner Outcomes (CASLOs). Please click on the HELP icon for more information.

Standard 1 - Written Communication Write effectively to convey ideas that meet the needs of specific audiences and purposes.		
Outcome 1.1 - Use writing to discover and articulate ideas.		1
Outcome 1.2 - Identify and analyze the audience and purpose for any intended communication.		0
Outcome 1.3 - Choose language, style, and organization appropriate to particular purposes and audiences.		1
Outcome 1.4 - Gather information and document sources appropriately.		1
Outcome 1.5 - Express a main idea as a thesis, hypothesis, or other appropriate statement.		1
Outcome 1.6 - Develop a main idea clearly and concisely with appropriate content.		1
Outcome 1.7 - Demonstrate a mastery of the conventions of writing, including grammar, spelling, and mechanics.		1
Outcome 1.8 - Demonstrate proficiency in revision and editing.		1
Outcome 1.9 - Develop a personal voice in written communication.		0
Standard 2 - Quantitative Reasoning Synthesize and articulate information using appropriate mathematical methods to solve problems of quantative reasoning accurately and appropriately.		
Outcome 2.1 - Apply numeric, graphic, and symbolic skills and other forms of quantitative reasoning accurately and appropriately.		3
Outcome 2.2 - Demonstrate mastery of mathematical concepts, skills, and applications, using technology when appropriate.		3
Outcome 2.3 - Communicate clearly and concisely the methods and results of quantitative problem solving.		3
Outcome 2.4 - Formulate and test hypotheses using numerical experimentation.		3
Outcome 2.5 - Define quantitative issues and problems, gather relevant information, analyze that information, and present results.		3
Outcome 2.6 - Assess the validity of statistical conclusions.		3
Standard 3 - Information Retrieval and Technology. Access, evaluate, and utilize information effectively, ethically, and responsibly.		
Outcome 3.1 - Use print and electronic information technology ethically and responsibly.		1
Outcome 3.2 - Demonstrate knowledge of basic vocabulary, concepts, and operations of information retrieval and technology.		1
Outcome 3.3 - Recognize, identify, and define an information need.		1
Outcome 3.4 - Access and retrieve information through print and electronic media, evaluating the accuracy and authenticity of that information.		1
Outcome 3.5 - Create, manage, organize, and communicate information through electronic media.		2
Outcome 3.6 - Recognize changing technologies and make informed choices about their appropriateness and use.		2
Standard 4 - Oral Communication Practice ethical and responsible oral communications appropriately to a variety of audiences and purposes.		
Outcome 4.1 - Identify and analyze the audience and purpose of any intended communication.		1
Outcome 4.2 - Gather, evaluate, select, and organize information for the communication.		1
Outcome 4.3 - Use language, techniques, and strategies appropriate to the audience and occasion.		1
Outcome 4.4 - Speak clearly and confidently, using the voice, volume, tone, and articulation appropriate to the audience and occasion.		1
Outcome 4.5 - Summarize, analyze, and evaluate oral communications and ask coherent questions as needed.		1
Outcome 4.6 - Use competent oral expression to initiate and sustain discussions.		1

Standard 5 - Critical Thinking **Apply critical thinking skills to effectively address the challenges and solve problems.**		
Outcome 5.1 - Identify and state problems, issues, arguments, and questions contained in a body of information.		1
Outcome 5.2 - Identify and analyze assumptions and underlying points of view relating to an issue or problem.		2
Outcome 5.3 - Formulate research questions that require descriptive and explanatory analyses.		3
Outcome 5.4 - Recognize and understand multiple modes of inquiry, including investigative methods based on observation and analysis.		3
Outcome 5.5 - Evaluate a problem, distinguishing between relevant and irrelevant facts, opinions, assumptions, issues, values, and biases through the use of appropriate evidence.		2
Outcome 5.6 - Apply problem-solving techniques and skills, including the rules of logic and logical sequence.		2
Outcome 5.7 - Synthesize information from various sources, drawing appropriate conclusions.		2
Outcome 5.8 - Communicate clearly and concisely the methods and results of logical reasoning.		3
Outcome 5.9 - Reflect upon and evaluate their thought processes, value system, and world views in comparison to those of others.		2
Standard 6 - Creativity **Able to express originality through a variety of forms.**		
Outcome 6.1: Generate responses to problems and challenges through intuition and non-linear thinking.		2
Outcome 6.2: Explore diverse approaches to solving a problem or addressing a challenge.		2
Outcome 6.3: Sustain engagement in activities without a preconceived purpose.		2
Outcome 6.4: Apply creative principles to discover and express new ideas.		2
Outcome 6.5: Demonstrate the ability to trust and follow one's instincts in the absence of external direction		2
Outcome 6.6: Build upon or adapt the ideas of others to create novel expressions or new solutions.		2

33. Additional Information