# **FlexPace Course Alignment for AVT 1122 Synthetic Aperture Radar & Light Detection & Ranging Data Analysis – CBE [2.0 Credit Hours]**

| **CO 1** | **Synthetic Aperture Radar Data Analytics** - Analyze a variety of synthetic aperture radar data. |
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| **CO 2** | **Light Detection and Ranging Data Analytics** - Analyze a variety of light detection and ranging data. |
| **CO 3** | **SAR and LiDAR Data Analysis Products** - Evaluate synthetic aperture radar and light detection and ranging data analysis products. |
| **CO 4** | **Portfolio** - Create a portfolio of synthetic aperture radar and light detection and ranging data analysis products. |

**Note:** Course Objectives are institutionally mandated and taken from the [Master Syllabus](https://cmt.sinclair.edu/#reports.mastersyllabus).

# **Course Structure and Alignment**

**Note:** Topic Objectives are developed by the course coordinator to align with the Course Objectives.

|  | **Topic Objectives** | **CO #** | **Materials** | **Activities** | **Assessments** |
| --- | --- | --- | --- | --- | --- |
|  | **Write 3-5 Objectives for your topic**  Formulate using terms from [Bloom’s revised taxonomy](https://www.celt.iastate.edu/teaching/effective-teaching-practices/revised-blooms-taxonomy/) or another resource – ONE action verb per objective.  **EXAMPLE**  After completing this module, students will be able to \_\_\_\_\_:   * Explain … * Differentiate … * Identify… * Evaluate ... | **Which COs apply?** | *What tools will you use to deliver the material/ demonstrate the skill, etc.?*  **EXAMPLES**   * Chapter X * Lessons * Videos * Links * Recorded Lectures * Other | *What activities will students complete?*  **EXAMPLES**   * Read assigned textbook chapter and online lessons * Watch videos * Complete practice activities * Complete assignments | *How will students demonstrate their mastery of the skill or concept being taught in this unit/topic?*  **EXAMPLES**   * Pre-Assessment | Unit 1 * Unit Assignment | add title (if needed – complete to open Post-Assessment) * Post-Assessment | Unit 1 (if needed) * Required Assignment | add title |
| **Unit 1 - Electromagnetic Spectrum Review** | TO 1 Identify and describe EMS bands used in UAS-mounted SAR and LiDAR remove sensing, their frequency range, and wavelength characteristics. | CO 1  CO 2  CO 3 | Textbook  Lesson Websites Videos |  | * Unit Pre-Assessment * Practice Quiz | Electromagnetic Spectrum Review (if needed) * Practice Quiz | SAR and LiDAR Terminology and Acronyms (if needed) * Practice Quiz | SAR Theory (if needed) * Practice Quiz | SAR Sensors (if needed) * Unit Post-Assessment (if needed – must complete practice quizzes to open) |
| TO 2 Identify, understand, and describe the divisions (bands) of the EMS, including their frequency and wavelength ranges, that relate to SAR and LiDAR remote sensing. | CO 1 |
| TO 3 Memorize the acronym for the entire EMS (RMIVUXG, i.e. Rich Men In Venice Use X-ray Guns). | CO 1 |
| TO 4 Memorize the acronym for the visible light component of the EMS (ROY G BIV); i.e., Red, Orange, Yellow, Green, Blue, Indigo, and Violet. | CO 1 |
| **Unit 1 - SAR and LiDAR Terminology and Acronyms** | TO 1 Recall the terminology related to the electromagnetic spectrum with special emphasis on the Microwave, Near Infrared, and Visible Light Bands. | CO 1  CO 2 | Textbook  Lesson  Study Mate |  |
| TO 2 Become familiar with the terminology and acronyms used in describing basic and advanced SAR and LiDAR theory and technology. | CO 1  CO 2 |
| TO 3 Become familiar with the terminology and acronyms used in describing UAS SAR and LiDAR sensor architecture and operation. | CO 1 |
| TO 4 Become familiar with the terminology and acronyms used in describing UAS SAR and LiDAR applications. | CO 2 |
| TO 5 Become familiar with the terminology and acronyms used in describing UAS SAR and LiDAR data analysis and processing. | CO 1  CO 2 |
| **Unit 1 - Synthetic Aperture Radar (SAR) Theory** | TO 1 Recall the theory and operation of SAR on moving platforms; especially UAVs. | CO 1 | Textbook  Lesson  Websites  Videos |  |
| TO 2 Recall and describe the relationships among aperture (antenna) length, ground area coverage (footprint), and image resolution. | CO 1  CO 2 |
| TO 3 Identify and describe the process of SAR data collection, processing, and SAR image construction. | CO 1 |
| TO 4 Recall and describe Slant-range distortion effects including image foreshortening, layover, and shadowing effects. | CO 2 |
| TO 5 Recall the difference between coherent and non-coherent radar processing and why coherent radar processing allows analysis of Doppler effects. | CO 2 |
| TO 6 Describe the different types of "clutter" in a SAR system and how they are handled in SAR data processing. | CO 2 |
| **Unit 1 - Synthetic Aperture Radar (SAR) Sensors**    ***Note: This is the 25% milestone of the course.*** | TO 1 Recognize and describe SAR sensor components that are mounted on UAS platforms. | CO 1 | Textbook  Lesson  Websites  Videos |  |
| TO 2 Recognize and describe the three modes of SAR sensor operation. | CO 1  CO 2 |
| TO 3 Become familiar with the characteristics and specifications for at least four commercially available UAS-based SAR systems. | CO 1 |
| TO 4 Identify and describe the types of images produced by a UAS-mounted SAR sensor. | CO 1 |
| **Unit 2 - Synthetic Aperture Radar (SAR) Sensing - UAS Applications** | TO 1 Recognize and describe SAR sensor components that are mounted on UAS platforms. | CO 1  CO 2 | Textbook  Lesson  Websites  Videos | Read Directions | Course Paper and Presentation | * Unit Pre-Assessment * Practice Quiz | SAR Sensing: UAS Applications (if needed) * Practice Quiz | SAR Data Analysis Processing (if needed) * Unit Post-Assessment (if needed – must complete practice quizzes to open) |
| TO 2 Recognize and describe the three modes of SAR sensor operation. | CO 2 |
| TO 3 Become familiar with the characteristics and specifications for at least four commercially available UAS-based SAR systems. | CO 1 |
| TO 4 Identify and describe the types of images produced by a UAS-mounted SAR sensor. | CO 1  CO 2 |
| **Unit 2 - Synthetic Aperture Radar (SAR) Analysis/Processing** | TO 1 | CO 3 | Textbook  Lesson  Websites  Videos |  |
| TO 2 | CO 2 |
| TO 3 | CO 2  CO 4 |
| **Unit 2 – Required Assignments**  ***NOTE: This is the 50% milestone of the course.*** | TO 1 | CO 3 | Textbook  Lesson  Websites  Videos |  | * Assignment | Paper Abstract (required) * Assignment | SAR Data Analysis Exercise (required) |
| TO 2 | CO 3 |
| TO 3 | CO4 |
| TO 2 |  |
| TO 3 |  |
| **Unit 3 - Light Detection and Ranging (LiDAR) Theory** | TO 1 |  | Textbook  Lesson  Websites  Videos |  | * Unit Pre-Assessment * Practice Quiz | LiDAR Theory (if needed) * Practice Quiz | LiDAR Sensors (if needed) * Practice Quiz | LiDAR Sensing: UAS Applications (if needed) * Practice Quiz | LiDAR Data Analysis Processing (if needed) * Unit Post-Assessment (if needed – must complete practice quizzes to open) |
| TO 2 |  |
| TO 3 |  |
| **Unit 3 - Light Detection and Ranging (LiDAR) Sensors** | TO 1 |  | Textbook  Lesson  Websites  Videos |  |
| TO 2 |  |
| TO 3 |  |
| **Unit 3- Light Detection and Ranging (LiDAR) Sensing - UAS Applications** | TO 1 Understand the known applications where UAS-mounted LiDAR systems are currently used and candidates for expansion in the future. | CO 3 | Textbook  Lesson  Websites  Videos |  |
| TO 2 Identify which LiDAR sensor scanning mirrors are most commonly used in each application. | CO 2 |
| TO 3 Describe the data sets that are created by these applications. | CO 3 |
| **Unit 3 - Light Detection and Ranging (LiDAR) Data Analysis/Processing** | TO 1 Recognize preprocessing techniques including Control Point selection, image registration, Control Point alignment, and creating a unified Point Cloud image such as the in the above figure. | CO 3  CO 4 | Textbook  Lesson  Websites  Videos |  |
| TO 2 Identify data analytic techniques including data reduction, object classification, RGB height conversion, and creation of Digital Elevation Maps (DEM), Digital Surface Maps (DSM), and Triangular Irregular Networks (TIN). | CO 2  CO 3 |
| TO 3 Identify data analytic techniques associated with one or two selected UAS LiDAR applications. | CO 2  CO 3 |
| **Unit 3 – Required Assignments**  ***NOTE: This is the 75% milestone of the course.*** | TO 1 Describe the types of LiDAR data that can be collected using the features of light emitted through the Electromagnetic Spectrum. | CO 1  CO 2  CO3 | Data analysis exercise | Read Assignment Guidelines  Complete Assignment | Course Paper Draft  Complete | LiDAR Data Analysis Exercise | * Assignment | Course Paper Draft (required) * Assignment | LiDAR Data Analysis Exercise (required) |
| TO 2 Describe the type sensors that are used to collect this data. | CO 1  CO 2  CO 3  CO4 |
| TO 3 Describe the analysis process, the type information that can be obtained from LiDAR data and at least two practical uses of that information. | CO 2  CO 3  CO 4 |
| **Unit 4** | TO 1 Describe the type remote sensing (SAR or LiDAR) you chose for your report. | CO 3  CO 4 | Final Paper and Presentation Instructions  Final Exam Review | Complete Final Paper  Complete Paper Presentation  Review for final exam  Complete Final Exam | * Assignment | Course Paper Final (required) * Assignment | Paper Presentation (required) * Final Exam (required) |
| TO 2 Describe the type sensors that are used in this type sensing. | CO 3 |
| TO 3 Describe the type data that can be obtained with those sensors. | CO 3 |
| TO 4 Describe the data analysis process and at least two practical uses of that data.  TO 5 Demonstrate analysis and evaluation of synthetic aperture radar and light detection and ranging data analysis data. | CO 3  CO 3  CO 4 |