UNITED STATES AIR FORCE ACADEMY

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ECE 215/S Syllabus - Fall 2026

Overview

Understanding complex systems like the F-35, hypersonic weapons, and GPS is essential for leaders in the world's most advanced military. Regardless of your academic discipline or career field, ECE215S will equip you with the tools to analyze these systems and tackle technical challenges as they arise (because they will!), preparing you for success in the Air Force, Space Force, and beyond.

Instructors

Dr. Neil Rogers	2E46D	neil.rogers@afacademy.af.edu
Col Juan Jurado	2F6A	juan.jurado@afacademy.af.edu
Ms. Vanessa Rosario (Lab Tech)	2E36B	vanessa.rosario@afacademy.af.edu

Course Goals

In ECE215S, cadets will explore the principles of electrical and computer engineering to support well-informed decision-making. By the end of the course, cadets will be equipped to develop systems-level solutions for air, space, and cyberspace operations while addressing real-world constraints.

Course Prerequisites

CompSci 110 and Math 142. Can be co-requisites; chat with your instructor if an issue.

Course Materials

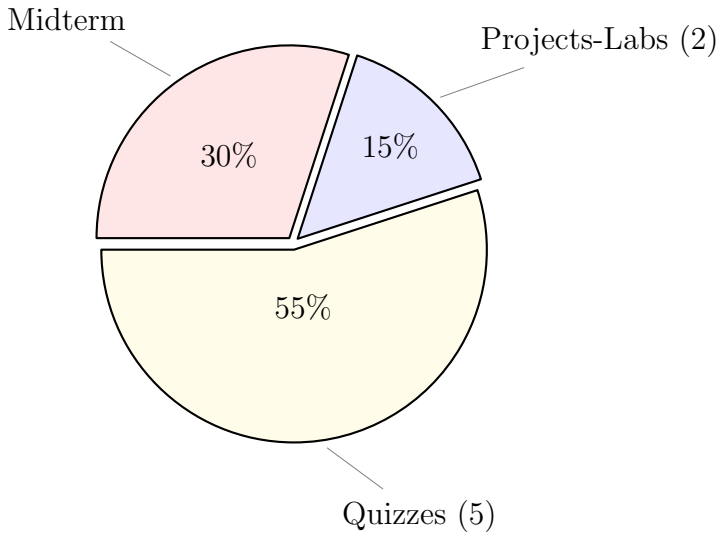
The course website contains the course schedule, readings, lesson slides, practice problems, project descriptions, and more. The website may be updated when necessary, so bookmark it and return to it often.
https://usafa-ece.github.io/ece215-book/intro.html

Course Communication

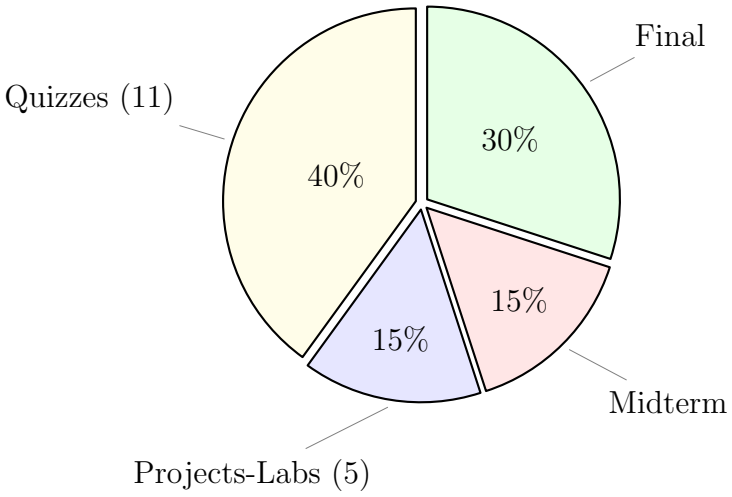
- **Gradescope** Cadets will be enrolled in the course on Gradescope. All assignments will be submitted, graded, and/or returned through Gradescope.
- **Teams** Most communications regarding the course will be through Teams, including any schedule changes.
- **Email** Bedrest, SCAs, and other communications requiring formal documentation must be submitted via email.

The grade breakdown for the course at Prog and for your final grade are shown below. A number in parentheses indicates the number of items for that graded event.

Prog Grade Weighting



Final Grade Weighting



Grade Scale

F	D	C-	C	C+	B-	B	B+	A-	A
$\leq 60\%$	70%	73%	77%	80%	83%	87%	90%	93%	100%

This course will utilize an alternative grading format. The intent is that your grades will be fairer, more accurate, and more meaningful. This grading format should also improve your learning and retention of concepts taught throughout the semester.

This course will focus on specific learning objectives, which are key concepts required to succeed in this course and retain knowledge for future academic and professional endeavors. The Learning Objectives section of this syllabus details all learning objectives for this course. Your mastery (i.e. understanding) of each learning objective will be assessed with quizzes, projects, and examinations (midterm and final).

Quizzes Quizzes will be given to ensure you are mastering learning objectives at an appropriate pace for success in ECE215S. Key things to know:

- Quizzes will consist of several problems. Material will be covered during lectures and through assigned reading.
- Some objectives may be covered in multiple problems across multiple quizzes to improve your retention of the concept.
- Grading for quizzes will utilize an alternative grading system:
  - For each quiz problem, you may earn a 1 (correct with at most trivial math errors) or 0 (incorrect) for each problem.
  - If you receive a 0 on a quiz problem, you will be provided meaningful feedback on how to improve your understanding of that learning objective. The correct answer will not be provided.
  - If you receive a 0, you have the opportunity to improve your score within one week of the returned, graded quiz *if and only if* you have submitted your assessment problems with clear effort by the original due date.
  - To change your score from a 0 to a 1, you must demonstrate full understanding of the objective by making changes to correct your quiz problem and submitting the correction with a shareable link through a regrade request on Gradescope.
  - If you do not complete a submission by the deadline for a quiz problem or you clearly did not put effort into your submission, you can earn a retake. To earn a retake, you can read a scientific publication or article chosen by your instructor, give a 3-5 minute summary of the paper to the class, and facilitate a meaningful discussion with your instructor and/or classmates regarding the paper. *Please, put in effort and submit your quiz answers on time!* Also take special note of the absences policy and adhere to due dates!
  - Each quiz problem will be worth 1 point. A quiz with 3 problems will therefore be worth a total of 3 points.
  - The final quiz score for the course will be based on the number of quiz problems given throughout the semester. Example: if there are a total of 20 quiz questions across 6 quizzes for the entire semester and you scored a 1 for 18 quiz questions and 0 for 2 quiz questions, your quiz grade for the course is therefore $\frac{18}{20} = 90.0\%$

  - Be sure to seek help from your instructor early if you worry you may receive a score of 0.

- Ungraded practice problems will be provided with answers to help you prepare for your quizzes.
- Quizzes will be individual effort.
- You may only use a calculator and class resources to complete your quiz. Search engines, ChatGPT, or other AI assistants are not allowed during quizzes.
- Quizzes will be assigned, submitted, graded, and returned via Gradescope.
- Check Gradescope for official deadlines.

Projects and Labs Projects and labs will solidify your understanding of learning objectives through engineering applications. Key things to know:

- Projects and labs will be completed as a group with group sizes detailed within each Project Assignment.
- Projects and labs will be scored similar to quizzes, where you will receive a score of 1 (correct with at most trivial math errors) or 0 (incorrect).
- To earn a 1, all specifications listed in the instructions must be completed correctly as laid out in your Project or Lab Assignment.
- If you receive a 0, you have the opportunity to improve your score by correcting your original submission within one week of the returned, graded project *if and only if* you have submitted your project with clear effort by the original due date. *Exceptions to this are noted in the specific Project Assignments.*
- There will be dedicated work day(s) during lecture periods for each project and lab; however, work outside of class will be required to complete the projects.
- Projects and labs will be assigned, submitted, graded, and returned via Gradescope.
- Restrictions regarding resources used to complete your projects and labs will be provided for each individual project. Be cautious that ChatGPT is known to provide incorrect methodology and answers to engineering problems - be sure to use generative AI tools responsibly (i.e. as a learning tool, not as a way to complete your project).
- Check Gradescope for official deadlines.

Examinations Your midterm and final represent a culmination of your learning throughout this course. Key things to know:

- The midterm and final are one-time examinations. As such, there will be no retakes offered.
- Each problem within the midterm and final will receive one of the following scores:
  - 1: The correct mathematical framework is chosen, given data is correctly used in the terms of the framework, and solutions are neat, organized, and easy to grade. Only trivial (simple math) errors are present, if any. Understanding of concepts is therefore evident.
  - .5: The correct mathematical framework is chosen, but the given data is *incorrectly* used in the terms of the framework. Solutions are neat, organized, and easy to grade. Partial understanding of concepts is therefore evident.
  - 0: The correct mathematical framework is *not* chosen, solutions are *not* neat, organized, and easy to grade, or no work completed for the problem. An understanding of concepts is therefore *not* evident.
- Your score for each examination is the number of points earned out of points possible. Example: if there are ten problems on the final and you earn a 1 on eight problems, a 0 on one, and a .5 on one, you would earn an 8.5/10, i.e. 85% on your final exam.
- The midterm and final examinations are individual effort.
- The midterm will be a take-home examination. It will be assigned, graded, and returned via Gradescope.
- The final will occur during finals week as scheduled by the registrar. It will be handwritten and submitted directly to the final exam proctor.
- Your instructor will detail resources allowed prior to each examination.

Learning Objectives

The learning objectives for this course are listed in the order in which they are covered throughout the semester and organized by course block. Mastery of all learning objectives will be assessed by respective quiz and exam questions.

Obj	Description
Block 1 – Resistive Circuits Analysis and Power Distribution	
1.1	I can calculate the voltages, currents, and power associated with devices in a simple DC-powered circuit using tools such as KVL, KCL, voltage and current dividers, Ohm's Law, and the power equation.
1.2	I can determine appropriate circuit breaker values for adequate system protection.
1.3	I can calculate the voltages, currents, instantaneous power, and average power associated with devices in a simple AC-powered circuit using tools such as KVL, KCL, voltage and current dividers, Ohm's Law, RMS values, and the power equation.
1.4	I can compute the reactive and apparent power values for an AC-powered circuit.
1.5	I can calculate the efficiency of a system modeled as an electrical circuit.
1.6	I can use a transformer's turns ratio, input voltages and currents, and output voltages and currents to calculate the efficiency, source voltage, and current of a power transmission system with one or more transformers.
1.7	I can calculate the efficiency, source voltage, and current of a power transmission system with one or more power converters.
1.8	I can use a decision matrix to quantitatively compare various measures of merit.
Block 2 – Signal Processing	
2.1	I can graph a given sinusoidal signal, including DC components, in both the time and frequency domains and determine its bandwidth.
2.2	I can identify types of ideal filters, determine their cutoff frequencies, and analyze their output given an input sinusoidal signal or signal spectrum.
2.3	I can model capacitors and inductors as complex resistors and use circuit analysis tools (such as voltage dividers, Ohm's Law, and the power equation) to calculate voltage, current, and power in AC circuits containing these components.
2.4	I can determine the filter type, gain, and cutoff frequency of simple series circuits containing a resistor, capacitor, and/or inductor.
2.5	I can calculate the ADC sampling rate, voltage resolution, and digital output based on a given input voltage and the ADC's operational parameters, and determine the number of bits a required resolution demands.
2.6	I can implement signal conditioning to avoid aliasing and clipping and to ensure maximum compatibility of the dynamic ranges between two devices.
2.7	I can relate digital inputs to digital outputs using tools such as fundamental digital logic gates (AND, OR, NOT), truth tables, and Sum of Products (SOP) and Product of Sums (POS) Boolean expressions.
2.8	I can model Moore and Mealy Finite State Machines (FSMs) using tools such as state transition diagrams, transition tables, and combinational and sequential logic circuits.
Block 3 – Communication Systems, Radar, and Electronic Warfare	

Obj	Description
3.1	I can determine the modulation index, output signal, and output signal bandwidth of an Amplitude Modulation (AM) system and assess whether the system is under-modulated, over-modulated, or fully modulated.
3.2	I can design a demodulator given a modulated signal for envelope and synchronous detection.
3.3	I can calculate the signal wavelength, antenna size, max antenna gain, and basic gain pattern for dipole, monopole, and parabolic dish antennas.
3.4	I can calculate the maximum line-of-sight (LOS) distance between two terrestrial objects.
3.5	I can calculate the maximum communication distance between a transmitter and receiver using the Friis and Line-of-Sight equations.
3.6	I can calculate the maximum detection range from a radar antenna to a target using the Radar Range equation.
3.7	I can calculate the range resolution, unambiguous range, and target velocity for pulse Doppler radar.
3.8	I can calculate signal-to-noise ratio (SNR) and determine the effects on wireless communications.
3.9	I can analyze jamming scenarios using the Friis equation, RADAR equation, and SNR.

Dates below are the Fall 2026 lesson days. Each lesson meets **once** — on its M-day or its T-day, depending on your section. **No classes** on 7 Sep (Labor Day), 11 Sep (Commandant's Training Day), 18 Sep (Fall VALEX), 12 Oct (Columbus Day), 11 Nov (Veterans Day), or 25–30 Nov (Thanksgiving break). Classes end 10 Dec; finals run 14–17 Dec.

Block 1: This block reviews basic circuit theory and introduces you to power systems. You will learn to analyze signal and power system requirements, evaluate the capabilities of system components, and design a system to meet stated requirements. The block culminates in a group project focused on designing a power distribution system. For each lesson, read the assigned material and attempt the practice problems ***before*** coming to class.

Block 1 – Resistive Circuits Analysis and Power Distribution			
Lesson	**Date (M / T)**	**Topic**	**Due**
1	6 Aug / 7 Aug	Course Overview	
2	10 Aug / 11 Aug	Obj 1.1	Quiz 0 Due (Skills Review)
3	12 Aug / 13 Aug	Obj 1.1	
4	14 Aug / 17 Aug	Obj 1.1	
5	18 Aug / 19 Aug	Obj 1.2	
6	20 Aug / 21 Aug	Obj 1.3	Quiz 1 Due (Obj 1.1-1.2)
7	24 Aug / 25 Aug	Obj 1.4	
8	26 Aug / 27 Aug	Obj 1.5	
9	28 Aug / 31 Aug	Obj 1.6	
10	1 Sep / 2 Sep	Obj 1.7	Quiz 2 Due (Obj 1.3-1.5)
11	3 Sep / 4 Sep	Obj 1.8	
12	8 Sep / 9 Sep	Block 1 Wrap-up	
13	10 Sep / 14 Sep	Project 1 Workday	Project 1 Pt 1 Due 14 Sep 2359
14	15 Sep / 16 Sep	Project 1 Workday	Project 1 Pts 2-3 Due 16 Sep 2359

Block 2: This block introduces you to the frequency domain, filters, analog-to-digital conversion, digital logic, and state machines. You will complete the block with a group project focused on implementing a finite state machine on a microcontroller. For each lesson, read the assigned material and attempt the practice problems ***before*** coming to class.

Block 2 – Signal Processing			
Lesson	**Date (M / T)**	**Topic**	**Due**
15	17 Sep / 21 Sep	Obj 2.1 - Obj 2.2	Quiz 3 (Obj 1.6-1.7) Due 21 Sep 2359
16	22 Sep / 23 Sep	Obj 2.3	
17	24 Sep / 25 Sep	Obj 2.4	
18	28 Sep / 29 Sep	Midterm Review	Quiz 4 Due (Objs 2.1-2.2)
19	30 Sep / 1 Oct	Analog Filters Lab Workday	Turn in lab handout (worth 1 project point); Midterm Due (Objs 1.1-1.7, 2.1-2.3)
20	2 Oct / 5 Oct	Obj 2.5	
21	6 Oct / 7 Oct	Obj 2.6	Quiz 5 Due (Obj 2.3-2.4)
22	8 Oct / 9 Oct	ADC/Arduino Lab Workday	Answer Gradescope questions; worth 1 project point
23	13 Oct / 14 Oct	Obj 2.7	
24	15 Oct / 16 Oct	Obj 2.8	Quiz 6 Due (Objs 2.5-2.6)
25	19 Oct / 20 Oct	Obj 2.8	
26	21 Oct / 22 Oct	Project 2 Workday	
27	23 Oct / 26 Oct	Project 2 Workday	Quiz 7 Due (Objs 2.7-2.8)

Block 3: This block introduces several aspects of communication systems. You will study modulation, antennas, radar, and electronic warfare concepts. You will complete the block with a group project focused on radar design and electronic warfare. For each lesson, read the assigned material and attempt the practice problems ***before*** coming to class.

Block 3 – Communication Systems, Radar, and Electronic Warfare			
Lesson	**Date (M / T)**	**Topic**	**Due**
28	27 Oct / 28 Oct	Obj 3.1	
29	29 Oct / 30 Oct	Obj 3.1	Project 2 Due
30	2 Nov / 3 Nov	Obj 3.2	
31	4 Nov / 5 Nov	Obj 3.3	
32	6 Nov / 9 Nov	Obj 3.4	Quiz 8 Due (Objs 3.1-3.2)
33	10 Nov / 12 Nov	Obj 3.5	
34	13 Nov / 16 Nov	Obj 3.6	
35	17 Nov / 18 Nov	Obj 3.7	Quiz 9 Due (Objs 3.3-3.5)
36	19 Nov / 20 Nov	Obj 3.8	
37	23 Nov / 24 Nov	Obj 3.9	
Thanksgiving break – no classes 25–30 Nov			
38	1 Dec / 2 Dec	Project 3 Workday	Quiz 10 Due (Objs 3.5-3.9); Project 3 open on Gradescope since 27 Nov
39	3 Dec / 4 Dec	Course Review	Project 3 Design Due to Gradescope
40	7 Dec / 8 Dec	Project 3 Discussion	Individual Questions start in class
41	9 Dec / 10 Dec	Final Exam Review	Project 3 Individual Questions Due; finals run 14-17 Dec

1. **Instructor Philosophy**

   As your instructors, we believe learning should be both challenging and rewarding, no matter your academic background. We're here to support your success by fostering an inclusive environment and working alongside you. If you put in the effort and communicate with us, we'll ensure you have the tools and support you need to succeed. If something doesn't feel right, don't hesitate to speak up — we are committed to making this a space where everyone thrives.

2. **Academic Honor**
   Your honor is extremely important. The course's academic security policies are designed to help you succeed in meeting academic requirements while practicing the honorable behavior our country rightfully demands of its military. Do not compromise your integrity by violating academic security or by taking unfair advantage of your classmates.

3. **Extra Instruction**
   EI is one of the best and easiest ways to succeed in this class; EI is recommended and welcomed early and often. Unless communicated otherwise via Teams, we will hold an open EI session every T-day during AW time in the classroom. Individual EI is also available and should be scheduled with the instructor via an Outlook calendar invite. Finally, you can message your instructor via Teams with questions.

4. **Collaboration**
   Collaboration (not copying) is highly encouraged unless your instructor provides direction otherwise. *A highly recommended avenue for collaboration is the Discussions channel on the course Teams site, as this both gives cadets with questions a way to ask everyone for help AND gives cadets opportunities to explain processes and concepts to those with questions, thus further improving understanding and retention of the material.*

   A good litmus test to distinguish between copying and collaboration is as follows: students must be able to explain every step indicated on their submitted work to be considered collaboration and not copying. All help received on work submitted for grading must be documented in accordance with the course documentation policy below.

5. **Absences**

In the event of an absence, communicate with your instructor **beforehand.** Please expect all quizzes, projects, and other submissions to be due as scheduled, regardless of absence type. Should you have extenuating circumstances such as no internet while on approved travel or too ill to complete work while on bedrest, you must communicate an alternate plan with your instructor and ensure that your instructor has approved the alternate plan **before** the deadline for quizzes, projects, or other submissions have occurred. If the original deadline passes and you have not submitted your assignment without an approved extension from your instructor, you will receive a 0 for that submission, and the correction path described under **Quizzes** is not available to you — a 0 earned this way can only be recovered through the retake described in that same section. Note that the midterm and final are one-time examinations with no retake of any kind.

6. **Generative AI**
   This course is generally a GenAI Usage Level 4 (use of GenAI to co-create and/or revise work), as described in the AW GenAI Policy AY 25-26, unless noted otherwise (example: quizzes). We expect you to use GenAI platforms (ChatGPT, etc) as tools rather than to complete assignments for you. It will become clear quickly if you are using GenAI irresponsibly. ChatGPT is not very good at math, and, if you aren't following in class and seeking EI, you should not miraculously have a perfect answer on a quiz. If you utilize GenAI on *any* assignment, include a documentation statement as outlined in the Documentation Policy and AW GenAI Policy.

7. **Documentation**
   In accordance with the Dean's policy for documentation, all ECE assignments must have a documentation statement. The documentation statement should be clearly identified with the word "Documentation." If you did not collaborate, then the statement "Documentation: None," is appropriate. In the instance that you utilize a generative AI platform to assist you on your assignment, your documentation statement should contain the platform you utilized, *how* you used it, and the link to the conversation if available. Example "Documentation: ChatGPT to write a for loop in python. Link here." Assignments without a documentation statement or with an incomplete documentation statement will receive a 0 with retake policies as described in the Grading section.