

# AE 4580 – Introduction to Avionics Integration

## Course Syllabus

Summer Semester 2026

### CLASS SCHEDULE

Lecture: 8am-10am, Monday-Thursday

### INSTRUCTORS

Dr. Jonathan Rogers, Professor, School of Aerospace Engineering  
Office: Montgomery Knight 421B  
Office Hours: Tuesday, Thursday, 11:30am-12:30pm  
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Normally office hours will be held in person. Occasionally office hours will be virtual at the following link:

<https://gatech.zoom.us/j/2499414718?pwd=NXg4VkJnVjVqcWVaM2lqSDhxTVE5Zz09>

### COURSE DESCRIPTION

Avionics are the electronic devices and mechanisms used on an aircraft for the purposes of pilot control, navigation, air traffic management, and autonomy. The first avionics systems were developed in the early 1910s to enable pilots to fly safely in clouds. Avionics systems have progressed rapidly over the decades as computers, sensors, and communications technology has advanced. Today's commercial aircraft are equipped with thousands of small onboard computers – avionics makes up 30% of their cost.

This course will provide an overview of avionics technology for fixed-wing aircraft and helicopters. Avionics may be roughly divided into several categories: aircraft actuators and control devices, vehicle state sensors, navigation systems, human interfaces, autopilots and stability augmentation systems, vehicle management systems, and communications/air traffic management systems. The operating principles behind each of these types of avionics systems will be explained through six course modules and several homework assignments. Upon completing the course, students will be familiar with the various types of avionics technology, the operating principles behind important avionics components, and the certification requirements and methods employed in the industry. Through the course assignments, students will also gain experience designing basic stability augmentation systems and sensor fusion algorithms which form the backbone of avionics systems for modern aircraft. Students will utilize an engineering flight simulator to gain experience integrating and testing their prototype

avionics implementations. Note that the course does not cover spacecraft electronics or drone electronics, but rather is focused on manned or optionally-piloted airplanes and helicopters.

## **PREREQUISITE COURSES**

There are no official prerequisites for the course. However, students who have not completed the following courses may struggle with the course material and will need to do some self-study early in the semester:

AE 3530 System Dynamics and Vibration  
AE 3531 Control System Analysis and Design

It is also extremely helpful if students have already taken AE 4531 (Aircraft Flight Dynamics) or if they are taking it concurrently with this course.

## **COURSE TEXTBOOK**

There is no official textbook for this course. However, a useful textbook on this subject is:

Collinson, R. P. G., Introduction to Avionics Systems, Springer, 3<sup>rd</sup> Edition, 2011, ISBN 978-94-007-0708-5.

Students are not required to purchase this textbook, but they may find it useful as a reference. It is available for free in PDF form from the GT library.

## **COURSE OBJECTIVES**

At the end of this course, students will be able to:

1. Design aircraft stability augmentation systems (SAS) and identify the feedback loop structures for SAS, basic autopilots, and advanced autopilots.
2. Describe the operating principles of important aircraft state sensors such as gyroscopes, accelerometers, magnetometers, airspeed sensors, altimeters, and GPS.
3. Develop basic sensor fusion algorithms such as complementary filters and describe the methodology of sensor fusion used in attitude/heading reference systems (AHRS) and inertial navigation systems (INS).
4. Describe the principles of redundancy and failure survival used in commercial autopilot design.
5. Enumerate the basic requirements of common avionics design standards such as ARINC 429, ARINC 629, and MIL STD 1553.
6. Describe the operation of ADS-B and air traffic radar, as well as common navigation and landing aids such as VOR and ILS.
7. Explain the purpose and operating principles of standard cockpit gauges and flight displays, and the human factors design processes used in cockpit layout.
8. Describe the operation of modern pilot interface devices including head-up displays and active control inceptors.

## GRADING

Grades will be determined based on demonstrated proficiency on homework sets and a final project. The points associated with each graded event are shown below along with the associated letter grade. Note that this course is not graded on a curve. **The instructor reserves the right to increase or decrease the number of assignments and adjust the point totals below accordingly as the semester progresses.**

Point Breakout:

|                   |                     |
|-------------------|---------------------|
| Homework Sets (4) | = 450 points        |
| Final Exam        | = 250 points        |
| <hr/>             |                     |
| <b>Total</b>      | <b>= 700 points</b> |

Class participation: +, 0, -

Grading Scale:

|             |              |
|-------------|--------------|
| A = 630-700 | Total Points |
| B = 560-630 | Total Points |
| C = 490-530 | Total Points |
| D = 420-490 | Total Points |
| F = 0-419   | Total Points |

Occasionally, students will be offered the opportunity to obtain extra credit points. These points are added to the student's total while the total points for the course remains at 700.

In borderline cases, the class participation score will be used to influence the final grade.

## HOMEWORK SETS

Several homework sets will be issued during the semester. These problem sets are intended to deepen understanding of the material. Unless stated otherwise, homework sets are to be submitted before class begins on the due date. **Students are permitted to turn in 1 homework set up to 3 days late with no justification necessary. Otherwise, homework sets will not be accepted late.**

In this course, because of the nature of the assignments, **all homework submissions must be typed** with clear plots embedded in the submitted PDF document.

Homework should be submitted online. Draw a box around the final answer, and include proper units.

**A sufficient amount of work must be shown for each problem on the homework.** If sufficient work is not shown, points will be taken off.

### **ADDITIONAL INSTRUCTION**

Supplemental instruction by the instructor or grader is a valuable resource available to any student having difficulty with a particular concept in the course. Get help when you have a problem! Be prepared to ask specific questions about concepts that are confusing or unclear. **Students are highly encouraged to attend office hours or make an appointment with the instructor or grader via email.**

### **OTHER CLASS POLICIES**

**Attendance: Class attendance is required.** In previous classes there has been a strong correlation between students who received good grades and students who attended class regularly.

**Cell Phones and Electronic Devices:** Cell phones and computers *should not be out during class.*

Students with disabilities will receive necessary accommodations. For details, please refer to the GT Disabilities Services' "Policies and Procedures" page located at this link: <http://disabilityservices.gatech.edu/content/15/policies-procedures>.

### **ACADEMIC DISHONESTY**

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review Georgia Tech's [Honor Code](#) and the student [Code of Conduct](#).

Any student suspected of cheating or plagiarism on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

### **AI POLICY**

Generative AI-based assistance, such as, but not limited to ChatGPT and Copilot, is comparable to collaboration with other people – for an individual assignment the use of generative AI is a violation of the Honor Code.

This course is designed to teach you how to do technical writing, coding, and analysis, so all work you submit must be your own. You should never include in your assignment anything that was not written directly by you without proper citation (including quotation marks and in-line citation for direct quotes). This includes code written by AI that was used to generate results for an assignment, or using AI to assist in the writing of code.

Inclusion of anything you did not write in your assignments (prose or code) without proper citation will be treated as an academic misconduct case. If you are unsure if you have gone too far consider these two simple guidelines: (1) avoid hitting “copy” in a conversation with an AI assistant; (2) do not have both your assignment and the AI agent open at the same time. Avoid using tools that directly add content to your submission. Use of spell and grammar checkers are acceptable (and encouraged) for all assignments.

You MUST adhere to Georgia Tech’s rules regarding the use of AI in courses. Here is the link to the current policy:

<https://oit.gatech.edu/ai/guidance>

## **ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES**

If you are a student with learning needs that require special accommodation, contact the [Office of Disability Services](#) (404-894-2563) as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

## **STUDENT FACULTY EXPECTATIONS AGREEMENT**

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The [Student-Faculty Expectations](#) articulate some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.