Recent Announcements

Welcome to SPCE5025 - Fundamentals of Astronautics

(https://canvas.uccs.edu/courses/174054/discussion_topics/794907)

Welcome to SPCE5025 - Fundamentals of Astronautics. Live, on-line classes begin on Tuesday, 20 January 2026 at 7:00 pm Mountain Time, and will occur every Tuesday at 7:00 pm Mountain Time. If you cannot attend in person, all on-line sessions are recorded and made available for later reference. Note: Some lectures may be rescheduled due to instructor conflicts. Class 2 will be on MONDAY, 26 January at 7:00 pm Mountain Time. On-line "Office Hours" sessions are on Thursdays at 7:00 pm Mountain Time. Course Aims – The emphasis of this course is on giving you some familiarity with topics that are common and widespread within the Space Operations discipline, including orbital mechanics, coordinate transformations and pointing, satellite observations, and a variety of supporting computations. Purely optional: So that I can better present the subject matter, I find it helpful to get an idea of your technical and work background. If you wish to provide brief background description of (a few sentences at most), please feel free to do so.The course syllabus and class presentations are available on Canvas, in the Modules area. Materials for a given week will always be available well before the scheduled session, as will the homework solutions. Microsoft Teams – All on-line sessions will use Microsoft Teams. I have included each of you on the Teams invitation for both lectures and office hours (two separate invites); please let me know if you have not received a notification, and I will ensure that you're on the invitation list. I will open the meeting prior to each class session, and you will automatically be provided an e-mail link to the conference. Fair warning: This is a computation-intensive course, and you will be writing programs. You will want access to a programming language, or a computational environment such as MATLAB. You may program in any language you wish. UCCS offers free student access to MATLAB. For details, go to https://kb.uccs.edu/display/KB/MATLAB+Installation+Guide Many languages and development environments may be downloaded for free from the internet, including Python, Java, Visual Studio (including C, C++, C#), Java, and others. I look forward to working with you during this semester!

Posted on:

Jan 4, 2026, 2:27 PM

Fundamentals of Astronautics - 2026Sp SPCE 5025 OL1

SPCE5025 – Fundamentals of Astronautics

Spring 2026

Instructor: Edward Brown

Course Description: Introduces the fundamental principles of astrodynamics applied to satellite motion. Includes orbital mechanics, coordinate systems, two-body problems, orbit determination, and orbital maneuvers.

Prerequisite: SPCE 5005 – Engineering Analysis for Space Applications

Week	***Class Date***	***Topic***
1	20 Jan 26 Tue	The Two-Body Problem, Kepler's Equation (§1.3, 2.2)
2	**26 Jan 26 Mon**	Kepler's problem (§2.3), Applications of the Two-Body Problem
3	03 Feb 26 Tue	Orbit State Representations (§2.4), Vectors, Coordinate Systems and Coordinate Transformations (Ch. 3)
4	10 Feb 26 Tue	**Exam Week – due 14 Feb 25**

Week	*Class Date*	*Topic*
5	17 Feb 26 Tue	Numerical Integration Techniques (§8.5) Runge-Kutta methods, Multi-step concepts
6	24 Feb 26 Tue	Sun and Moon, Time Systems Computing sun and moon: low-precision and high-precision methods
7	03 Mar 26 Tue	Perturbations (§8.6) Gravity, drag, 3rd-body, solar pressure, outgassing/thruster firings, higher-order effects
8	10 Mar 26 Tue	**Exam Week – due 14 Mar 25**
9	17 Mar 26 Tue	Observing satellites (Ch. 4) Range, azimuth, elevation
10	24 Mar 26 Tue	**SPRING BREAK (UCCS spring break is 23 March – 27 March)**
11	31 Mar 26 Tue	Orbit Estimation (Ch. 10) Initial Orbit Determination, Least squares concepts, Applications to Orbit Determination, Kalman filters
12	07 Apr 26 Tue	**Exam Week – due 11 Apr 25**

Week	*Class Date*	*Topic*
13	14 Apr 26 Tue	Orbital Mechanic's Toolbox (1) Relative Motion, vector comparison, ephemeris comparison, using ephemerides, interpolation techniques, ephemeris searches, orbit period, drift rates, ground track computation,
14	21 Apr 26 Tue	Orbital Mechanic's Toolbox (2) Satellite attitude concepts, orbit angles, sun lighting, "seeding the search", RFI, close approach, selecting the right coordinate system, orbit angles, directions and pointing
15	28 Apr 26 Tue	Orbital Maneuvers (Ch. 6) Targeting concepts, first approximations, propulsion models, precise targeting
16	05 May 26 Tue	Mission Orbits, Mission Analysis (Ch. 11),
17	12 May 26 Tue	**Final Exam Week – due 16 May 25**
18	16 May 26 Sat	SEMESTER END

- Section references correspond to Vallado text (5th Edition)
- Unless otherwise noted, dates correspond to Tuesday of each week (class lecture night)

Course Texts

Fundamentals of Astrodynamics and Applications, David A. Vallado, Fifth Edition, 2022.

If you can't get it through the bookstore, try: **https://astrobooks.com/vallado5hb.aspx (https://astrobooks.com/vallado5hb.aspx)**

Fundamentals of Astrodynamics, Roger R. Bate, Donald D. Mueller, Jerry E. White, 1971

Other materials and sources will be provided as appropriate.

Course Aims

Many concepts and computational methods are common across nearly all space missions. This class introduces the student to various concepts that comprise "astronautics", and provides experience with the methods, providing insight to their actual use in the context of satellite mission operations. The homework assignments in this course are designed for the student to create solutions to common astronautical problems. Detailed answer keys are posted along with each assignment. The instructor also offers weekly "Office Hours" sessions to discuss class contents and homework. Completion of homework assignments will enable the student to build a "toolkit" of basic functions that can be used for later work.

Computational Capabilities Required

Applied astrodynamics is a computationally intensive subject and the course work for this class emphasizes computer-based solutions. Access to a computational environment such as MATLAB, or a programming language (e.g., Python, C++, or even Excel with Visual Basic), is strongly encouraged. You may use whatever language is most familiar to you.

UCCS provides student access to MATLAB, and MATLAB solutions will be provided for each homework assignment. MATLAB access from UCCS is available here:

- **Matlab - Help Desk Knowledge Base - University of Colorado Colorado Springs (https://kb.uccs.edu/display/KB/Matlab)** .

Many programming languages and development environments are available for free. For example,

- Python: **https://www.python.org/downloads/ (https://www.python.org/downloads/)** and **https://www.spyder-ide.org/ (https://www.spyder-ide.org/)**
- Visual Studio Community: **https://visualstudio.microsoft.com/vs/community/ (https://visualstudio.microsoft.com/vs/community/)**

Course Lectures

Weekly on-line lecture sessions will be conducted **each Tuesday at 7:00 pm, Mountain Time**. During exam weeks these sessions will be Q&A sessions. Lecture sessions are approximately 2 hours.

> *Note*: It may be necessary to reschedule some lecture sessions due to instructor conflicts.

“Office hours” sessions will be conducted each Thursday at 7:00 pm, Mountain Time. These unstructured sessions cover student questions and include MATLAB tutorials as necessary. Additional sessions for individuals or groups can be scheduled as necessary.

Lectures and office hours sessions will use UCCS Microsoft Teams. Students will receive invitations from Teams. **All sessions will be recorded and made available for later access.**

Equipment Required

This class uses an on-line, interactive package that includes desktop sharing, voice, and instant messaging capability. Students will need:

- A computer with internet access
- Sound and voice capability (e.g., headset with microphone)

Course Grading

Homework: 20%

Exams (Take Home): 40%

Final Exam (Take Home): 40%

Course Policies

Coursework Submission: Please submit to instructor via email: **ebrown3@uccs.edu (mailto:ebrown3@uccs.edu)**

Homework – All homework assignments will be provided as part of the presentation materials for each lecture. Homework is DUE at 11:59 pm on the Saturday following the lecture in which it is assigned. Homework should be submitted via e-mail, in PDF, MS Word, or Excel format.

Individual work only: no “team” submissions.

Students are allowed **PARTIAL COLLABORATION** on homework assignments. You may discuss ***qualitatively*** with other students the concepts required to solve homework problems. However, copying or in any way using the written work of another person as well as relaying or receiving solutions via any means is strictly prohibited. The intent of this policy is to allow you to share ideas, discuss concepts, and clarify processes when needed.

Students are required to write their own code. Course materials include instructor-provided MATLAB solutions, which can be used for reference but *must not be copied*.

Exams – The exams will be made available prior to the exam week, and will be due at 11:59 pm on the Saturday of the exam week. The instructor will be available to answer questions on the exams. Late submissions will result in a 10% per day reduction of grade, *unless you have made previous arrangements with the instructor*.

All Exams are to be **INDIVIDUAL EFFORT** and **NO COLLABORATION** is acceptable. You are authorized the use of the course textbooks, course notes, and any other materials readily found in a typical University library that you might find useful. Sources other than from the text or class materials may be used, but must be properly referenced.

There will be no lectures during exam weeks, but Q&A sessions will be offered.

Instructor Availability

E-mail inquiries are preferred for more detailed discussions.

EMAIL: **ebrown3@uccs.edu (mailto:ebrown3@uccs.edu)**