

AE 142 – Astrodynamics

Instructor Info	Prof. Jeanine Hunter
Office Hours	TBA
Email:	Jeanine.hunter@sjsu.edu
Credit	3 units
Class Days / Time	TBA
Final Exam	TBA
Classroom	TBA
Prerequisites	“C-” or better in AE 138 & AE 165
Text	Hunter: Astrodynamics Course Reader (Maple Press)
References	Curtis: Orbital Mechanics for Engineering Students Anderson: Introduction to Flight Szebehely: <i>Adventures in Celestial Mechanics</i> Sellers: <i>Understanding Space</i> Thomson: <i>Introduction to Space Dynamics</i> Bate, Mueller & White: <i>Fundamentals of Astrodynamics</i>
Course Website	< https://sjsu.instructure.com > Under the courses tab, select this course.

Course Description

Two-body problem analysis and orbit design; Kepler’s Laws; Keplerian elements; Single-impulse orbit transfers; Hohmann transfers; Circularization; Plane changes; Kepler’s Equation; Planetary sphere of influence; Vector mechanics and relative motion of interplanetary flight; Patched conic trajectory model; Gravity-assist trajectories; Case studies; Introduction to the restricted three-body problem.

Course Goals

1. Provide a fundamental knowledge of orbital mechanics.
2. Understand the assumptions of the various astrodynamics models.
3. Apply the equations of three-dimensional particle dynamics to orbits & trajectories.
4. Use vector mechanics to model interplanetary flight.
5. Examine case studies and develop an understanding of optimal orbit design strategies.
6. Model the Earth/Moon/spacecraft system using the assumptions of the restricted three-body problem.

Student Learning Objectives

1. Derive two-body problem equations of motion.
2. Model two-body orbit as a conic section.
3. Solve for velocity variation as a function of position along orbit.

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4. Define elliptical orbit from burnout conditions.
5. Orbit determination from two observations.
6. Calculate circular velocity and escape velocity as a function of altitude.
7. Derive and understand the significance of Kepler's Laws of Planetary Motion.
8. Calculate Earth-centered Newtonian position and velocity from Keplerian elements.
9. Find time along the orbit (time since periapsis passage) using Kepler's equation.
10. Calculate velocity along a hyperbolic orbit, turn angle, aiming radius, hyperbolic excess speed, etc.
11. Model orbits from case studies and discuss the tradeoffs made in the design decisions.
12. Design single impulse Δv burns for orbit transfers.
13. Calculate total Δv for a Hohmann transfer around a single central force body.
14. Optimize the circularization maneuver.
15. Find wait time and phasing angle for a rendezvous scenario.
16. Design an impulse burn to pivot the orbital plane and calculate the required Δv .
17. Compute the sphere of influence of a given central force body.
18. Using appropriate reference frames and knowledge of relative motion, design patched conic trajectories for interplanetary travel.
19. Design & analyze planetary flyby opportunities for changing heliocentric orbital energy.
20. Derive equations of motion for the restricted three body problem and solve simple cases.

Grading

Homework	15%
Project & Presentation	25%
Two Hour Exams	40%
Final Exam	20%

Grading Scale: 100 – 97% A+; 96.9 – 93% A; 92.9 – 90% A-; 89.9 – 87% B+; 86.9 – 83% B; 82.9 – 80% B-; 79.9 – 77% C+; 76.9 – 73% C; 72.9 – 70% C-; 69.9 – 67% D+; 66.9 – 63% D; 62.9 – 60% D-; < 59.9% F. All exams must be taken to receive a passing grade.

For issues related to Canvas, please contact the eCampus Help Desk. The Help Desk can give technical support for issues encountered in Canvas Courses. Phone: (408) 924-2337 Submit a help ticket using the following URL: <https://isupport.sjsu.edu/ecampus/ContentPages/Incident.aspx>. While logged into Canvas, click on the word **Help** on the upper right corner of the screen.

POLICIES**AE Program Policies****Faculty Web Page and MYSJSU Messaging**

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on the instructor's web page. You are responsible for regularly checking with the messaging system through MySJSU (or other communication system as indicated by the instructor) to learn of any updates.

Attendance

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Attendance will not be taken during class but will be taken during lab. If you miss a class you are still responsible for any material discussed or assignments given. A large portion of each class will be used for problem solving in small groups. All students are expected to participate in class discussions and problem solving. Students who are often absent will find themselves at a disadvantage during the tests. If you miss a lab session, you will get zero score on this lab.

Teamwork

- You are required to work in teams for a number of assignments. Please make yourself available to meet and work with your teammates outside of class.
- Instructor will normally form all the teams.
- At the end of each project or team assignment, each team must submit along with their report each member's [peer evaluation](#) of the other members in a separate, sealed envelope. All peer evaluation forms must be included in the team report. If you disagree with the scores you receive from your peers, you may provide an explanation to your instructor in writing and request an individual exam on the assignment. To get full credit on a team assignment, your teammates must give you at least 85% in all areas of peer review (see [team member report card](#)). Otherwise, your score for this assignment will be your team's score multiplied by the average peer review score.
- If your name appears on a team paper, you are expected to be able to explain whatever answer / solution / derivation is on the paper. Failure to explain the team's answer by any individual is considered a violation of academic integrity (see University Policies below) and will result in a grade of zero for the team.

University Policies**Academic Success**

Success in this course is based on the expectation that students will spend, for each unit of credit, **a minimum of** forty-five hours over the length of the course (normally 3 hours per unit per week with 1 of the hours used for lecture) for instruction or preparation/studying or course related activities including but not limited to internships, labs, clinical practica. Other course structures will have equivalent workload expectations as described in the syllabus.

Dropping and Adding

Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, etc. Refer to the current semester's [Catalog Policies](http://info.sjsu.edu/static/catalog/policies.html) section at <http://info.sjsu.edu/static/catalog/policies.html>. Add/drop deadlines can be found on the current academic year calendars document on the [Academic Calendars webpage](http://www.sjsu.edu/provost/services/academic_calendars/) at http://www.sjsu.edu/provost/services/academic_calendars/. The [Late Drop Policy](http://www.sjsu.edu/aars/policies/latedrops/policy/) is available at <http://www.sjsu.edu/aars/policies/latedrops/policy/>. Students should be aware of the current deadlines and penalties for dropping classes. Information about the latest changes and news is available at the [Advising Hub](http://www.sjsu.edu/advising/) at <http://www.sjsu.edu/advising/>.

Consent for Recording of Class and Public Sharing of Instructor Material

[University Policy S12-7](http://www.sjsu.edu/senate/docs/S12-7.pdf), <http://www.sjsu.edu/senate/docs/S12-7.pdf>, requires students to obtain instructor's permission to record the course. □

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- Common courtesy and professional behavior dictate that you notify someone when you are recording him/her. You must obtain the instructor's permission to make audio or video recordings in this class. Such permission allows the recordings to be used for your private, study purposes only. The recordings are the intellectual property of the instructor; you have not been given any rights to reproduce or distribute the material.”
- In classes where active participation of students or guests may be on the recording, permission of those students or guests should be obtained as well.
- Course material developed by the instructor is the intellectual property of the instructor and cannot be shared publicly without his/her approval. You may not publicly share or upload instructor generated material for this course such as exam questions, lecture notes, or homework solutions without written instructor consent.

Academic integrity

- Your commitment as a student to learning is evidenced by your enrollment at San Jose State University. The [University Academic Integrity Policy S07-2](http://www.sjsu.edu/senate/docs/S07-2.pdf) at <http://www.sjsu.edu/senate/docs/S07-2.pdf> requires you to be honest in all your academic course work.
- Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development.
- The [Student Conduct and Ethical Development website](http://www.sjsu.edu/studentconduct/) is available at <http://www.sjsu.edu/studentconduct/>.
- Instances of academic dishonesty will not be tolerated. Cheating on exams or plagiarism (presenting the work of another as your own, or the use of another person's ideas without giving proper credit) will result in a failing grade and sanctions by the University. Assignments are to be completed by the individual student unless otherwise specified. If your name appears on a team paper, you are expected to be able to explain whatever answer / solution / derivation is on the paper. Failure to explain the team's answer by any individual will result in a grade of zero for the team.
- If you would like to include your assignment or any material you have submitted, or plan to submit for another class, please note that SJSU's Academic Integrity Policy S07-2 requires approval of instructors.
- For help with paraphrasing and referencing please see the [SJSU Library Tutorial on Plagiarism](http://www.indiana.edu/~wts/pamphlets/plagiarism.shtml). The following websites also show you how to paraphrase properly and avoid plagiarism:
<http://www.indiana.edu/~wts/pamphlets/plagiarism.shtml> <http://owl.english.purdue.edu/handouts/research/index.html>

Campus Policy in Compliance with the American Disabilities Act

If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Presidential Directive 97-03 requires that students with disabilities requesting accommodations must register with the [Accessible Education Center](http://www.sjsu.edu/aec) (AEC) at <http://www.sjsu.edu/aec> to establish a record of their disability.

Student Technology Resources

Computer labs for student use are available in the [Academic Success Center](http://www.sjsu.edu/at/asc/) at <http://www.sjsu.edu/at/asc/> located on the 1st floor of Clark Hall and in the Associated Students Lab on the 2nd floor of the Student Union. Additional computer labs may be available in your department/college. Computers are also available in the Martin Luther King Library. A wide variety of audio-visual equipment is available for student checkout from

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Media Services located in IRC 112. These items include DV and HD digital camcorders; digital still cameras; video, slide and overhead projectors; DVD, CD, and audiotape players; sound systems, wireless microphones, projection screens and monitors.

SJSU Peer Connections

Peer Connections, a campus-wide resource for mentoring and tutoring, strives to inspire students to develop their potential as independent learners while they learn to successfully navigate through their university experience. You are encouraged to take advantage of their services which include course-content based tutoring, enhanced study and time management skills, more effective critical thinking strategies, decision making and problem-solving abilities, and campus resource referrals. □ □ In addition to offering small group, individual, and drop-in tutoring for a number of undergraduate courses, consultation with mentors is available on a drop-in or by appointment basis. Workshops are offered on a wide variety of topics including preparing for the Writing Skills Test (WST), improving your learning and memory, alleviating procrastination, surviving your first semester at SJSU, and other related topics. A computer lab and study space are also available for student use in Room 600 of Student Services Center (SSC). □ □ Peer Connections is located in three locations: SSC, Room 600 (10th Street Garage on the corner of 10th and San Fernando Street), at the 1st floor entrance of Clark Hall, and in the Living Learning Center (LLC) in Campus Village Housing Building B. Visit [Peer Connections website](http://peerconnections.sjsu.edu) at <http://peerconnections.sjsu.edu> for more information.

SJSU Writing Center

The SJSU Writing Center is located in Clark Hall, Suite 126. All Writing Specialists have gone through a rigorous hiring process, and they are well trained to assist all students at all levels within all disciplines to become better writers. In addition to one-on-one tutoring services, the Writing Center also offers workshops every semester on a variety of writing topics. To make an appointment or to refer to the numerous online resources offered through the Writing Center, visit the [Writing Center website](http://www.sjsu.edu/writingcenter) at <http://www.sjsu.edu/writingcenter>. For additional resources and updated information, follow the Writing Center on Twitter and become a fan of the SJSU Writing Center on Facebook. (Note: You need to have a QR Reader to scan this code.) □

SJSU Counseling Services

The SJSU Counseling Services is located on the corner of 7th Street and San Fernando Street, in Room 201, Administration Building. Professional psychologists, social workers, and counselors are available to provide consultations on issues of student mental health, campus climate or psychological and academic issues on an individual, couple, or group basis. To schedule an appointment or learn more information, visit [Counseling Services website](#)

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Lecture	Topic
1	Course Introduction
2&3	The Two-Body Problem
4	Conic Section Solution to the Equations of Motion
5&6	Orbit Energy
7	Relationship of Orbit Energy to Orbit Type
8&9	Escape Velocity, Circular Velocity
10	Orbit Determination from Observations
11	History of Celestial Mechanics
12&13	Kepler's Laws of Planetary Motion
14&15	The Six Keplerian Elements
16	Hohmann Transfer, Single Central Force Body
17	Rendezvous and Phasing
18&19	Interplanetary Flight Strategies & Case Studies
20&21	Sphere of Influence; Patched Conic Trajectory Approximation
22&23	Gravity-Assist (Flyby) Trajectory
24 – 27	The Restricted Three-Body Problem
28	Final Exam Review