San José State University
Aerospace Engineering Department
AE 243, Advanced Astrodynamics, Spring 2019

Course and Contact Information

Instructor:	Dr. Lucía Capdevila
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Office Hours:	Mondays: 11:00 – 12:00, 13:30 – 15:30, Wednesdays 11:00 – 12:00 and 14:00-15:00
Class Days/Time:	Mondays and Wednesdays 18:00 – 19:15
Classroom:	Sweeney Hall 435
Prerequisites:	BSc degree in Aerospace Engineering

Faculty Web Page and Messaging

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on Canvas Learning Management System course login website at http://sjsu.instructure.com. You are responsible for regularly checking the email address listed in your MySJSU at http://my.sjsu.edu profile and the Canvas Inbox to learn of any updates.

Course Description

Analysis of spacecraft motion using different dynamic models and perturbations. Use of the state transition matrix and differential corrections technique for trajectory computation. Introduction to the three-body problem. Application of computational and analytic methods to solve astrodynamics problems.

Course Goals

1. Model satellite dynamics in multi-gravity fields
2. Calculate various types of solutions for satellite motion under the influence of multi-gravity fields
3. Analyze stability of satellite motion
4. Construct numerical tools for trajectory design in multi-gravity fields
5. Become familiar with astrodynamics literature

Course Learning Outcomes (CLO)

Upon successful completion of this course, students will be able to:

1. Derive and simulate the Circular Restricted Three-Body Problem (CR3BP) equations of motion
2. Calculate CR3BP Jacobi constant
3. Calculate CR3BP zero-velocity curves

4. Calculate equilibrium solutions or libration points in the CR3BP
5. Linearize CR3BP motion about the collinear and equilateral libration points
6. Calculate a periodic orbit about a libration point in the CR3BP
7. Calculate the State Transition Matrix (STM) associated with motion in the CR3BP
8. Calculate the monodromy matrix associated with periodic motion in the CR3BP
9. Determine the stability of a periodic orbit in the CR3BP using the STM
10. Calculate the manifold associated with a periodic orbit in the CR3BP
11. Calculate a Poincaré map of flow in the CR3BP
12. Demonstrate ability to understand and reproduce work published in astrodynamics journals

Required Texts/Readings

Textbook

None

Other Readings

- Notes and handouts
- References:
    1. Szebehely, V. (1967). *Theory of orbits, the restricted problem of three bodies.* New York: Academic Press. This book will be available at the MLK
    2. Roy, A. (1982). *Orbital motion* (2nd ed.). Bristol: A. Hilger.
    3. Parker, T., & Chua, L. (1989). *Practical numerical algorithms for chaotic systems*. Berlin ; New York: Springer Verlag.
    4. Maruskin, J. (2018). *Dynamical systems and geometric mechanics: An introduction* (De Gruyter studies in mathematical physics ; volume 48). Berlin/Boston: De Gruyter.

Availability: References listed are available through the SJSU Dr. Martin Luther King Jr. Library. Szebehely (1967) and Parker & Chua (1989) are available as a Course Reserve at the library, and Maruskin (2018) is available to borrow online through the library. Roy (1982) may be available through CSU Inter Library Loan. All of the references listed above are also available for purchase online.

Other technology requirements / equipment / material

Access to a computer and the ability to write and execute code for calculations and simulations.

Course Requirements and Assignments

Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally three hours per unit per week) for instruction, preparation/studying, or course related activities, including but not limited to internships, labs, and clinical practica. Other course structures will have equivalent workload expectations as described in the syllabus.

Final Examination or Evaluation

The culminating activity for this class will be an individual final project. Details will be provided during class.

Grading Information

Determination of Grades

- Grade Scale:
  100 to 97% A+; 96.9 to 93% A; 92.9 to 90% A-; 89.9 to 87% B+; 86.9 to 83% B; 82.9 to 80% B-; 79.9 to 77% C+; 76.9 to 73% C; 72.9 to 70% C-; 69.9 to 67% D+; 66.9 to 63% D; 62.9 to 60% D-; less than 59.9% F
- Grade Components and Distribution:
  - Homework assignments: 70 %
  - Project: 30 %
- All assignments will be submitted via *Canvas Learning Management System course login website at http://sjsu.instructure.com* by the due date posted on Canvas.
- Late work is not accepted for credit without a valid justification and proper documentation.
- Extra credit opportunities will be announced in class.
- Project details will be provided during class.

Classroom Protocol

It is expected that everyone will treat each other and themselves with the highest respect at all times. We all benefit from each other's contributions to the class, so everyone's timely attendance and participation are also expected.

University Policies (Required)

Each student is responsible for reviewing the information listed at the

- Office of Graduate and Undergraduate Program's Syllabus Information Page at http://www.sjsu.edu/gup/syllabusinfo/
- AE Program Policies Page at http://www.sjsu.edu/ae/programs/policies/

and let the instructor know if you have any questions.

AE 243 / Advanced Astrodynamics, Spring 2019, Course Schedule

The following is an approximate course schedule that is subject to change with fair notice given during class and/or via email and/or Canvas messaging.

Course Schedule

Date	Topics
01/28/19	CR3BP eoms and Jacobi integral
01/30/19	CR3BP eoms and Jacobi integral
02/04/19	Libration points
02/06/19	Regions of motion (ZVCs)
02/11/19	Linearized motion about Li
02/13/19	Linearized motion about Li
02/18/19	Linearized motion about Li
02/20/19	Linearized motion about Li
02/25/19	Project Proposal Presentations
02/27/19	Project Proposal Presentations
03/04/19	Differential Corrections and STM
03/06/19	Differential Corrections and STM
03/11/19	Differential Corrections and STM
03/13/19	Differential Corrections and STM
03/18/19	Periodic Orbits
03/20/19	Periodic Orbits
03/25/19	Project Progress Presentations
03/27/19	Project Progress Presentations
04/01/19	No instruction (SJSU Spring Break)
04/03/19	No instruction (SJSU Spring Break)
04/08/19	Stability of Periodic Orbits
04/10/19	Stability of Periodic Orbits
04/15/19	Manifolds
04/17/19	Manifolds
04/22/19	Maps

Date	Topics
04/24/19	Maps
04/29/19	In-class work-time and Q&A
05/01/19	In-class work-time and Q&A
05/06/19	In-class work-time and Q&A
05/08/19	Final Project Presentations
05/13/19	Final Project Presentations
5/15/2019	Final Exam *slot* 17:15 – 19:30 in classroom (as listed on the Final Exam Schedule - Spring 2019) – **No final exam administered for this class**