San José State University
Aerospace Engineering Department
AE138: Vector-Based Dynamics for Aerospace Applications
Fall 2022

Instructor:	**Prof. J.M. Hunter**
Office Location:	**Link for office hours: https://sjsu.zoom.us/j/96580183367**
Email:	**jeanine.hunter@sjsu.edu**
Office Hours:	**MW 12:00 – 1:00pm**
Class Days/Time:	**MW 9:00 – 10:15am and MW 1:30 – 2:45pm**
Prerequisite:	**Grade of C or better in Math 32 and Physics 50**
Co-requisite:	**AE 112**

Course Format

Class Website: https://sjsu.instructure.com **Under the courses tab, select this course.**

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.

Course Description

Vector mechanics of aerospace vehicle center of mass (three degree-of-freedom particle motion). Particle kinematics, reference frames and rotational relative motion. Two degree-of-freedom aerospace vehicle (rigid body) motion, moments/products of inertia. Equations of motion and numerical time histories of the vehicle's center of mass & rigid body motions (attitude dynamics).

Course Goals

1. **To provide a fundamental knowledge of vector dynamics for aerospace applications.**
2. **To establish the basics of reference frame mechanics and relative motion.**
3. **To provide the fundamentals of aerospace vehicle center of mass (particle) kinematics of using Newtonian methods.**

Course Learning Outcomes

1. **Combine and solve for vectors using the operations of vector algebra.**
2. **Find area using vector algebra.**
3. **Set up aerospace-vehicle-fixed basis vectors and use them to express and solve for cm (particle) position.**
4. **Set up a direction cosine matrix relating the planar orientation of two reference frames.**
5. **Express and resolve vectors (position, velocity, acceleration) into reference frames related by direction cosine matrices.**
6. **Differentiate scalars representing vehicle states; differentiate vectors in arbitrary reference frames.**
7. **Express vehicle angular velocity/acceleration and relate these concepts to the dire** [redacted]

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Required Text

Mitiguy: Dynamics of Mechanical, Aerospace and Biomechanical Systems, MotionGenesis, Inc.

References

Greenwood: Principles of Dynamics
Kane: Dynamics
Hunter: AE140 Course Reader
Thomson: Introduction to Space Dynamics
Anderson: Introduction to Flight

Course Requirements and Assignments

Homework	**10%**
Quizzes	**30%**
Daily Problem Team Participation	**10%**
Daily Problems	**10%**
Project	**25%**
Oral Final Exam	**15%**

Reading assignments will be posted for most classes and should be completed before coming to class. Homework problems will be assigned every week or two. These homework sets are essential to your understanding. Allow 8 – 10 hours per week for homework. Often we will work problems in groups during the class period, sometimes for credit, sometimes not. As homework is graded and returned to you, I will post the solutions on Canvas and work selected problems on the board. If there is a particular problem that you would like to see worked out, please let me know and I will be sure to make time to do this.

Determination of Grades

**Grading Scale: 100 – 97% A plus;   96.9 – 93% A;   92.9 – 90% A minus;   89.9 – 87% B plus;
86.9 – 83% B;   82.9 – 80% B minus;   79.9 – 77% C plus;   76.9 – 73% C;   72.9 – 70% C minus;
69.9 – 67% D plus; 66.9 – 63% D;   62.9 – 60% D minus;   < 59.9% F.**

Late Homework Policy: Homework is due at the beginning of class, either on Canvas or as a paper submission (as specified). Late homework will be accepted for 70% credit on Canvas until 11:59pm on the due date.

Course Schedule

Lecture	Lecture Outline
1	Class Overview
2	Vector dynamics review
3	Vector basis
4	Position vectors and vector geometry
5&6	Direction cosine matrices
7&8	Vector differentiation and integration
9&10	Angular velocity & angular acceleration
11&12	Particle equations of motion; Newton’s second law
13&14	Constraints
15	Linearized second order systems; Introduction to vibrations
16	Forced motion; Resonance
17	Mass, center of mass, centroid
18&19	Moments / Products of inertia
20&21	Inertia dyadic; dyadic algebra
22&23	Rigid bodies, force and momentum
24 - 26	Moments and torque; Angular momentum principle
27&28	2D Rigid body equations of motion
29	Final exam review

University Policies

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 section at http://info.sjsu.edu/static/catalog/policies.html. Add/drop deadlines can be found on the current academic calendar web page located at http://www.sjsu.edu/academic_programs/calendars/academic_calendar/. The Late Drop 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 at http://www.sjsu.edu/advising/.

Academic Integrity Your commitment as a student to learning is evidenced by your enrollment at San Jose State University. The University’s Academic Integrity policy, located at http://www.sjsu.edu/senate/S07-2.htm, 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 is available at http://www.sa.sjsu.edu/judicial_affairs/index.html.

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 for the course and sanctions by the University. For this class, all assignments are to be completed by the individual student unless otherwise specified. 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 Policy S07-2 requires approval of instructors.

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 [Disability Resource Center](http://www.drc.sjsu.edu/) (DRC) at http://www.drc.sjsu.edu/ to establish a record of their disability.

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