San José State University
Aerospace Engineering
AE140 Rigid Body Dynamics

Instructor:	Prof. J. M. Hunter
Office Location:	E272F
Email:	jeanine.hunter@sjsu.edu
Office Hours:	TBA
Class Days/Time:	TBA
Classroom:	E164
Prerequisites:	"C-" or better in AE138
Course Website:	https://sjsu.instructure.com Under the courses tab, select this course.

Course Description

Co-ordinate frames and descriptions of absolute and relative motion. Particle motion with respect to the rotating Earth. General equations of rotation motion in Newtonian and Lagrangian formulations. Spinning bod motions. Gyroscopic instruments. Stable platform for inertial guidance. Applications to aerospace vehicles.

Course Goals

1. To provide the fundamentals of intermediate dynamics of rigid bodies using Newtonian, Lagrangian and Eulerian dynamics.
2. To provide a review of point-mass dynamics.
3. To show the different approaches available in analyzing an equation of motion.
4. To demonstrate the connection between modeling, simulation, numerical solution.

Course Learning Outcomes (CLO)

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

1. Develop a direction-cosine matrix and use it to transform vectors among reference frames.
2. Different a vector in multiple reference frames.
3. Choose the appropriate reference frames for writing equations of motion.
4. Derive point-mass equations of motion using Newton's or Lagrange's method.
5. Write equations which define the motion of a particle with respect to the rotating Earth; identifying Coriolis and centripetal contributions.
6. Integrate Earth-relative particle equations to determine particle position.
7. Predict Earth-relative particle position using engineering judgment
8. Describe the differences between northern- and southern- hemisphere motion, e.g. rotation of low pressure systems.
9. Calculate rigid body mass properties and transform them among reference frames.

10. Compose the angular momentum vector and differentiate it intertially.
11. Write rigid body equations of motion using Newtonian and Lagrangian methods.
12. Apply concepts of nutation and precession in describing the motion of aerospace vehicles.
13. Compute and draw the orientations of the space and body cones.
14. Distinguish between direct and retrograde motion; understand and predict the differences in dynamic response from the equations of motion.
15. Understand and predict the motion of a top.
16. Apply the principles of rigid body motion to gyroscopic instruments.

Required Texts/Readings

Textbook

Mitiguy: Dynamics of Mechanical, Aerospace and Biomechanical Systems

Other Readings

Synge & Griffith: Principles of Mechanics
Cannon, Robert: Dynamics of Physical Systems
Greenwood: Principles of Dynamics
Kane: Dynamics

Course Requirements and Assignments

Final Examination or Evaluation

Two Midterms (one hour) and one Final Exam (two hours and 15 minutes)

Grading Information

Homework	15%
Project	20%
Paper Review	5%
Two Hour Exams	40%
Final Exam	20%

Determination of Grades

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.

University Policies

Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs' Syllabus Information web page at http://www.sjsu.edu/gup/syllabusinfo/.

AE Department and SJSU policies are also posted at http://ae.sjsu.edu/program-policies.

AE 140 Rigid Body Dynamics Spring 2016 Course Schedule

Course Schedule

Week	Date	Topics, Readings, Assignments, Deadlines
1		Class Overview Vector dynamics review
2		Rigid body translational kinematics
3		Vector dynamics review
4		Rigid body translational kinematics
5		General motion with respect to the rotating Earth
6		Euler angles
7		Rigid body rotational kinematics
8		Angular momentum of a rigid body
9		Moments/products of inertia, principal axes
10		Euler's moment equation
11		Solution of general gyro equations
12		General rigid body gyroscopic motion
13		Gyroscopic instruments
14		Stable platform for inertial guidance
15		Six degree of freedom rigid body equations of motion
16		Satellite despinning Spacecraft attitude drift
17		Lagrange's equations
18		Final exam review