

San José State University
Charles W. Davidson College of Engineering
Mechanical Engineering
ME 101H Honors Dynamics, Section 01, Fall 2022

Course and Contact Information

Instructor: Burford Furman
Office Location: E310G
Telephone: 408-924-3817
Email: burford.furman@sjsu.edu
Office Hours: M 1315 – 1415 (in person); Tu 1330 – 1430 (by Zoom) or by appointment
Class Days/Time: MW 1030 - 1145
Classroom: E135
Prerequisites: CE 95 or CE 99 and Math 32 (with a grade of C- or better in each).

Course Description

Kinematics and dynamics of particles and rigid bodies. Mass distribution, forces, moments, and torques. Principles of work, power, potential and kinetic energy, impulse, and momentum. Laws of motion. Computational solutions to equations governing dynamic systems. Demonstrations and physical examples. 3 semester units.

Course Communication and Materials

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on in the Canvas course shell: <https://sjsu.instructure.com/courses/1487578>. You are responsible for regularly checking with the messaging system through MySJSU on Spartan App Portal (or other communication system as indicated by the instructor) to learn of any updates.

Program Information

In the context of the BS Mechanical Engineering program assessment, this course is intended to help students achieve ABET Student Outcome 3a: “an ability to apply knowledge of mathematics, science, and engineering.” For more information on ABET Student Outcomes, see <https://www.abet.org/accreditation/accreditation-criteria/>

Course Learning Outcomes (CLO)

The overall learning outcome we are aiming for in this class is for you to be able to:

Model a real physical system, drawing relevant schematics and free body diagrams, creating and analyzing its mathematical representation, and gaining insight about its physical behavior.

To achieve the overall learning outcome, you will need to master these learning objectives:

1. Apply vector concepts and vector operations to solve problems in 2D and 3D geometry.
2. Efficiently describe vectors using multiple/mixed vector bases and rotation matrices.
3. Efficiently calculate the derivative of a vector in one or more reference frames.
4. Determine the angular velocity of a rigid body (or reference frame) as observed from another reference frame.
5. Calculate the position, velocity, and acceleration of a point in a reference frame.
6. Formulate constraint equations, particularly for rolling and closed linkages.
7. Calculate the mass properties for a system of particles and/or rigid bodies.
8. Calculate the inertia properties for a particle or system of particles and/or rigid bodies.

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9. Calculate the angular momentum of a particle or system of particles and/or rigid bodies about a point in a reference frame.
10. Calculate the resultant force on a particle or system of particles and/or rigid bodies.
11. Calculate the moment of a vector or set of vectors about a point (e.g., moment of a force or moment of momentum).
12. Calculate the kinetic energy of a particle, system of particles and/or rigid bodies.
13. Define and use mechanical power and work to size actuators/dampers and to determine energy requirements.
14. Use conservation of kinetic plus potential energy to design and analyze dynamic systems
15. Optional: Use kinetic and potential energy to form Lagrange's equations.
16. Formulate static and dynamic equations for simple systems, e.g., a particle or rigid body.
17. Implement a Dynamics Roadmap to efficiently form static and dynamic equations for multibody systems.
18. Use a computational tool such as MotionGenesis, MATLAB, or Python to formulate and/or solve equations of motion.

Required Materials

Textbook

Dynamics of Mechanical, Aerospace, and Biomechanical Systems - 3D Computational Guided (For undergraduates) . The book is only available through this website:

<http://www.motiongenesis.com/MGWebSite/MGTextbooks/TextbookDynamicsMechanicalAerospaceBioRoboticsReceipt.html> . I will bring your hard copy book on the first day of class, and exchange it for your proof of purchase. You will need the book from day 1, and it takes time for the printer to assemble them, so in order to get your book on the first day of class, you will need to have made your purchase by August 4, 2022.

Purchase of the text allows you to receive a 3 yr license for [MotionGenesis](#), an extremely powerful software package that can be used to form and solve equations of motion and do all sorts of associated symbolic and numeric mathematics. Follow the instructions for downloading MotionGenesis, installing, and requesting your license on this web page: <http://www.motiongenesis.com/MGWebSite/MGFAQ/MGInstallAndLicense.html>

You will find a wealth of resources on the MotionGenesis website. Pay particular attention to the Textbook Resources section, which you can find at: https://bit.ly/MG_textbook_resources.

Course Requirements and Assignments

This course will be conducted in-person using a mastery framework, which means:

- I will likely have assignments (readings, homework, and quizzes) for you to complete before each lecture, so that you will be ready to learn what we will cover during the lecture session.
- Progress through and success in the class will depend on your mastering the learning objectives. There will be regular opportunities throughout the semester where you will be assessed for mastery of the learning objectives.

This is not a class where you can slack off and hope to eek out a passing grade by cramming for exams and hoping for partial credit! You will need to invest time *every week* to progress to mastery of the learning objectives. Your final grade will depend on your level of mastery of the course topics.

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Take the time to review the University policies that apply to this class and all your work at SJSU: <https://www.sjsu.edu/gup/syllabusinfo/>. You are expected to be familiar with the policies and abide by them, particularly those relating to Academic Integrity.

The [Syllabus Information web page](#) listed above also has links to University resources, such as counseling, writing assistance, etc., should you need additional help.

Per [University Policy S16-9](#), success in this course is based on the expectation that a student 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 with one of the hours used for lecture) for instruction or preparation/studying or course related activities including but not limited to internships, labs, clinical practica, etc. Other course structures will have equivalent workload expectations as described in the syllabus. [Thus, for this class, it is expected that you will spend *at least 6.5 hours outside of class working on homework, project work, test preparation, etc.*] See: <http://www.sjsu.edu/senate/docs/S12-3.pdf> for more information.

We will use Canvas extensively. You can access the course shell with this URL: <https://sjsu.instructure.com/courses/1487578>

For help with using Canvas, visit: http://www.sjsu.edu/ecampus/teaching-tools/canvas/student_resources

Final Examination or Evaluation

The final exam will be a comprehensive assessment of your grasp of the concepts presented in the class. It will take place on Monday, December 12, 2022, 0945 – 1200 in our lecture classroom (E135). More details will be given as we get closer to the date.

Grading Information

Grade Range	Criteria
C- → C+	All Assignments submitted (50% or better on each and overall average of at least 60%); All LOs mastered at 80% or better; Participation at least 70%; Final Exam at least 60%.
B- → B+	All Assignments submitted (60% or better on each, with at least 80% average overall); All LOs mastered at 80% or better; Participation at least 80%; Final Exam at least 70%.
A- → A	All Assignments submitted (70% or better on each, with at least 80% average overall); All LOs mastered at 80% or better; Participation at least 80%; Final Exam at least 80%; MIPS project

Within the grade ranges outlined by the Criteria above, your final course grade will be figured by the weighted sum of percentages from your class participation, Assignments, your LO mastery percentage, and your final exam percentage. The weightings are:

- In class and participation: 10%
- Homework: 25%
- Mastery Assessments: 40%
- Final Exam: 25%
- [Optional] MIPS project: 15% bonus

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<i>Grade</i>	<i>Percentage</i>
<i>A plus</i>	<i>96 to 100%</i>
<i>A</i>	<i>93 to 95%</i>
<i>A minus</i>	<i>90 to 92%</i>
<i>B plus</i>	<i>86 to 89 %</i>
<i>B</i>	<i>83 to 85%</i>
<i>B minus</i>	<i>80 to 82%</i>

<i>Grade</i>	<i>Percentage</i>
<i>C plus</i>	<i>76 to 79%</i>
<i>C</i>	<i>73 to 75%</i>
<i>C minus</i>	<i>70 to 72%</i>
<i>D plus</i>	<i>66 to 69%</i>
<i>D</i>	<i>63 to 65%</i>
<i>D minus</i>	<i>60 to 62%</i>

Classroom Protocol

Unless you are feeling ill or responding to some bonafide emergency, I expect you to attend each class session. [Err on the side of caution if you feel sick. We need to strive to keep the class well, so pay attention to your body. Seek a Covid test if you are displaying any symptoms of this virus]. Please arrive by the start of the session, so as to minimize distractions for everyone else. I will strive to start right at 1030.

I encourage active participation during our class sessions. I will likely call on individuals to make sure everyone is tracking with the flow of the class session. Please ask questions in class, and use the ME 101H Question Tracker document. Chances are that if you have a question, most of the rest of the class has the same question, and we can further everyone's learning if you ask your question.

Supplemental Instruction and Peer Connections

This semester the class will have a Supplemental Instructional Leader supplied by [Peer Connections](#). Your Supplemental Instruction (SI) Leader will facilitate group study sessions outside of class to review course concepts and learn the best strategies for studying. While all SI sessions are voluntary and your professor will not know who attends and who does not, your SI Leader will work with your professor to tailor your study sessions so that they cover the most important course concepts. Students who attend SI Sessions tend to excel in the course. Please take advantage of this extra help!!

University Policies

Per [University Policy S16-9](#), relevant university policy concerning all courses, such as student responsibilities, academic integrity, accommodations, dropping and adding, consent for recording of class, etc. and available student services (e.g. learning assistance, counseling, and other resources) are listed on [Syllabus Information web page](#) (<https://www.sjsu.edu/curriculum/courses/syllabus-info.php>). Make sure to visit this page to review and be aware of these university policies and resources.

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Course Schedule (Tentative. Check back frequently to see if there have been changes)

Week	Date	Topics	L.O.
1		No class meeting until 8/22! Get started on reading and HW 1-2	1 – 2
2	8/22 8/24	Course overview and review of math and vectors Vector operations (+, *, -, dot product, cross product, exponentiation)	1 – 2
3	8/29 8/31	Position vectors and vector geometry, measurements of distance, area, volume, and angles) Vector bases, rotation table, direction cosines	1 – 2
4	9/5 9/7	Labor Day holiday Vector differentiation	3
5	9/12 9/14	Angular velocity, angular acceleration - pt 1 Angular velocity, angular acceleration - pt 2	4
6	9/19 9/21	Velocity and acceleration of points - pt 1 Velocity and acceleration of points - pt 2	5
7	9/26 9/28	Constraints - pt 1 Constraints - pt 2	6
8	10/3 10/5	Particles Mass, center of mass, centroids	7 – 8
9	10/10 10/12	Moment of inertia, inertia dyadic Rigid bodies	7 – 8
10	10/17 10/19	Forces and resultant force Moments and torque	10 – 11
11	10/24 10/26	Newton/Euler dynamics Impulse, conservation of momentum	12
12	10/31 11/2	Energy and Work - pt 1 Energy and Work - pt 2	13 – 14
13	11/7 11/9	MG Road Maps - pt 1 MG Road Maps - pt 2	16 – 17
14	11/14 11/16	Equations of motion and their solution MG for developing equations of motion	16 – 17
15	11/23 11/25	MIPSI project consulting Non-instructional day (for Thanksgiving)	
16	11/28 11/30	MIPSI Project Presentations - Day 1 MIPSI Project Presentations - Day 2	
17	12/5	Last lecture	
18	12/12	Final Exam, Monday, December 12, 2022, 0945 – 1200 E135	