THE PENNSYLVANIA STATE UNIVERSITY
MONT ALTO CAMPUS
Spring 2024

EMCH 212 – Dynamics

Course Title: EMCH 212 "Dynamics"
Section: 001
Credits: 3
Class Meeting: MWF 1:25 – 2:15, Room 313 Sci-Tech Building
Text and Material: Materials online for this course: Textbook available at http://mechanicsmap.psu.edu, all other materials available through Canvas.

Instructor: Dr. Jacob Moore, Associate Professor of Engineering
E-mail: jmoore@psu.edu
Phone: (717) 749-6209
Office Location: 7 Bookstore Building
Office Hours: Mondays 9 AM - 10 AM, Tuesdays 10 AM – 12PM, and Wednesdays 9 AM - 10 AM or by appointment.

Course Goals:
Acquire a working knowledge of vector calculus and to apply it to the description of kinetic and kinematic quantities such as forces, moments, position, velocity, and acceleration. Apply calculus to correctly relate position, velocity, and acceleration to one another. Model mechanical systems by drawing free body diagrams of particles and rigid bodies and then by writing the governing equations of motion. These models may be applicable at either a specific instant in time and/or point in space or they may be applicable over a range of time and space. Apply algebra, calculus, and elementary differential equations (usually through the use of computer software), to the solution of the equations of motion. Apply the work-energy principle to relate the energy of a mechanical system to its spatial configuration variables (i.e., position variables). Apply the impulse-momentum principle to relate the momentum of a mechanical system to the system of forces applied to it. Learn appropriate physical and mathematical assumptions and begin to develop the analytical capability necessary for tackling a wide variety of engineering problems.

Course Learning Objectives:
Upon successfully completing this course students will be able to…

- Apply mathematical principles (algebra, trigonometry, and calculus) to relate position, velocity, and acceleration to one another in different co-ordinate systems.
- Create free body diagrams (FBD) of particles and rigid bodies.
- Apply mathematical principles to the solution of the equations of motion, i.e. particle kinetics.

- Solve problems using the work done by a force and apply the work-energy principle to relate the kinetic energy of a system to its position variables.
- Apply the impulse-momentum principle to relate the change of linear and angular momentum of a mechanical system to the system of linear and angular impulse applied to it.
- Identify and solve problems involving the impact of particles.
- Apply rigid body kinematics to solve problems.
- Apply mathematical principles to the solution of equations of rigid body motion, i.e. rigid body kinetics.
- Apply fundamental work-energy and impulse-momentum principles to rigid body kinetics.

Course Policies:

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Pre-Class Preparation:

- The class will be run as a flipped classroom, and students will be expected to do the required reading and pre-class quiz before class starts on the assigned day.
- A short review of the reading will be presented before class by the instructor, but it will not replace the course reading. The instructor will not use class time to explain materials to students who have failed to prepare before class, you will need to do the reading on your own.
- Extensions on quizzes will only be offered in instances of illness or other extenuating circumstances.

Attendance:

- Students are expected to attend all classes except in cases of illness or other extenuating circumstances.
- Students experiencing any symptoms of COVID 19, or those who were exposed to someone testing positive or presumed positive should not attend class and should alert the instructor. If possible, these students will be encouraged to continue to participate remotely.
- Class will begin promptly at the designated time, and you are expected to be ready to go at that point.
- Each unexcused absence will result in losing one point from your attendance grade, up to a maximum of 5 points.
- Students should contact the instructor before class for any pre-scheduled absences. In the case of an illness or another unexpected reason for absence, the student should contact the instructor as soon as possible.
- It is the responsibility of the student to determine what activities and assignments were missed in the case of any missed classes or significant tardiness. This can be done by contacting the instructor. Not all assignments may be made up in the case of non-university sanctioned excuses for absence.

Homework Assignments:

- All homework assignments will be graded according to the mastery grading system. For details on this system, see the section on "Mastery Assignment Grading".
- All assignments and dues dates will be documented on Canvas (https://lmstools.ais.psu.edu/login.html). Though assignments may be introduced in class, students are expected to consult the documentation on Canvas for more complete guidance for the assignments.
- All assignments are due at the beginning of class on the listed due date. Assignments may be dropped off with the instructor in class. Late assignments will not be accepted without prior consent of the instructor.
- Students are encouraged to work in groups; however, students are expected to complete and submit their own original work.

Labs:

- Labs will be done in teams of two (three only if absolutely necessary).
- Time will be allotted to work on the labs in class, but students may need to work beyond that time to complete the assignment. All due dates and guidelines for the lab are listed in the syllabus.
- Each team will submit a single report and each student in the team will receive the same grade except in instances where it is apparent that the workload was unequally distributed.
- As much of the lab will be done in class it is essential that you attend class on lab days. Unexcused absences on lab days will result in 20 points being deducted from your grade for each lab day missed.
- Any student that has a team member that they feel is not sufficiently contributing to the project is encouraged to address the issue with the instructor.

Tests:

- Tests will be conducted during the class periods indicated on the schedule unless otherwise noted in class. Because of this the tests will be limited to the regular 50-minute time period. Time starts at the beginning of class regardless of when the student shows up.
- Tests will be closed book, but open note. Students are highly encouraged to make crib sheets of common formulas that can be quickly.
- The tests will consist of two main sections:
    - The basics section will cover the fundamentals of the topics covered in class and consist of a combination of multiple choice and open response style questions. Students will be expected to answer all the questions in this section.
    - The challenge section will cover more complex topics and may string various topics together. This section will consist entirely of open response style questions and students will be expected to choose and solve a subset of the questions.

General Conduct:

- Students are expected to act professionally during all class related activities and meetings. Inappropriate behavior or language during any class activities will not be tolerated.
- All students are expected to wear a mask, covering mouth and nose, for the duration of class.

Mastery Assignment Grading:

The purpose of having assignments in this class is to help students learn the material and mastery the skills covered in the course. Students are expected to show mastery of the material through complete and correct solutions to the homework assignments, though it is understood that this may not happen the first-time students attempt to solve a problem. To match this expectation, the following process will be used to grade all homework assignments unless otherwise noted.

1. Students will be given a weekly assignment with several homework problems in the class readings. Students must complete all problems to the best of their abilities, completely document all their work using the appropriate homework formatting guidelines, and turn in their work by the assigned due date.
2. Within one week, the instructor will grade and return the assignment. Each problem will have one of three marks on it, indicating whether the instructor feels the problem was mastered.
    - **M (Mastered):** Indicating that the student completely and correctly answered the problem.
    - **NM (Not Mastered):** Indicating that the student did not completely and correctly answer the problem. This will be accompanied by comments from the instructor indicating any mistakes or missing information that the instructor has identified.
    - **X (Not Attempted):** Indicating that the instructor felt that the student did not make a reasonable attempt at answering the problem.
3. All problems that were marked NM (Not Mastered) can be redone and resubmitted within one week of being returned. Problems may not be resubmitted more than one week after being returned (due dates will be printed on the assignments). All problems resubmitted will be regraded and just as the original assignment was. The new marks for each problem will replace the previous marks the student received. <u>Resubmissions should be written on a separate sheet and must be stapled to the front of the original assignment</u> and any previous resubmissions. The whole problem must be written out again unless the instructor has marked a “continue from here” point in the previous submission.
4. Problems can be resubmitted as many times as needed so long as the problem is marked NM.
5. The last day of classes will be the last day to resubmit any assignment. After this date, no more resubmissions will be accepted.
6. Each student’s final course homework grade will be the number of problems the student has marked as mastered over the total number of problems assigned to the class.

Services for Students with Disabilities
In order to receive consideration for reasonable accommodations, you must contact the Disability Coordinator, Kendra Wolgast, located on the first floor of the General Studies Building in the Student Success Center. Appointments can be made at https://psu.mywconline.com/. She can also be reached at 749-6045 or kmw24@psu.edu. Students must complete an introductory meeting and provide documentation: http://equity.psu.edu/sdr/guidelines. If the documentation supports your request for reasonable accommodations, the disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. You must follow this process for every semester that you request accommodations.

Counseling and Psychological Services:
Many students at Penn State face personal challenges or have psychological needs that may interfere with their academic progress, social development, or emotional wellbeing. The university offers a variety of confidential services to help you through difficult times, including individual and group counseling, and crisis intervention. Mantra Health Telepsychiatry services offer evaluations and limited medication prescriptions. Penn State students receive limited sessions free of charge. These services are provided by staff who welcome all students and embrace a philosophy respectful of clients' cultural and religious backgrounds, and sensitive to differences in race, ability, gender identity and sexual orientation.

To schedule an appointment contact:
Counseling Services
Darlene Pasi, M.S., LPC
104 Conklin Hall
Drp16@psu.edu
Phone: 717-749-6125

Penn State Crisis Line (24 hours/7 days/week): 877-229-6400
Crisis Text Line (24 hours/7 days/week): Text LIONS to 741741

Academic Support Center:
The Academic Support Center provides academic and skill building support for all students. If you are having difficulty in any of your classes, or with academic skills, contact the Academic Support Center.
E-mail: kmw24@psu.edu
Call: (717) 749-6046
Schedule a Tutoring Appointment: http://www.psu.mywconline.com
Stop by: 1st floor of the General Studies Building

Academic Integrity:
Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner. Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State

University, and all members of the University community are expected to act in accordance with this principle. Consistent with this expectation, the University's Code of Conduct states that all students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts.

Academic integrity includes a commitment by all members of the University community not to engage in or tolerate acts of falsification, misrepresentation or deception. Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others.

Students charged with a breach of academic integrity will receive due process and, if the charge is found valid, academic sanctions may range, depending on the severity of the offense, from F for the assignment to F for the course. The University's statement on academic integrity, from which the above statement is drawn, is available at https://undergrad.psu.edu/aappm/G-9-academic-integrity.html

Reporting Educational Equity Concerns:
Consistent with University Policy AD29, students who believe they have experienced or observed a hate crime, an act of intolerance, discrimination, or harassment that occurs at Penn State are urged to report these incidents as outlined on the University's Report Bias webpage (http://equity.psu.edu/reportbias/)

Grading Policy:
Grades will be distributed as follows:

- Attendance 5%
- Quizzes 10%
- Labs 10% (2 labs)
- Homework Assignments 15%
- Midterm Exams 60% (4 exams)

Final letter grade will be assigned as follows:

93 - 100	A
90 – 92.99	A-
87 – 89.99	B+
83 – 86.99	B
80 – 82.99	B-
75 – 79.99	C+
70 – 74.99	C
60 – 69.99	D
below 60	F

Tentative Schedule:

Week of	Topic	Pre-Class Reading	Assignments Due
1/8	M- Preliminaries and Course Introduction W- Continuous Particle Motion F – Non-Continuous Particle Motion	 8.1 8.2	
1/15	M – No Class, MLK Day W – 2D Motion with Rectangular Coordinates F – 2D Motion with Normal/Tan Coordinates	 8.3 8.4	W – HW1
1/22	M – 2D Motion with Polar Coordinates W – Boom Lift Analysis Lab F – Boom Lift Analysis Lab (cont.)	8.5	W - HW2
1/29	M- Dependent Motion Systems W – Relative Motion Analysis F – Review for Exam	8.6 8.7	M – Boom Lift Lab F – HW3
2/5	M – **Exam 1** W – 1-D Kinetics F- Particle Kinetics in Rectangular Coords	 9.1 9.2	
2/12	M - Particle Kinetics in Normal/Tan and Polar W – Kinematics of Fixed Axis Rotation F – Belt and Gear Driven Systems	9.3 – 9.4 12.1 12.3	W – HW4
2/19	M – Absolute Motion Analysis W – Absolute Motion Analysis cont. F – Relative Motion Analysis	12.4 12.5	
2/26	M – Relative Motion Analysis cont. W – Review for Exam F – **Exam 2**		W –HW5
3/4	Spring Break – No Classes		
3/11	M – Kinetics of Translation and Fixed Axis Rotation W – Mass Moments of Inertia F – General Planar Kinetics	13.1 – 13.2 A2.7 13.3	 F – HW6
3/18	M - General Planar Kinetics cont. W – Work and Energy in Particles F – Power and Efficiency	 10.1 – 10.2 10.3 – 10.4	W – HW 7
3/25	M – Work and Energy in Systems of Particles W – Review for Exam F – **Exam 3**	10.5	W – HW8
4/1	M - Work and Energy in Rigid Bodies W – Power and Efficiency in Rigid Bodies F – Energy Storage Lab	14.1 – 14.2 14.3 -14.4	 F – HW9
4/8	M – Energy Storage Lab W – Impulse Momentum in Particles F - Surface Collisions and 1D Collisions	 11.1 – 11.2 11.3 – 11.4	W – Energy Storage Lab
4/15	M – Impact in Particles (2D) W – Steady Flow Systems F – No Class, Academic Festival	11.5 11.6	W – HW 10
4/22	M – Rigid Body Impulse Momentum W – Rigid Body Surface Collisions F – Review for Exam	15.1 – 15.2 15.3	 F – HW11
4/29 – 5/2	**Finals Week – Exam 4**		