Department of Mechanical Engineering
Spring Semester 2020
Course Number: ME 104

Course Title:	**Engineering Mechanics II: Dynamics**
Units:	**3**
Faculty:	**Casey, Ma, Morris, and O'Reilly**

Catalog Description (Brief overview of the course):

This course is an introduction to the dynamics of particles and rigid bodies. The material, based on a Newtonian formulation of the governing equations, is illustrated with numerous examples ranging from one-dimensional motion of a single particle to planar motions of rigid bodies and systems of rigid bodies.

Course Prerequisites (optional):

Engineering 7 and Mechanical Engineering C85

Course Restrictions (if any):

Course and Student Learning Objectives (optional):

Reintroduce students to Newton's 3 laws; introduce rigorous kinematical analysis of particles and rigid bodies; discuss creation of equations of motion for particles and rigid bodies in planar motion; discuss orbital mechanics and general momentum conservation problems; introduce energy-based approaches to determining system motion.

Upon completion of this course students will be able to: Determine the kinematics and kinetics to allow the calculation of equations of motion for single particles, multiple particles and rigid bodies, all in planar motion; analyze the equations of motion, solve impact problems, and characterize the performance of a wide range of mechanical systems.

Instruction Methods/Structure:

3 hours of lecture per week and 1 hour of discussion

Course Textbooks/Readings:

1. **Engineering Dynamics: A Primer, by Oliver M. O'Reilly, Third Edition, Springer Nature, 2019.**

2. **Engineering Mechanics: Dynamics, by J. L. Meriam, L. G. Kraige, and J. N. Bolton. Ninth Edition, Wiley, New York, 2019.**

Class Schedule:

14 weeks – 3 hours of lecture per week & time for assignments & readings. The weekly discussion sessions are used to present additional material to assist students with homework assignments. One week during RRR week for review sessions in preparation for the final examination.

Grading (assessment of student progress towards course objectives):

10% - Homework
20% - Midterm (1)
25% - Midterm (2)
45% - Final Exam

Descriptions of Assignments/Problem Sets/Reports/Research Papers:

Assignments in the class consist of problems from textbooks, such as Meriam, Kraige and Bolton. These problems are often supplemented with numerical analyses and visualization. The numerical computing environment Matlab, or an equivalent, is used to perform the numerical analyses and aid in the visualization of the results.

Weekly Schedule: Topics, Readings, and Assignments for Each Week.

Example:

Week/Date	Topics	Assignments / Readings
1	Dynamics of a Single Particle using Cartesian Coordinates	Chapter 1 of [1] or equivalent
2	Dynamics of a Single Particle using Cylindrical Polar Coordinates	Chapter 2 of [1] or equivalent
3	Dynamics of a Single Particle Moving on a Space Curve	Chapter 3 of [1] or equivalent
4	Friction Forces and Spring Forces in the Dynamics of a Single Particle	Chapter 4 of [1] or equivalent
5	Energy and Power for a Single Particle	Chapter 5 of [1] or equivalent
6	Dynamics of a System of Particles	Chapter 6 of [1] or equivalent
7	Dynamics of a System of Particles	Chapter 7 of [1] or equivalent
8	Planar Kinematics of a Rigid Body: Preliminary Developments	Chapter 8 of [1] or equivalent
9	Planar Kinematics of a Rigid Body: Momenta and Energies	Chapter 8 of [1] or equivalent
10	Planar Kinetics of a Rigid Body: Purely Translational Motion, Work-Energy Theorems, & Balance Laws	Chapter 9 of [1] or equivalent
11	Planar Kinetics of a Rigid Body: General Motion of a Rigid Body including Motion of a Rigid Body about a Fixed Point	Chapter 9 of [1] or equivalent
12	Planar Kinetics of a Rigid Body: Sliding Motions and Rolling Motions	Chapter 9 of [1] or equivalent
13	Dynamics of a System of Rigid Bodies and Particles: Kinematics	Chapter 10 of [1] or equivalent
14	Dynamics of a System of Rigid Bodies and Particles: Kinetics	Chapter 10 of [1] or equivalent
RRR week	Review Sessions for Final Exam	

Contribution of the Course to Meeting the Professional Component
This course contributes primarily to the students' knowledge of engineering topics and does not provide hands on design experience. It does strengthen the students' abilities to utilize MATLAB as an experimental tool with which to explore the dynamical response of complex systems

Relationship of the Course to ABET Program Outcomes

This course provides invaluable training in the modeling and analysis of dynamic systems and as such provides a critical background for students wishing to study vibrations, advanced dynamics, controls, design, biomechanics, solid mechanics, and so on. An ability to apply knowledge of mathematics, science, and engineering. An ability to function on multidisciplinary teams. An ability to identify, formulate, and solve engineering problems. The broad education necessary to understand the impact of engineering solutions in a global and societal context. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Other Notes:

Prepared by Oliver M. O'Reilly, November 15, 2019