San Francisco State University
School of Engineering

Course Outline for ENGR 201: Dynamics

Required

Civil and Mechanical Engineering

Bulletin Description

ENGR 201 Dynamics (3 units)
Prerequisite: ENGR 102. Vector treatment of kinematics and kinetics of particles, systems of particles and rigid bodies. Methods of work, energy, impulse and momentum. Vibrations and time response. Applications to one– and two–dimensional engineering problems.

Textbook

J. L. Meriam, and L.G. Kraige, Jr. *Engineering Mechanics Volume 2: Dynamics*. 5th ed. John Wiley & Sons, Inc., 2001.

References

1. Hibbeler, R.C. *Engineering Mechanics: Dynamics*, 7th ed. Prentice Hall, 1997.
2. McGill, D.J. and W.W. King. *Engineering Mechanics: An introduction to Dynamics*. 3rd ed. PWS-KENT, 1995.
3. Meriam, J.L. *Engineering Mechanics: Dynamics*. 3rd ed. Wiley, 1996.
4. Torby. B.J. *Advanced Dynamics for Engineers*. Holt, Rinehart, and Winston, 1984.
5. Greenwood, D.T. *Principles of Dynamics*. 2nd ed., Prentice Hall, 1988.

Coordinator

Michael Holden, Assistant Professor of Mechanical Engineering

Prerequisites by Topic

1. Vector algebra
2. Forces as vectors
3. Graphing of functions
4. Static equilibrium
5. Representation of points in space
6. Moment of a force as a cross-product
7. Differentiation

8. Integration
9. Natural laws
10. Moments of inertia
11. Force–free bodies

Course Objective[1]

1. The description of the motion of points in space using the position vector and its derivatives. [A1, A2, B1]
2. The use of F = ma to relate force to motion for particles and rigid bodies. [A1, A2, B1]
3. The use of work-energy to solve motion problems. [A1, A2, B1]
4. The use of impulse and momentum methods[A1, A2, B1]
5. Rigid body motion and rotating reference frames. [A1, A2, B1]
6. The use Euler's laws for the description of two–dimensional rigid body motion. [A1, A2,]
7. The analysis of simple harmonic motion and undamped vibration. [A1, A2, B1]
8. Comprehending natural law and dynamics as an axiomatic science. [A1, A2, B1]

Topics

1. Position vector its derivatives – velocity and acceleration.
2. Rectilinear motion and its graphical description.
3. Constrained motion.
4. Newton's laws of motion
5. Work, power and energy.
6. Conservation of energy.
7. Impulse and momentum methods and collisions.
8. Conservation of momentum.
9. Two-dimensional rigid body kinematics.
10. Euler's laws of motion.
11. Energy methods in rigid body motion.

Professional Component

Engineering Design 0%
Engineering Science 100%

Evaluation

1. Two 50–minute exams
2. One comprehensive Final Exam
3. Quizzes
4. Weekly homework assignments and project

(Students are encouraged to work together, but to hand in separate homework)

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[1]Numbers in brackets refer to the goals and objectives of the School of Engineering

Performance Criteria[2]

Objective 1

1.1 The student will demonstrate a good understanding of the motion, velocity and acceleration of a point.[1, 2, 3, 4]

1.2 The student will demonstrate a good understanding of the difference between a curve and its parameterization. [1, 2, 3, 4]

Objective 2

2.1 The student will demonstrate a good understanding of the use of the instantaneous state to derive equations of motion. [1,2,3,4]

2.2 The student will demonstrate a good understanding of the meaning of the terms in **F= ma.** [1, 2, 3, 4]

2.3 The student will demonstrate a good understanding of the meaning of **F= ma** as a law. [1, 2, 3, 4]

Objective 3

3.1 The student will demonstrate a good understanding of the concepts of work, power and energy. [1, 2, 3, 4]

3.2 The student will demonstrate a good understanding of conservative and non-conservative system. [1, 2, 3, 4]

Objective 4

4.1 The student will demonstrate a good understanding of the motion, velocity and acceleration of a point. [1, 2, 3, 4]

4.2 The student will demonstrate a good understanding of the difference between a curve and its parameterization. [1, 2, 3, 4]

Objective 5

5.1 The student will demonstrate a good understanding of the concept of angular velocity of a rigid body or reference frame. [1, 2, 3, 4]

5.2 The student will demonstrate a good understanding of time rates of change of unit vectors in a rotating reference frame. [1, 2, 3, 4]

5.3 The student will demonstrate a good understanding of absolute and relative velocity and acceleration in a rotating reference frame.[1, 2, 3, 4]

Objective 6

6.1 The student will demonstrate a good understanding of the computation of linear momentum and moment of a rigid body. [1, 2, 3, 4]

6.2 The student will demonstrate a good understanding of the use of Euler's laws of motion for two-dimensional problems. [1, 2, 3, 4]

Objective 7

7.1 The student will demonstrate a good understanding of the concept of frequency and period for simple harmonic motion. [1, 2, 3, 4]

7.2 The student will demonstrate a good understanding of the governing equation for the simple harmonic oscillator. [1, 2, 3, 4]

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[2]Numbers in brackets refer to evaluation methods used to asses students' performance

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Instructor: Mutlu Ozer
Office: Science 112-B
Phone: (415) 338-6578
Email: ozer@sfsu.edu

Class/Laboratory Schedule

Three 50-minute lecture sessions/week

Prepared by

Mutlu Ozer, Spring, 2005