San Francisco State University
School of Engineering

Course Outline for ENGR 204: Engineering Mechanics

Elective

Electrical Engineering

Bulletin Description

ENGR 204: Engineering Mechanics (3 units)

Prerequisite: MATH 227, PHYS 220

Vector treatment of force systems, kinematics and kinetics. Centroids and moments of inertia. Equilibrium of internal stresses. Methods of acceleration. Work, energy and momentum. Kinetic differential equations. Vibrations and time response.

Textbook

1. Bedford, and F. Wallace. *Engineering Mechanics: Statics*.4th ed. Pearson Prentice Hall, 2004.
2. J. L. Meriam, and L.G. Kraige, Jr. *Engineering Mechanics Volume 2: Dynamics*. 5th ed. John Wiley, 2001.

References

1. Hibbeler, R.C., *Engineering Mechanics: Dynamics,* 7th ed., Prentice Hall, 1997.
2. McGill, D.J. and King, W.W., *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. Basic mechanics with use of calculus
3. Techniques if integration and analytic geometry
4. Forces as vectors
5. Graphing of functions
6. Static equilibrium
7. Representation of points in space
8. Moment of a force as a cross-product
9. Differentiation
10. Integration
11. Natural laws
12. Moments of inertia
13. Force free bodies

Course Objective[1]

1. To understand the concepts and apply the equations of static equilibrium for cable, truss, machine and beam system. [A.1, A..2, B.1]
2. To learn to determine centroids and moment of inertia of bodies. [A.1, A.2, B.1]
3. To learn to analyze the behavior of systems with friction. [A.1, A.2, B.1]
4. To correctly draw free body diagrams for determining internal forces and reactions of various structures. [A.1, A.2, B.1]
5. The description of the motion of points in space using the position vector and its derivatives. [A.1, A.2, B.1]
6. The use of F = ma to relate force to motion for particles and rigid bodies. [A.1, A.2, B.1]
7. The use of work-energy to solve motion problems. [A.1, A.2, B.1]
8. The use of impulse and momentum methods. [A.1, A.2, B.1]
9. Rigid body motion and rotating reference frames. [A.1, A.2, B.1]
10. The use of Euler's laws for the description of two-dimensional rigid body motion. [A.1, A.2]
11. The analysis of simple harmonic motion and undamped vibration. [A.1, A.2, B.1]

Topics

1. Position vector its derivatives: velocity and acceleration
2. Using vectors to represent forces
3. Summing forces and moments
4. Developing force and moment equilibrium equations
5. Equilibrium of frictionless pulley and cable systems
6. Analyzing equilibrium of truss and beam systems
7. Determining centroids of areas, volumes and moments of inertia
8. Developing shear and bending moment diagrams
9. Rectilinear motion and its graphical description
10. Constrained motion

[1] Numbers in brackets refer to the educational objectives and outcomes of the School of Engineering.

11. Newton's laws of motion
12. Work, power and energy
13. Conservation of energy
14. Impulse and momentum methods and collisions
15. Conservation of momentum
16. Two-dimensional rigid body kinematics
17. Euler's laws of motion
18. 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. Class participation
5. Weekly homework assignments and project

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

Performance Criteria[2]

Objective 1

- *1.1* The student will demonstrate the ability to use vectors to represent forces [1,2,3,4,5]
- *1.2* The student will demonstrate the ability to sum forces and moments [1,2,3,4,5]
- *1.3* The student will demonstrate the ability to develop force and moment equilibrium equations [1,2,3,4,5]
- *1.4* The student will demonstrate the ability to find equilibrium of frictionless pulley and cable systems.[1,2,3,4,5]
- *1.5* The student will demonstrate the ability to analyze equilibrium of truss and beam systems. [1,2,3,4,5]
- *1.6* The student will demonstrate the ability to develop shear and bending moment diagrams[1,2,3,4,5]

Objective 2

- *2.1* The student will demonstrate an ability to determine the centroids of areas, volumes of various shapes using both integration and summation [1,2,3,4,5]
- *2.2* The student will demonstrate an ability to determine moments of inertia about axes using both integration and summation. [1,2,3,4,5]

[2] Numbers in brackets refer to evaluation methods use to assess students' performance.

Objective 3

3.1 The student will demonstrate an ability to analyze the behavior of simple systems with friction. [1,2,3,4,5]

Objective 4

4.1 The student will demonstrate an ability to draw free body diagrams for the purposes of determining internal forces in members and reactions. [1,2,3,4,5]

Objective 5

5.1 The student will demonstrate a good understanding of the motion, velocity and acceleration of a point. [1,2,3,4,5]

5.2 The student will demonstrate a good understanding of the difference between a curve and its parameterization. [1,2,3,4,5]

Objective 6

6.1 The student will demonstrate a good understanding of the use of the instantaneous state to derive equations of motion. [1,2,3,4,5]

6.2 The student will demonstrate a good understanding of the meaning of the terms in F= ma. [1,2,3,4,5]

6.3 The student will demonstrate a good understanding of the meaning of F= ma as a law. [1,2,3,4,5]

Objective 7

7.1 The student will demonstrate a good understanding of the concepts of work, power and energy. [1,2,3,4,5]

7.2 The student will demonstrate a good understanding of conservative and non-conservative systems. [1,2,3,4,5]

Objective 8

8.1 The student will demonstrate a good understanding of the motion, velocity and acceleration of a point. [1,2,3,4,5]

8.2 The student will demonstrate a good understanding of the difference between a curve and its parameterization. [1,2,3,4,5]

Objective 9

9.1 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]

9.2 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]

9.3 The student will demonstrate a good understanding of absolute and relative velocity and acceleration in a rotating reference frame. [1, 2, 3, 4, 5]

Objective 10

10.1 The student will demonstrate the ability to compute linear momentum and moment of a rigid body. [1,2,3,4, 5]

10.2 The student will demonstrate the ability to use Euler's laws of motion for two-dimensional problems. [1,2,3,4,5]

Objective 11

11.1 The student will demonstrate a good understanding of the concept of frequency and period for simple harmonic motion. [1,2,3,4,5]

11.2 The student will demonstrate a good understanding of the governing equation for the simple harmonic oscillator. [1,2,3,4,5]

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Class/Laboratory Schedule

Three 50-minute lecture sessions/week

Prepared by

Mutlu Ozer, Spring, 2005