# CE 235 Engineering Mechanics II: Dynamics 3 Units

**USC | SONNY ASTANI DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING**

*ABET Course Syllabus*

## Course Information, Textbook and Supplementary Materials

**Course Description:** Students will learn the mathematical tools and physics concepts necessary to solve problems involving dynamical motion, including kinematics and kinetics of particles, systems of particles and rigid bodies; impulse and momentum relations; energy methods. Students will understand the application of vector algebra and calculus in dynamics and transformation of coordinates to analyze and solve various dynamics problems.

**Required for:** BSCE, BSCE Structural, BSCE Building Science, and BSCE Environmental

**Prerequisite:** CE 205 Statics

**Co-Requisite:** None

**Required Textbook:** Engineering Mechanical Dynamics (Vol.13), by R. C. Hibbeler, Prentice Hall/Pearson

**Reference:** Dynamics, Eleventh Edition by R. C. Hibbeler

| Topics Covered | Learning Outcomes |
|---|---|
| Application of Vector Algebra and Vector Calculus in dynamics and transformation of coordinates | Students will understand the topic elements and will be able to analyze, compute and apply the results of the following:<br>1. Express force and position vectors in Cartesian and polar vector form, determine unit vectors, vector operations, scalar and cross products.<br>2. Express transformations of coordinates as orthogonal matrices and perform such transformations.<br>*3.* Determine the first and second time derivatives of vectors. |
| Kinematics:<br>Rectilinear and Cartesian Coordinates<br>Curvilinear Sec Coordinates | Analyze the:<br>4. Rectilinear and general curvilinear motion in Rectangular coordinate.<br>5. Motion of a projectile<br>6. Curvilinear motion in normal, tangential and cylindrical coordinates |
| Kinetics:<br>Equation of Motion<br>System of Particles | 7. Equations of motion in rectangular, normal-tangential and cylindrical coordinates and the equations of a system of particles |
| Work and Energy<br>Impulse and Momentum | 8. Principle of Work and Energy of one and a system of particles<br>9. Conservative forces, Potential Energy and Conservation of Energy<br>10. Principle of Linear Impulse and Momentum of one and a system of particles.<br>11. Conservation of Linear Momentum for system of Particles.<br>12. Moment and Angular Impulse and Momentum Principles. |

| | |
|---|---|
| Plane Rigid Body Kinematics<br>Kinematics of Rigid Bodies in Plane Motion<br>Kinetics of Rigid Bodies in Plane Motion<br>Work and Energy of Plane Rigid Bodies<br>Impulse and Momentum of Plane Rigid Bodies<br>3-D Kinematics of Rigid Bodies<br>3-D Kinetics of Rigid Bodies | Analyze the:<br>13. Translation, Fixed-Axis Rotation and General Plane Motion of a Rigid Body<br>14. Instantaneous center of Zero Velocity.<br>15. Plane Kinetic Equations of Motion.<br>16. 3-D Equation of Motion and Fixed Axis Rotation of a Rigid Body<br>17. Gyroscopic Motion of a Rigid Body.<br>18. Use computational tools for matrix computation and calculation of moment of inertia of irregular shapes |

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| Lecture and Lab Schedule | | | |
|---|---|---|---|
| **Lecture** | | **Lab** | |
| Sessions per Week | Duration per Session | Sessions per Week | Duration per Session |
| 3 | 1 hour | n/a | |

**Relation of Course Objectives to Program Outcomes**

The Civil Engineering program is designed to teach beyond the technical content of the curriculum and prepare the students to utilize what they learn in a professional setting.

This course does not contribute to the program outcomes..

| Course Contribution to Program Outcomes *(a-k)* | ✓ Key |
|---|---|
| n/a | |

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