



2. Will be able to draw a free body diagram and to focus in on the necessary physical aspects and associated geometry of a given problem.
3. Will be able to collect the appropriate data and apply methodically the relevant equations of mechanics to provide a solution to the problem at hand.

**Specific Objectives:**

1. To introduce the principles of kinematics of a particle.
2. To develop the principles used in kinetics and in determining the equations of motion.
3. To introduce the notion of work and energy and their conservation.
4. To investigate the properties of momentum, angular momentum, and impulse.
5. To analyze translational and rotational planar kinematics.
6. To apply all the principles of work and energy to planar kinematics.
7. To investigate the principles of momentum and impulse in planar kinematics.
8. To extend the principles of rotation and translation to three-dimensional motion.
9. To investigate moments and products of inertia and kinetic energy in three dimensions.
10. To analyze undamped and damped vibrations.

**8. COURSE OUTLINE:**

12. Kinematics of a Particle

- 12.1 Rectilinear kinematics: continuous motion
- 12.2 Rectilinear kinematics: erratic motion
- 12.3 General curvilinear motion
- 12.4 Curvilinear motion: rectangular components
- 12.5 Motion of a projectile
- 12.6 Curvilinear motion: normal and tangential components
- 12.7 Curvilinear motion: cylindrical components
- 12.8 Absolute dependent motion analysis of two particles
- 12.9 Relative-motion analysis of two particles using translating axes

13. Kinematics of a Particle: Force and Acceleration

- 13.1 Newton's laws of motion
- 13.2 The equation of motion
- 13.3 Equation of motion for a system of particles
- 13.4 Equations of motion: rectangular coordinates

- 13.5 Equations of motion: normal and tangential coordinates
- 13.6 Equations of motion: cylindrical coordinates
- 13.7 Central force motion and space mechanics

14. Kinetics of a Particle: Work and Energy

- 14.1 The work of a force
- 14.2 Principle of work and energy
- 14.3 Principle of work and energy for a system of particles
- 14.4 Power and efficiency
- 14.5 Conservative forces and potential energy
- 14.6 Conservation of energy

15. Kinetics of a Particle: Impulse and Momentum

- 15.1 Principle of linear impulse and momentum
- 15.2 Principle of linear impulse and momentum for a system of particles
- 15.3 Conservation of linear impulse and momentum for a system of particles
- 15.4 Impact
- 15.5 Angular momentum
- 15.6 Relation between moment of a force and angular momentum
- 15.7 Angular impulse and momentum principles
- 15.8 Steady fluid streams
- 15.9 Propulsion with variable mass
- 15.10 Reduction of a simple distributed loading

16. Planar Kinematics of a Rigid Body

- 16.1 Rigid body motion
- 16.2 Translation
- 16.3 Rotation about a fixed axis
- 16.4 Absolute general plane motion analysis
- 16.5 Relative-motion analysis: velocity
- 16.6 Relative-motion analysis: acceleration
- 16.7 Relative-motion analysis using rotating axes

17. Planar Kinematics of a Rigid Body: Force and Acceleration

- 17.1 Moment of inertia
- 17.2 Planar kinetic equations of motion
- 17.3 Equations of motion: translation
- 17.4 Equations of motion: rotation about a fixed axis
- 17.5 Equations of motion: general plane motion

18. Planar Kinematics of a Rigid Body: Work and Energy

- 18.1 Kinetic energy
- 18.2 The work of a force
- 18.3 The work of a couple
- 18.4 Principle of work and energy
- 18.5 Conservation of energy

19. Planar Kinematics of a Rigid Body:  
Impulse and Momentum

- 19.1 Linear and angular momentum
- 19.2 Principle of impulse and momentum
- 19.3 Conservation of momentum
- 19.4 Eccentric impact

20. Three-Dimensional Kinematics of a rigid Body

- 20.1 Rotation about a fixed point
- 20.2 The time derivative of a vector measured from a fixed and translating-rotating system
- 20.3 General motion
- 20.4 Relative motion analysis using translating and rotating axes

21. Three Dimensional Kinetics of Rigid Body

- 21.1 Moments and products of inertia
- 21.2 Angular momentum
- 21.3 Kinetic energy
- 21.4 Equations of motion
- 21.5 Gyroscopic motion
- 21.6 Torque-free motion

22. Vibrations

- 22.1 Undamped free vibration
- 22.2 Energy methods
- 22.3 Undamped forced vibration
- 22.4 Viscous damped free vibration
- 22.5 Viscous damped forced vibration
- 22.6 Electrical circuit analogs

**Assignments:** Selected problems from each chapter are assigned and are to be turned in on a bi-weekly basis.

9. **TEXTS AND MATERIALS USED:** List of materials and specific chapters and sections of book (or books) used in this course. List books by author, title, publisher, year. State whether each material is supplied by the student or by the school. If different textbooks are used, state which is used most commonly, and attach variations by instructor.

Supplied by the student:

Engineering Mechanics, Statics, R.C. Hibbeler, 8<sup>th</sup> Edition,  
MacMillan Publishing Company, 1998.

Chapters 12-22

10. **AMOUNT OF WRITING REQUIRED:**

The amount of writing required is that amount the student would need to explain the rationale and approach that he would use to solve the assigned problems.

11. **METHODS OF EVALUATION:**

Four exams (including a final) given at 3-4 week intervals - 80%  
Four quizzes - 10% (one quiz given in each exam period).  
Homework - 10% (graded on the quality of work as well as accuracy).

12. **AUTHORIZED SIGNATURE AND FILE DATE:**  
**DEPARTMENT AND CAMPUS:**

*Helene K. Kabele* 9/28/98  
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Harold Washington College