**Course Outcomes** [Related ME Program Outcomes in Brackets]

1. Learn how to understand and describe a wide range of physical phenomena using only a few fundamental principles of physics. [A1, A2, A3]
2. Learn a unified approach that relates microscopic behavior to macroscopic behavior, such as the combination of traditional mechanics, a modern view of quantized atomic levels and statistics leading to basic thermodynamics from mechanics. [A1, A2, A3]
3. Learn how to apply this unified approach to a broad array of applications including asteroids, black holes, nuclear fission and fusion, quantization in atoms and molecules, and heat capacity. [A1, A2, A3, A4]
4. Learn to model natural phenomena, enabling quantitative studies such as computer simulations describing specific physical behaviors using a programming language called VPython, with little or no prior programming experience. [A1, A2, A3]
5. Gain experience in team building practice while conducting experiments in the labs and solving problems in recitations in small groups. [A3, B2]

**Momentum**
1. Interactions and Motion
2. The Momentum Principle: Impulse and Momentum Change
3. The Momentum Principle: Non-constant Forces
4. Contact forces and the Momentum Principle

**Energy**
1. The Energy Principle
2. Energy in Macroscopic Systems
3. Energy Quantization
4. Multiparticle Systems
5. Collisions

**Angular Momentum**
1. Angular Momentum of Macroscopic Systems

**Thermodynamics**
1. Entropy: Limits on the Possible
2. Gasses and Engines

**Recitation Applications**
1. Relativity
2. Asteroid Mass
3. Dark Matter, Black Holes
4. Fission
5. Fusion
6. Driven Harmonic Oscillator
7. Molecules
8. Binary Stars
9. Fusion Revisited
10. Bohr Model of Hydrogen
11. Probabilities
12. Measure of Heat Capacity of Water

**Laboratory Experiments**
1. Vectors & VPython
2. Motion & Modeling
3. Gravity & Moon Voyage
4. The Spring Ball Model of Matter
5. Modeling Spring oscillations
6. Momentum & Energy of a Bouncing Ball
7. Energy on a Moon Voyage
8. Energy, Power and Internal Energy
9. Real and Point Particle Systems: Spectra
10. Collisions: Rutherford Scattering
11. Angular Momentum, Torques, & Moment of Inertia
12. Entropy & Temperature
13. Heat Capacity
1. COURSE NUMBER AND NAME: PHYS 17200 Modern Mechanics

2. CREDITS AND CONTACT HOURS: 3 credits
   a. Lecture – 2 days per week at 50 minutes for 16 weeks
   b. Recitation – 1 day per week at 50 minutes for 16 weeks
   c. Laboratory – 1 day per week at 100 minutes for 16 weeks

3. COURSE COORDINATOR OR INSTRUCTOR:
   A. Hirsch

4. TEXTBOOK:

5. SPECIFIC COURSE INFORMATION:
   a. Catalog Description: Introductory calculus-based physics course using fundamental interactions between atoms to describe Newtonian mechanics, conservation laws, energy quantization, entropy, the kinetic theory of gases, and related topics in mechanics and thermodynamics. Emphasis is on using only a few fundamental principles to describe physical phenomena extending from nuclei to galaxies. 3-D graphical simulations and numerical problem solving by computer are employed by the student from the very beginning. Typically offered in fall, spring and summer.

   b. Prerequisites:
      MA 16100 – Plane Analytic Geometry and Calculus II

   c. Status: Required

6. SPECIFIC GOALS FOR THE COURSE:
   a. Course Outcomes:
      [Related ME Program Outcomes in Brackets]
      1. Learn how to understand and describe a wide range of physical phenomena using only a few fundamental principles of physics. [A1,A2, A3]
      2. Learn a unified approach that relates microscopic behavior to macroscopic behavior, such as the combination of traditional mechanics, a modern view of quantized atomic levels and statistics leading to basic thermodynamics from mechanics. [A1,A2, A3]
      3. Learn how to apply this unified approach to a broad array of applications including asteroids, black holes, nuclear fission and fusion, quantization in atoms and molecules, and heat capacity. [A1, A2, A3, A4]
      4. Learn to model natural phenomena, enabling quantitative studies such as computer simulations describing specific physical behaviors using a programming language called VPython, with little or no prior programming experience. [A1,A2, A3]
      5. Gain experience in team building practice while conducting experiments and solving problems in small groups. [A3, B2]

   b. Related ME Program Outcomes:
      [Related ABET Outcomes Listed in Brackets]
      A1. Engineering Fundamentals; B3. Prof/Ethical Responsibility;
      A3. Experimental Skills; B5. Life-Long Learning;
      A4. Modern Engr Tools; C1. Leadership,
      A5. Design Skills; C2. Global Engineering Skills;
      A6. Impact of Engr Solns; C3. Innovation;
      B1. Communication Skills; C4. Entrepreneurship
      B2. Teamwork Skills

7. LIST OF TOPICS: See following page.