**PHY 112 Calculus-based Physics I**

*All information is current for Summer 2010.*

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**Course Description (from Undergraduate Bulletin, 2009-2010):**  
PHY 112, 4 Credits

This is the first part of a three-semester course in introductory physics intended for students majoring in the physical sciences or in engineering. The subject matter is the study of Newtonian mechanics.

Prerequisite: M 144 [Calculus I] (may be taken concurrently). Laboratory fee.


**Laboratory Experiments:** There will be eleven laboratory experiments performed during the course. Full lab reports will be collected and graded. The laboratory constitutes 25% of the course grade.

- Density (scientific method and error analysis)
- Free Fall (velocity and acceleration as slopes)
- Force Table (balanced forces and vector addition)
- Acceleration of a cart (measuring acceleration with acceleration sensor, speed sensor, and force sensor)
- Dynamics (force and acceleration as related vectors)
- Centripetal Force (forces in a rotating system)
- Work and Energy (Work-Energy Theorem, gravitational and spring potential energy, kinetic energy)
- Ballistic Pendulum (Conservation of Momentum and Work-Energy Theorem)
- Elastic Collisions (2-D collisions)
- Moment of Inertia (rotational motion and Inertia)
- Torques (rotational equilibrium)

**Topics: Chapters 1 through 13 of the Text**

**Chapter 1**  All sections 1 - 7
- General Overview; scientific method
- Unit Basics: MKS system; dimensional analysis; scientific notation, unit conversions

**Chapter 2**  Sections 1 - 9; omit 10
- Center of mass motion for rigid bodies (kinematics); translation
- Position vs. displacement; 1-D vectors (positive and negative)
- Point in time vs. duration
- Velocity as rate of change in position; as slope of graph; negative velocity
- Acceleration as rate of change in velocity (faster/slower); as slope of graph
- Negative acceleration with positive velocity; area under v vs. t graph
- Basic 1-D Motion under constant acceleration; free fall

**Chapter 3**  All sections 1 - 8
- Magnitude and direction; unit vectors
- 2-D Vectors; components; notation
- Adding vectors graphically; adding by components
- Multiplying vectors to get a scalar; multiplying vectors to get a vector

**Chapter 4**  All sections 1 - 9
- Motion in 2 dimensions
- Position, displacement, velocity, acceleration in 2-D
- Basic Motion in 2-D; Projectile motion; parabolas; maximum range
- Uniform Circular Motion
- Relative motion (e.g., upstream vs. downstream)

**Chapter 5**  All sections 1 - 9
- Force and Motion
- Fundamental Forces; dissipative and conservative forces

continued on reverse side
Inertia and mass
Newton’s First Law: result of no net force
Newton’s Second Law: result of net force
Inertial and Non-inertial frames of reference
Newton’s Third Law: force is an interaction, not an actor (requires two objects)
Forces: balanced forces as a closed polygon
Force and balanced forces; dynamic and static equilibrium

Chapter 6
Sections 1 - 3, 5 omit 4
Special forces: normal forces; weight; static and kinetic friction; fluid and drag; tension
Uniform Circular Motion; polar coordinates; centripetal force; centrifugal force

Chapter 7
All sections 1 - 9
Conservation of Energy; work; kinetic energy; work-energy theorem
Work done by gravity
Work done by a spring
Work done by any varying force
Power

Chapter 8
All sections 1 - 8
Potential energy;
Conservative forces and path independence
Potential energy curves
Work done on a system by an external force
Conservation of energy problems and work-energy problems

Chapter 9
Sections 1 - 11; omit 12
Inertia and center of mass
Momentum; linear momentum and collisions;
Conservation of momentum
Newton’s Second Law in terms of momentum; impulse
Elastic vs. inelastic collisions; 2-D collisions

Chapter 10
All sections 1 - 10
Rotational motion; polar coordinates
Period; speed in UCM; angular speed
Rotational analogues to linear quantities
Rotation with constant angular acceleration
Rotational inertia; Rotational kinetic energy
Torque (“rotational force”); Newton’s Second Law in rotational terms
Work-Energy in rotational terms

Chapter 11
Sections 1-3, 6 - 11; omit 4, 5, and 12
Rolling as translation and rotation combined; kinetic energy of rolling
Torque revisited
Angular momentum; angular momentum of a system, of a rigid object
Newton’s Second Law with angular momentum
Conservation of angular momentum

Chapter 12
All sections 1 - 7
Equilibrium (linear and rotational)
Elasticity, stress and strain; tensile, shear and compressional stress.

Chapter 13
Sections 1 - 8; omit 9
Gravitation; universal law of gravitation
Principle of Superposition
Gravitational potential energy
Satellites and gravity; geosynchronous orbits