

2011-2012
University School
KAP Physics (Physics 140): Classical Physics
KAP Physics Lab (Physics 141): Classical Physics Lab
Instructor – Gordon Loveland

Course Description

This course is a theoretical and experimental introduction to calculus-based mechanics. It is taught through daily meetings with a 3-hour weekly laboratory session. Topics covered in the course include the kinematics and dynamics of particles, gravitation, work and energy, momentum, rotation, and special relativity. Participants are expected to also enroll in calculus, but we will develop the necessary mathematical tools in class as well. It is a year course.

The text used is Halliday, Resnick and Walker, *Fundamentals of Physics* 8th Edition Extended. Accompanying ancillary material is also used.

The syllabus of the course is that of Physics 140 at Kenyon College, and is essentially that suggested by the College Board for a C-level AP physics course in mechanics. In addition, coverage is given to one dimensional waves, special relativity, and elementary particle theory. The mathematical level of the course is the same level as the Halliday, Resnick, and Walker text, using calculus whenever appropriate.

Exams and Grading Information

Semester 1 Grades and weights:

Exam 1	20%
Exam 2	20%
Exam 3 (Semester Exam)	20%
Formal lab or lab exam	20%
Quizzes/Homework/Labs	20%

Semester 2 Grades and weights:

Exam 1	20%
Exam 2	20%
Exam 3 (Final Exam)	20%
Formal lab or lab exam	20%
Quizzes/Homework/Labs	20%

Lab

Students will keep a laboratory notebook that is inspected and signed off at the end of each lab period, and they undergo a formal laboratory evaluation each semester.

Experiments include:

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|----------------------------------|---|
| 1. Analysis of Experimental Data | 10. Rotational Kinematics |
| 2. Acceleration Due to Gravity | 11. Rotational Inertia of a Ring |
| 3. Projectile Motion | 12. Rotational and Gravitational Energy |
| 4. Centripetal Force | 13. Rotational Collisions |
| 5. Young's Modulus | 14. Simple Harmonic Motion |
| 6. Air Resistance | 15. Angular Simple Harmonic Motion |
| 7. The Ballistic Pendulum | 18. Elastic Scattering of Particles |
| 8. Collisions in One Dimension | 19. Inelastic Scattering of Particles |
| 9. Collisions in Two Dimensions | |

Outline of Topics

I. Newtonian Mechanics

A. Kinematics (including Vectors)

1. Motion in one dimension
2. Motion in two or three dimensions, including projectile motion.

B. Dynamics

1. Newton's Laws of motion
 - i. Static equilibrium
 - ii. Dynamics of a single particle
 - iii. Systems of two or more objects
2. Elasticity

C. Work, energy, power

1. Work and work-energy theorem
2. Forces and potential energy
3. Conservation of energy
4. Power

D. Systems of particles, impulse and linear momentum

1. Center of mass
2. Impulse and momentum
3. Conservation of linear momentum, collisions

E. Circular motion and rotation

1. Uniform circular motion
2. Torque and rotational statics
3. Rotational kinematics and dynamics
4. Angular momentum and its conservation

F. Oscillations and gravitation

1. Simple harmonic motion
2. Mass on a spring
3. Pendulum and other oscillations
4. Newton's law of gravitation
5. Orbits of planets and satellites

II. Relativity

1. Postulates
2. Relativity of time and length
3. Lorentz Transformations
4. Mass, momentum, and energy

III. Topics in Particle Physics