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# CURRICULUM PROPOSAL COVER SHEET
University-Wide Undergraduate Curriculum Committee

## I. CONTACT

Contact Person Dennis Whitson and W. Larry Freeman Phone 7-4593/4592

Department Physics

## II. PROPOSAL TYPE (Check All Appropriate Lines)

X **COURSE** Mechanics I
Suggested 20 character title

_____ New Course* _____
Course Number and Full Title

X Course Revision PHYS 222 Mechanics I
Course Number and Full Title

Rev.

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_____ Liberal Studies Approval + for new or existing course _____
Course Number and Full Title

_____ Course Deletion _____
Course Number and Full Title

_____ Number and/or Title Change _____
Old Number and/or Full Old Title

_____
New Number and/or Full New Title

_____ Course or Catalog Description Change _____
Course Number and Full Title

Rev.

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**PROGRAM:** _____ Major _____ Minor _____ Track

_____ New Program* _____
Program Name

_____ Program Revision* _____
Program Name

_____ Program Deletion* _____
Program Name

_____ Title Change _____
Old Program Name

_____
New Program Name

## III. Approvals (signatures and date)

Kenneth E. Hershman 11/16/00
Department Curriculum Committee

Richard D. Roberts 11/16/00
Department Chair

College Curriculum Committee 12/6/00

John D. Ecl 1/12/01
College Dean

_____
+Director of Liberal Studies (where applicable)

_____
*Provost (where applicable)

1993

# Syllabus of Record for PHYS 222

## I. Catalog Description

PHYS 222 Mechanics I

2 lecture hours
0 lab hours
2 credits
(2c-0l-2sh)

Prerequisites: PHYS 112 or 116 or 132; MATH 122 or 124

This course covers the basic laws and concepts of the mechanical universe. The dynamics of a particle in one, two, and three dimensions are covered. Central forces, including planetary and satellite motion, are discussed and analyzed in detail using Newton's gravitational law. Other covered topics are statics, multiple particle system dynamics, mechanical energy, and oscillations.

## II. Course Objectives

Upon successful completion of this course, the student will be able to:

1. Analyze and calculate the dynamics of a particle in one, two, and three dimensions.
2. Discuss, explain, analyze, and calculate central force problems including planetary and satellite motion.
3. Analyze the role of energy in particle dynamics and solve typical problems.
4. Describe, analyze, and calculate problems dealing with statics.
5. Analyze, explain, and apply the physics of oscillations.
6. Discuss, analyze, and calculate the interactions of systems of particles.

## III. Course Outline (28 hrs)

1. Mathematical Preliminaries (5 hrs)
   - A. Coordinate transformations
     - 1) definition of a vector
     - 2) properties of rotation matrices
     - 3) matrix operations
   - B. Vector analysis
     - 1) dot product
     - 2) cross product
     - 3) unit vectors
     - 4) velocity and acceleration in various coordinates systems
     - 5) gradient operator
2. Newtonian Mechanics (4 hrs)
   - A. Newton's Laws of motion

B. Constant Forces
C. Position-Dependent Forces
   1) Kinetic Energy
   2) Potential Energy
D. Velocity-Dependent Forces
   1) Fluid Resistance
   2) Terminal Velocity
E. Numerical Solutions

3. Oscillations (5 hrs)
   A. Linear Restoring Force
   B. Energy Considerations in Harmonic Motion
   C. Damped Harmonic Motion
   D. Forced Harmonic Motion, Resonance
   E. Non-Linear Oscillation
   F. Non-Sinusoidal Driving Force

4. Motion of Particle in Three Dimensions (5 hrs)
   A. The Work Principle
   B. Conservative Forces and Force Fields
   C. Potential Energy
   D. Forces of the Separable Type
   E. Harmonic Oscillator
   F. Motion of Charged Particles in Electric and Magnetic Fields

5. Gravitation and Central Forces (7 hrs)
   A. Newton's Law of Universal Gravitation
   B. Gravitational Force Between a Uniform Sphere and a Particle
   C. Kepler's Law of Planetary Motion
   D. Potential Energy in a Central Field
   E. Perturbed Circular Orbits

Testing (2 hrs)

## IV. Evaluation Methods

The final grade for the course will be determined as follows:

**70% Tests.** Two examinations for one hour each and a comprehensive final consisting of problem solutions and/or discussion questions.

**30% Homework and class discussion.** Students will be expected to participate in the discussion of problems, offering solutions to problems for the other students.

Grading Scale:
90-100% : A; 80-89% : B; 70-79%: C; 60-69% : D; below 60% F.

Attendance Policy: The attendance policy will conform to the University wide attendance criteria.

## V. Required Textbook

Fowles and Cassidy, *Analytical Mechanics*, 6th Ed., Saunders Publishing Co., 1999

## VI. Bibliography


Arya, A., *Classical Mechanics*, Simon & Schuster, Needham Heights, Mass., 1990

Barger, V., and Olsson, M., *Classical Mechanics*, 2nd Ed., McGraw Hill, New York, 1995

Goldstein, H., *Classical Mechanics*, 2nd Ed., Addison-Wesley, Reading, Mass., 1980

Kleppner, D., and Kolenkow, R., *An Introduction to Mechanics*, McGraw Hill, New York, 1973

Marion, J., and Thornton, S., *Classical Dynamics*, 4th Ed., Saunders Publishing Co., Philadelphia, 1995

Moore, E., *Theoretical Mechanics*, Wiley, New York, 1983

Rossberg, K., *A First Course in Analytical Mechanics*, Wiley, New York, 1983

Symon, Keith R., *Mechanics*, 3rd Ed., Addison-Wesley, Reading Massachusetts, 1971


## 2. Summary of Proposed Revisions

The only changes are in the prerequisites for PHYS 222, Mechanics I, where PHYS 116 is added to the list, MATH 128 is dropped, PHYS 111is changed to PHYS 112, and PHYS 131 is changed to PHYS 132. The change is from

Prerequisites: PHYS 111 or 131; MATH 122, 124, or 128
to
Prerequisites: PHYS 112 or 116 or 132; MATH 122 or 124

## 3. Justification/rationale for the revision

The proposed Electro-Optics program is the reason for this change. In this program two new physics courses are proposed, PHYS 115, Physics I for Electro-Optics, and PHYS 116, Physics II for Electro-Optics. If a student transfers to the main campus after finishing the Associate in Science in Electro-Optics degree he/she can then work on the Applied Physics degree with an Electro-Optics track. Mechanics I is a required course in this track and the relevant prerequisite is PHYS 116.

The change of PY 111 to PY 112 and PY 131 to PHYS 132 is because it was determined through experience that the students needed the extra background and experience of another semester of physics in order to do well in PHYS 222.

MATH 128 is being deleted from the list because the students who used to take this course now take MATH 124. MATH 128 was last offered in Spring 1998. The Mathematics Department program revision, that was effective in the 1998-99 catalog, no longer requires MATH 128. It was not deleted as a course so it is still listed as a prerequisite for courses in other programs.

**4. The old syllabus of record:**

# COURSE SYLLABUS

## I. Catalog Description

PHYS 222 Mechanics I 2 credits
Prerequisites: PHYS 111 or 131; MATH 122, 124 or 128

Dynamics of a particle in one, two, and three dimensions, central forces including planetary and satellite motion, energy in particle dynamics, statics, and systems of particles.

## II. Course Objectives

1. To presents a modern treatment of classical mechanical systems in such a way that the transition to the quantum theory of physics can be made with the least possible difficulty. To this end, modern notation and terminology are used throughout.

2. To acquaint the student with new mathematical techniques wherever possible, and to give him/her sufficient practice in solving problems so that he/she may become reasonably proficient in their use.

3. To impart to the student, at the crucial period in his/her career between introductory and advanced physics, some degree of the theory and the operational technique of problem solving.

## III. Procedure

1. The use of lectures, demonstrations and discussion on each topic presented.
2. Readings from assigned textbooks and outside readings from other pertinent texts.
3. Daily problem sets are assigned and graded to develop computational skill.
4. Two one-hour tests and a two-hour final test are used to further encourage the student and evaluate his/her progress.

## IV. Course Outline

1. Mathematical Preliminaries
   - A. Coordinate transformations
     1) definition of a vector
     2) properties of rotation matrices
     3) matrix operations

   - B. Vector analysis
     1) dot product
     2) cross product
     3) unit vectors
     4) velocity and acceleration in various coordinates systems
     5) gradient operator

2. Newtonian Mechanics
   - A. Newton's laws
     1) what is force

2) horizontal motion of particle in resisting medium
3) vertical motion of particle in resisting medium
4) motion of a projectile in a resisting medium
5) computer solutions
6) motion with variable mass

B. Conservation Theorems
1) single particle
a) linear momentum
b) angular momentum
c) energy

2) system of particles
a) definition of center of mass
b) linear momentum
c) angular momentum
d) energy

C. Gravitation
1) universal law
2) field vector
3) potential

3. Oscillations
A. Linear Oscillations
1) simple harmonic oscillations
2) damped oscillations
a) mechanical
b) electrical

B. Driven oscillations
1) sinusoidal driving
2) transient effects
3) driven electrical oscillations
4) Fourier series
5) impulse forcing functions

C. Nonlinear oscillations
1) oscillations for general potential functions
2) Plane pendulum
3) method of perturbation (optional)

4. Hamilton's Principle
A. Some methods in calculus of variations
1) statement of the problem
2) Euler's equation
3) functions with several dependent variables

B. Lagrange's equations of motion
1) derivation using Hamilton's Principle

2) examples

C. Hamiltonian Dynamics

## V. Evaluation Methods

The final grades for the course will consist of the following:

**70% Tests.** Two examinations consisting of problem solutions or discussion questions.

**30% Homework and class discussion.** Students will be expected to participate in the discussion of problems, offering solutions to problems for the other students.

## VI. Required Textbook

Analytical Mechanics, Fowles, Saunders Publishing CO., 5sth ed., 1993

Dr. Dennis Whitson
Physics Department
IUP

Dear Dr. Whitson:

The Mathematics Department supports the deletion of MATH 128 as a prerequisite for PHYS 222 and PHYS 331 since there are no plans to teach the course again.

Sincerely Yours

Gerald Buriok 11/17/00

Dr. Gerald Buriok
Chair, Mathematics Department