

**COURSE SYLLABUS**  
**PHY 3110 – Analytical Mechanics**  
**Fall Semester, 2016**

**Course Description -** PHY 3110, Analytical Mechanics, 4 credit hours

*Prerequisite: PHY 2120, MTH 2210 or permission of instructor*

This course explores topics from classical physics including linear and nonlinear oscillations, momentum and energy theorems, conservation laws, rigid body dynamics, and central force field motion. The course is intended for physics, engineering physics, pre-engineering, and other science fields.

**Instructor:** Dr. Hawley

**Office:** Janet Ayers Academic Center (JAC), room 4008

**Phone:** (615) 460-6206

**E-mail:** scott.hawley@belmont.edu

**Office Hours:** MWF 2-3pm, Tues 1-2pm, and by appointment.

*This is your time. Do not hesitate to come see me if you have questions or want to talk.*

**Meeting Times and Locations:**

9:30 a.m. - 10:45 a.m. T Th JAAC2144

1pm - 1:50pm M JAAC2144

**Textbook:** Classical Dynamics of Particles and Systems, 5th Edition by S.T. Thornton and J.B. Marion

**Skill Objectives:**

1. Students should be able to demonstrate a functional understanding of the analytical methods of classical physics. As such they will be prepared for future studies in science which build upon this knowledge.
2. Students should be able to successfully employ problem solving techniques such as dimensional analysis, approximation methods, and mathematical expansions.
3. Students will be able to work collaboratively in (some) problem solving experiences.

**Course Outline**

1. Review of Some Fundamental Concepts
  - a. Dimensions in physics
  - b. Vectors and scalars
  - c. Various coordinate systems
  - d. The transformation matrix
2. Newtonian Mechanics
  - a. Newton's laws; structure and meaning
  - b. Motion in one dimension
  - c. Position dependent forces
  - d. Time dependent forces
  - e. Velocity dependent forces
  - f. Consequences of Newton's laws
3. Oscillations
  - a. The simple harmonic oscillator
  - b. Phase space diagrams
  - c. Damped and driven oscillations
  - d. Resonance
  - e. Applications to physical systems
  - f. Nonlinear oscillations

4. Noninertial Frames of Reference
  - a. Accelerated coordinate systems
  - b. Rotating frames of reference
  - c. Dynamics of particles in noninertial reference systems
  - d. Effects of rotation
5. Motion in Central Force Fields
  - a. The inverse square force
  - b. Potential energy in central force fields
  - c. Angular momentum
  - d. Orbits in central force fields
  - e. The gravitational force
  - f. Planetary motion; Kepler's laws
  - g. Rutherford scattering
6. Systems of Particles
  - a. Center of mass concept
  - b. Center of mass frame of reference
  - c. Linear and angular momentum
  - d. Motion with variable mass
  - e. Elastic and inelastic collisions
  - f. Cross sections
7. Lagrangian & Hamiltonian Dynamics
  - a. Hamilton's variational principle
  - b. Calculus of variations
  - c. Generalized coordinates
  - d. Lagrange's equations
  - e. Constraints & Lagrange multipliers
  - f. Generalized momenta
  - g. Hamilton's equations

### Grading Procedures

Tests (4)	60%
Final Examination (comprehensive)	20%
Homework / Class Assignments	15%
Class Participation*	5%

\*Class participation grade will be based on the student's asking & answering questions during class, contributing (positively) to discussions, working problems (at the board or in groups).

### Grading Scale:

Course Average	Letter Grade
90 - 100	A
87 - 89	B+
83 - 86	B
80 - 82	B-
77 - 79	C+
73 - 76	C
70 - 72	C-
67 - 70	D+
63 - 66	D
60 - 62	D-
Below 60	F

## **Examination Schedule (Take-Homes). Turn in under Hawley's office door.**

Exam 1	Due Mon Sep 26 by 4pm
Exam 2	Due Wed Oct 12 by 3pm
Exam 3	Due Wed Nov 2 by 3pm
Exam 4	Due Tue Nov 22 by 9:30am (Morning before Thanksgiving Break)
Final Exam	Due at end of Belmont-scheduled final exam for this class time

For exams, you may ONLY refer to the textbook, course notes, and the Instructor. Collaborating with other students, consulting any (non-approved) external sources (e.g. solutions guides) is STRICTLY PROHIBITED and will result in referral to the Honor Court for cheating.

## **Policy on Missed Examinations**

No make-up examinations will be given. Should you have a valid reason for missing an examination, then your score on the final examination will be used in lieu of the examination you missed. If you fail to take an examination without a valid reason, then you will be assigned a zero on that examination. The course instructor determines the validity of your reason for missing an examination.

## **Policy on Class Attendance**

Your class attendance will not have any direct effect on your grade in this course, i.e., your grade will not be automatically raised or lowered because of exceptional class attendance or poor class attendance. Your grade, however, will probably be indirectly affected by your class attendance. The University policy on class attendance, stated on pages 51 and 52 of the current *Belmont University Bulletin*, will be followed. You must complete all work that you miss as a consequence of not being in class.

## **University Policies**

***Honor Code:** I will not give or receive aid during examinations; I will not give or receive false or impermissible aid in course work, in the preparation of reports, or in any other type of work that is to be used by the instructor as a basis for my grade; I will not engage in any form of academic fraud. Furthermore, I will uphold my responsibility to see that others abide by the spirit and the letter of the Honor Pledge.*

***Accommodation of Disabilities:** In compliance with Section 504 of the Rehabilitation Act and the Americans with Disabilities Act, Belmont University will provide reasonable accommodations of all medically documented disabilities. If you have a disability and would like the university to provide reasonable accommodations of the disability during this course, please notify Tammy Tanksley, Director of Counseling & Developmental Support, in the Office of Student Affairs (460-6407) as soon as possible.*

## **Disclaimer:**

The policies, topics and course organization described in this syllabus are subject to change. Adequate prior notice will be provided to all students in the event of a change.