University of Arkansas - Fort Smith
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General Syllabus

PHYS 3403 Classical Mechanics

Credit Hours: 3 Lecture Hours: 3 Laboratory Hours: 0

Prerequisite: PHYS 2923 University Physics II

Effective: 2018~2019

I. Course Information

A. Catalog Description

Mathematically rigorous treatment of classical mechanics, with emphasis on sophisticated problem solving. It builds on material from previous courses in mathematical physics and continues the introduction to mechanics the student was introduced to in University Physics.

B. Additional Information

The main purpose of the course is to increase the student's familiarity with classical mechanics, both because of its importance in contemporary physics and as an introduction to other fields such as quantum and statistical mechanics. A secondary purpose of the course is to reinforce the mathematical methods previously studied -- vector algebra, differential equations, vector calculus, matrices, eigenvalue problems -- that are so important in almost all areas of physics.

II. Student Learning Outcomes

A. Subject Matter

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

1. Determine the constants of motion.
2. Evaluate basic Newtonian dynamics using vectors and vector calculus.
3. Determine gravitation, gravitational potential.
4. Assess generalized coordinates, velocities, momenta, and forces.
5. Derive the Lagrangian.
6. Analyze differential equations for generalized coordinates.
7. Derive the Hamiltonian and write the differential equations for generalized coordinates and momenta.

8. Determine oscillations, both linear and nonlinear.
9. Develop a working knowledge of the calculus of variations.
10. Evaluate the motion of planets and other central force examples.
11. Evaluate notions of center of mass and relative coordinates.
12. Analyze rotations and motion in non-inertial frames.
13. Evaluate rotational motion of rigid bodies and Euler's equations.
14. Evaluate coupled oscillations.
15. Analyze how continuous systems can be described as limits of systems of particles.

B. University Learning Outcomes

This course enhances student abilities in the following areas:

Analytical Skills

Critical Thinking Skills: Students will identify a problem or issue and will research, evaluate, and compare information from varying sources in order to evaluate authority, accuracy, recency, and bias relevant to the problems/issues. The student will generate solutions/analysis of problems/issues evaluated and will assess and justify the solutions and/or analysis.

Communication Skills (written and oral)

Students will communicate proficiently. The student will compose coherent documents appropriate to the intended audience and effectively communicate orally in a public setting.

Ethical Decision Making

Students will model ethical decision-making processes. The students will identify ethical dilemmas and affected parties and will apply ethical frameworks to resolve a variety of ethical dilemmas.

Global & Cultural Perspectives

Students will reflect upon cultural differences and their implications for interacting with people from cultures other than their own. The students will demonstrate understanding or application of their discipline in a global environment and will demonstrate how their discipline impacts or is impacted by different cultures.

III. Major Course Topics

A. Matrices, Vectors and Vector Calculus
B. Newtonian Mechanics
C. Simple Harmonic Motion
D. Central Force Motion
E. Hamilton's Principle
F. Lagrangian and Hamiltonian Dynamics
G. Dynamics of a System of Particles

H. Rotation of Systems and Rigid Bodies
I. Coupled Oscillators
J. Waves and the Wave Equation