PHYS 342 – Analytical Mechanics
Spring 2009

Room: MA 60 Credit: 4 semester hours	Lectures: 10:40 – 11:55 pm MWF
Instructor: Dr. David Chappell Phone: 593-3511 x4598 email: chappell@ulv.edu	Office: MA 64 Office Hours: T 1-4, W 2:30-4, F 2:30-3:30 Website: faculty.ulv.edu/~chappell

Analytical Mechanics a.k.a. Classical Mechanics is the body of physical laws initially laid down by Isaac Newton. According to the classical picture, objects have precisely defined properties and deterministically evolve through the mutual interaction of forces. Classical Mechanics has been shown to be an incomplete theory that breaks down at small scales, at velocities close the speed of light, or in strong gravitational fields. In these situations, it must be replaced by Quantum Mechanics, Special Relativity, or General Relatively respectively. But for most problems that we encounter in our everyday life, Classical Mechanics provides the simplest and most useful description of the world.

> There once was a classical theory,
> Of which quantum disciples were leery.
> They said, "Why spend so long
> On a theory that's wrong?"
> Well, it works for your everyday query!
> –David Morin

Goals:
At the end of the course students will be able to:

1. Solve statics problems by balancing the net forces and torques acting on the system. Be able to solve problems involving rigid objects, rods, massless strings, massive strings, inclined planes, friction forces, etc.

2. Solve dynamics problems by analyzing forces and torques. Be able to use Newton's second law to translate the forces into a set of ordinary differential equations (ODEs). Be able to solve ODEs using analytical methods.

3. Use MATLAB to numerically solve systems of ODEs, perform integral transforms, and solve eigenvalue problems. Be able to plot time series, phase plots, parametric equations, surfaces.

4. Analyze systems exhibiting chaotic dynamics. Be able to construct phase plots and Poincare' sections using MATLAB

5. Solve dynamics problems using conservation laws (mass, energy, linear momentum, angular momentum).

6. Solve constraint problems using Lagrangian and Hamiltonian Dynamics.

7. Analyze systems in accelerating frames of reference.

Text
Introduction to Classical Mechanics With Problems and Solutions (1st edition), David Morin, 2007

Prerequisites: PHYS 204, MATH 202

Evaluation
Your grade for the course will be based on the following:

Quizzes &homework	25%
3 exams @ 15% each	45%
Final cumulative exam	30%

Letter grades will be assigned as follows:

A, A-	90 – 100
B+, B, B-	80 – 89
C+, C, C-	70 – 79
D+, D, D-	60 – 69
F	below 60

Homework
Homework assignments will be due at the beginning of every class lecture. You will keep two lab notebooks for homework solutions. At the beginning of each class period you will turn in your solutions in one notebook and I will return your graded homework set in the other notebook. Thus, we will swap the notebooks back and forth throughout the semester. The notebooks will be a very helpful resource when studying for tests, so I recommend keeping then neat and organized. You will be graded on your "answers" and on how well you communicate your problem solving thought process. I recommend working through as many of the solved problems in your text in your notebooks as well. Some extra credit may be given for these problems at the end of the semester.

Quizzes
Quizzes will be given throughout the semester, often testing you on mathematical techniques. The lowest quiz score will be dropped at the end of the semester.

Tests
Three one-hour, in-class tests will be given in addition to a comprehensive final at the end of the class. Tests will cover material from the lectures, textbook, quizzes and problem sets. No equation sheet will be provided. You will be expected to derive all your results from fundamental laws or equations, such as Newton's second law, conservation of energy, or Lagrange's Equation.

MATLAB
We will be using MATLAB throughout the course to solve problems that require numerical solutions. Those problems requiring MATLAB will be explicitly stated. MATLAB in installed on the computers in the physics lab MA 60 as well as FH 206 and FH 207.

Schedule (Subject to Change)

Week Beginning	***Lecture***
Feb. 2	Chapter 1: Strategies for Solving Problems
Feb. 9	Chapter 2: Statics
Feb. 16	President's Day – No Class
Feb. 18	Chapter 3: Using F=ma
Feb. 23	Chapter 3: Using F=ma **TEST 1**
Mar. 2	Chapter 4: Oscillations
Mar. 9	Special Topic: Chaos
Mar. 16	Chapter 5: Conservation of Momentum and Energy
Mar. 23	Chapter 6: The Lagrangian Method
Mar. 30	Chapter 6: The Lagrangian Method (continued) **TEST 2**
Apr. 6	**Spring Break**
Apr. 13	Chapter 7: Central Forces
Apr. 20	Chapter 8: Angular Momentum – Part I (Constant L)
Apr. 27	Chapter 9: Angular Momentum – Part II (General L)
May 4	Chapter 9: Angular Momentum – Part II (General L)
May 11	Chapter 10: Accelerating Frames of Reference **TEST 3**
May 18	**Finals Week**