

# SYLLABUS FOR PHYSICS 331, MECHANICS

FALL TERM, 2009

Dr. Edward A. Roeder, instructor  
Office: Room 111, Collier Hall of Science  
Office Phone: Extension 1439  
e-mail address: meear01@moravian.edu  
Office hours will be posted.

## PURPOSE and GOALS:

The underlying philosophy of this course is that physics is a unified body of knowledge and that mechanics provides the basic concepts for the whole of physics. Mechanics was one of the earliest of the sciences to be developed. It profoundly influenced the growth of the later sciences such as sound, electricity, heat, light, and even modern physics. For example, the evasive neutrino, which was found to be associated with beta-particle emission in radioactivity, was originally introduced in order to satisfy the basic laws of conservation of energy and angular momentum.

Throughout this course, emphasis will be placed on physical concepts. Although mathematics is absolutely indispensable in the study of mechanics, it will be used not as the master, but as the servant. In presenting some of the more difficult concepts, an elementary introduction will first be given before proceeding to a more rigorous analysis. This is done to help the student to develop an understanding of the physical theory before he/she becomes involved in detailed mathematical procedures.

Vectors and vector analysis will be employed throughout the course because of their usefulness in presenting physical ideas in a concise manner. The general philosophy is that there is an advantage to becoming acquainted with vector methods and analysis earlier rather than later. The instructional pace may vary

with the particular topics being studied. The style of presentation will be step-by-step, with the ultimate goal being a thorough understanding of the theory as well as the associated mathematical methods. A subsequent goal will be the successful solution of numerous assigned homework problems. A final goal will be the application of techniques learned in this course to problems assigned in other upper level physics courses, both here at Moravian and also in graduate school.

**REQUIRED TEXT:** "Mechanics", 3rd Edition, by Keith R. Symon, Addison-Wesley, 1971.

**SUPPLEMENTARY READING:** "Newtonian Mechanics", by A.P. French, Norton, 1971.

**ATTENDANCE POLICY:** Each student is expected to attend all classes in this course. Daily attendance records will be kept. In the event that an exam is missed, a make-up will be given provided the absence is **EXCUSED**. If the absence is **UNEXCUSED**, a **ZERO** will be recorded for that exam. In order for an absence to be excused, the student must present a) a valid medical excuse signed by a doctor or nurse, or b) an explanatory statement from the Dean of Students verifying that the absence qualifies as "excusable".

In the event that the number of unexcused absences in the course exceeds three (3), **ONE POINT** will be subtracted from the student's final average for each additional unexcused absence following the third.

**POLICY REGARDING HOMEWORK:** "Due Dates" will be announced for the homework problems. Any problems turned in within 24 hours after a deadline will receive **HALF CREDIT**. Homework submitted after that time will automatically be assigned a grade of **ZERO**.

The Policy on Academic Honesty to be followed in this course is as

follows: Moravian College expects its students to perform their academic work honestly and fairly. A Moravian student, moreover, should neither hinder nor unfairly assist the efforts of other students to complete their work successfully. This policy of academic integrity is the foundation on which learning is built. The College's expectations and the consequences of failure to meet those expectations are outlined in the current Student Handbook, available from the Student Affairs Office, and in the statement on Academic Honesty at Moravian, available from the Academic Dean's Office. If, at any point in a student's academic work at Moravian, a student is uncertain about his or her responsibility as a scholar or about the propriety of a particular action, the instructor should be consulted. Any student failing to comply with the College's policy of academic honesty will be reported to the Academic Standards Committee.

GRADES will be determined as follows:

Exams-----50%

Homework-----25%

Final Exam-----25%

While grades will be computed by the indicated percentages, it is within the instructor's purview to apply qualitative judgment in determining the final grades for the course.

The following topics will be covered:

## I. INTRODUCTION

1. Fundamental Quantities of Mechanics
2. Scalar Product
3. Vector Product
4. Derivative of a Vector
5. Position, Velocity, and Acceleration
6. Tangential and Normal Components of Acceleration
7. Velocity and Acceleration in Plane Polar Coordinates

## II. NEWTONIAN MECHANICS

1. Kinematics---Description of Motion
2. Dynamics---Newton's Laws of Motion
3. Constant Forces
4. Forces That Depend Upon Position
5. Kinetic and Potential Energy
6. Time Dependent Forces
7. Impulse
8. Velocity Dependent Forces

## III. SIMPLE HARMONIC OSCILLATOR

1. Harmonic Motion
2. Energy in Simple Harmonic Motion
3. Damped Harmonic Motion
4. Forced Harmonic Motion
5. Resonance

## IV. MOTION OF A PARTICLE IN TWO OR THREE DIMENSIONS

1. Potential Energy
2. Separable Types of Forces
3. Projectile Motion
4. The Harmonic Oscillator
5. Motion of Charged Particles in Electric and Magnetic Fields
6. Constrained Motion of a Particle

## V. CENTRAL FORCES

1. Newton's Law of Universal Gravitation
2. Force Between a Particle and a Uniform Sphere
3. Potential Energy in a Gravitational Field
4. Gravitational Potential
5. Potential Energy in a General Central Field
6. Angular Momentum
7. Kepler's Laws
8. Orbit of a Particle in a Central Force Field
9. Orbits and Energies in an Inverse-Square Field
10. Periodic Time of Orbital Motion

## 11. Inverse-Square Repulsive Field