

# SYLLABUS FOR PHYSICS 332, MECHANICS

SPRING TERM, 2008

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## 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.

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. NONINERTIAL REFERENCE SYSTEMS

- 1) Accelerated Coordinate Systems and Inertial Forces
- 2) Rotating Coordinate Systems
- 3) Dynamics of a Particle in a Rotating Coordinate System
- 4) Effects of the Earth's Rotation
- 5) The Foucault Pendulum

II. DYNAMICS OF SYSTEMS OF PARTICLES

- 1) Center of Mass and Linear Momentum of a System
- 2) Angular Momentum and Kinetic Energy of a System
- 3) Motion of Two Interacting Bodies. The Reduced Mass
- 4) Collisions

- 5) Oblique Collisions with Scattering
- 6) Laboratory and Center of Mass Coordinates
- 7) Motion of a Body with Variable Mass

### III. MECHANICS OF RIGID BODIES. MOTION IN A PLANE

- 1) Center of Mass of a Rigid Body
- 2) Rotation of a Rigid Body About a Fixed Axis
- 3) Moment of Inertia
- 4) The Physical Pendulum
- 5) A General Theorem About Angular Momentum
- 6) Laminar Motion of a Rigid Body
- 7) Impulse and Collisions Involving Rigid Bodies

### IV. MOTION OF RIGID BODIES IN THREE DIMENSIONS

- 1) Rotation of a Rigid Body About an Arbitrary Axis
- 2) Moments and Products of Inertia
- 3) Angular Momentum and Kinetic Energy
- 4) Principal Axes of a Rigid Body. Dynamic Balancing
- 5) Euler's Equations of Motion
- 6) Free Rotation of a Rigid Body
- 7) Free Rotation of a Rigid Body with an Axis of Symmetry
- 8) The Eulerian Angles
- 9) Gyroscopic Precession
- 10) Motion of a Top
- 11) General Motion of a Rigid Body. The Rolling Wheel

### V. LAGRANGIAN MECHANICS

- 1) Generalized Coordinates
- 2) Generalized Forces
- 3) Lagrange's Equations
- 4) Some Applications of Lagrange's Equations
- 5) Generalized Momenta. Ignorable Coordinates
- 6) Hamilton's Variational Principle
- 7) The Hamiltonian Function
- 8) Hamilton's Equations

