# UNIVERSITY OF MASSACHUSETTS
# DEPARTMENT OF EXERCISE SCIENCE

## EXERCISE SCIENCE 531

## Mechanical Analysis of Human Motion

## Fall, 2004


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| **INSTRUCTOR** | **:** | Joseph Hamill, Ph.D. |
| **OFFICE** | **:** | Totman 110 |
| **OFFICE HOURS** | **:** | 9:00-10:00 Monday, Wednesday or by appointment. |
| **TELEPHONE** | **:** | 545-2245 |
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| **COURSE WEB PAGE** | **:** | http://courses.umass.edu/exsci531/index.htm |


## COURSE PREREQUISITES

Physics 141-142 (Mechanics) or equivalent
Math 131-132 (Calculus) or equivalent
Exercise Science 304 (Human Anatomy)
Exercise Science 305 (Kinesiology) or equivalent

## OBJECTIVES

Conducting mechanical analyses of human motion has become an important tool for understanding the control of human movement. These techniques are used in both research and clinical settings. Specifically, students will be expected to:

1) Demonstrate an understanding of the theoretical issues in Biomechanics.

2) Demonstrate knowledge of the conventions used in analyzing biomechanical data.

3) Describe the techniques used in the analysis of biomechanical data.

4) Provide examples of these techniques in the literature.

## COURSE FORMAT

This is a 3-credit course that consists of two 75-minute lectures (Tu and Th, 9:30 - 10:45 AM) per week. The lectures will cover the fundamental aspects of the course topics. In addition, they will cover specific information on the various lab sessions as well as homework assignments. Although attendance at the lectures is not mandatory, students are responsible for all announcements,

handouts, quizzes, etc. that may be given during the lecture meetings. Attendance at lab sessions is mandatory. The lab sessions will provide an experimental platform for the students to apply knowledge learned from the lectures to specific situations.

## COURSE REQUIREMENTS

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| 1. 2 mid term examinations | 50 | points each |
| 2. Final examination | 100 | points |
| 3. Assignments | 100 | points |
| Total | 300 | points |

All assignments must be turned in on the designated due date or they will not be accepted. No excuses will be accepted.

## GRADING

The grading for this course will follow the University of Massachusetts standard. That is:

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| A+ | >94 |
| A | 90> <93 |
| A- | 86> <89 |
| B+ | 80> <85 |
| B | 75> <79 |
| B- | 70 > <74 |
| F | less that 69 |

## SUGGESTED READING

There is no specific textbook for this class. However, class notes that follow the lectures are available. In addition, there will be weekly reading assignments either from books or papers in the literature. The required readings will be placed in the Biomechanics Laboratory in the Totman Building.

## COURSE CONTENT

1. Introduction

2. Math Review
   - vectors and scalars
   - vector algebra
   - matrix calculations

3. 2-D Kinematics
   - sagittal
   - rearfoot

4. 3-D Kinematics
   - coordinate systems
   - ordered rotations
   - joint angles
   - segment angles

Mid-Term Exam

5. Anthropometry

6. Kinetics
   - 2-D Newton-Euler method
   - 2-D Lagrangian method
   - 3-D Newton-Euler method

Mid-Term Exam

7. Energy, work and power

8. Modeling
   - point-mass model
   - force-driven harmonic oscillator model
   - mass-spring model
   - mass-spring-damper model

Final Exam