MISSISSIPPI STATE UNIVERSITY
COLLEGE OF EDUCATION

DEPARTMENT of KINESIOLOGY
COURSE SYLLABUS

Course Prefix & Number: EP 8453

Course Title: Biomechanics of Human Movement

Credit Hours: Three (3) semester hours

Course Type: Lecture

Catalog Description: Prerequisite: EP 3233 or equivalent. An overview of biomechanical principles/laws and their application to human movements (sport techniques and daily activities).

College of Education Conceptual Framework:

The faculty in the College of Education at Mississippi State University are committed to assuring the success of students and graduates by providing superior learning opportunities that are continually improved as society, schools, and technology change. The organizing theme for the conceptual framework for the College of Education at Mississippi State University is educational professionals **-** dedicated to continual improvement of all students' educational experiences. The beliefs that guide program development are as follows:

1. **KNOWLEDGE** - Educational professionals must have a deep understanding of the organizing concepts, processes, and attitudes that comprise their chosen disciplinary knowledge base, the pedagogical knowledge base, and the pedagogical content knowledge base. They must also know how to complement these knowledge bases with the appropriate use of technology.
2. **COLLABORATION** - Educational professionals must continually seek opportunities to work together, learn from one another, forge partnerships, and assume positions of responsibility.
3. **REFLECTION** - Educational professionals must be willing to assess their own strengths and weaknesses through reflection. They must also possess the skills, behaviors, and attitudes necessary to learn, change, and grow as life-long learners.
4. **PRACTICE** - Educational professionals must have a rich repertoire of research-based strategies for instruction, assessment, and the use of technologies. They must be able to focus that array of skills on promoting authentic learning by all students or clients, while exhibiting an appreciation and commitment to the value and role of diversity.

Course Objectives:

1. Learn to look at biomechanics as a scientific basis for the analysis of human movement CFPO #3
2. Understand the descriptions and the cause/effect components of human movement CFPO #3
3. Apply anatomical and biomechanical analyses to the study and improvement of a broad spectrum of movement activities CFPO #3, 4
4. Understand the mechanism of common musculoskeletal injuries and movement disorders CFPO #3

Topics to Be Covered:

1. Review Planes, Axis & Joint Actions: Review of the proper joint actions and the appropriate plane the movement occurs in and the axis that rotation occurs about (3 hours) CFPO #3
2. Vector Review & Vector Mathematics: Review of vector addition and subtraction, trigonometric functions, and how it applies to human movement and sport performance (3 hours) CFPO #3
3. Equations of Uniform Acceleration & Application of Uniform Acceleration Equations: Applying equations of uniform acceleration to projectile motion and human movements (3 hours) CFPO #3
4. Linear versus Angular Motion: Discussing the terminology for linear versus angular motion, similarities and differences. Ex. For linear motion = mass, for angular motion = mass moment of inertia (3 hours) CFPO #3
5. Kinematics of Gait, Gait Disorders: Learning the typical gait patterns; joint angles, velocities, and accelerations associated with normal gait versus abnormal gait (3 hours) CFPO #3
6. Newton's Laws of Motion & Free Body Diagrams: Studying Newton's 3 laws of motion and how they apply to human movement, applying these laws to the drawing of free body diagrams (3 hours) CFPO #3
7. Force and Equilibrium; Sum of Forces: Study of Newton's second law, F = ma, and how this applies to motion and equilibrium (3 hours) CFPO #3
8. Center of Gravity, Balance: Discussion of balance, the relationship between the center of gravity and balance, balance disorders (3 hours) CFPO #3
9. Human forces: Discussion of the internal forces found within the human body, ex. Muscles, bones (3 hours) CFPO #3
10. Rotational forces: How muscles and tendons create rotational forces at the joints, discussion of moments (torque) (3 hours) CFPO #3
11. Movement Analysis-Sum of forces: static, dynamic, impulse-momentum: Applying Newton's second law to static and dynamic motion, discussing the relationship between momentum and impulse (3 hours) CFPO #3, 4
12. Movement Analysis-Work-Energy: Learning the proper equations for work, power, and energy and applying these equation to motion analysis (3 hours) CFPO #3, 4
13. Types of Loading/Mechanisms of Injuries: Learning of the six types of loading, and how this loading can cause musculoskeletal injuries (3 hours) CFPO #3

14. Inverse Dynamics: The culmination of the class. This process will teach the student how to use kinematic measures (linear acceleration, angular acceleration, joint angles) and use Newton's second law to solve for the forces at specific joints. (6 hours) CFPO #3

Texts:

Enoka, R.M. (2008). *Neuromechanics of human movement (4th Ed.*). Human Kinetics, Champaign, IL. **Required**

Winter, D.A. (2005). *Biomechanics and motor control of human movement (3rd Ed.).* John Wiley & Sons, Inc., Hoboken, NJ. **Recommended**

Methods of Instruction:

1. Lecture (Objectives 1-4)
2. Class Discussion (Objectives 1-4)
3. Lab activities (Objectives 1-4)

Suggested Student Activities:

1. Attend all lectures and participate in classroom discussions (Objectives 1-4)
2. Complete all lab activities (Objectives 1-4)
3. Read appropriate chapters in the textbook and supplementary reading materials (Objectives 1-4)
4. Complete the end of semester project (Objectives 1-4)
5. Be prepared for all lectures, quizzes, and exams. If you are struggling with a topic, please see the professor as soon as possible (Objectives 1-4)

MSU Honor Code:

Mississippi State University has an approved Honor Code that applies to all students. The code is as follows:

> **"As a Mississippi State University student I will conduct myself with honor and integrity at all times. I will not lie, cheat, or steal, nor will I accept the actions of those who do."**

Upon accepting admission to Mississippi State University, a student immediately assumes a commitment to uphold the Honor Code, to accept responsibility for learning, and to follow the philosophy and rules of the Honor Code. Students will be required to state their commitment on examinations, research papers, and other academic work. Ignorance of the rules does not exclude any member of the MSU community from the requirements or the processes of the Honor Code. For additional information please visit: http://www.msstate.edu/dept/audit/1207A.html.

Honesty and integrity are expected of every student. All occurrences of academic misconduct will be dealt with in accordance with the guidelines and procedures outlined in the Academic

Misconduct Policy. Additional university policies related to students can be accessed at: http://www.msstate.edu/web/student_policies.html.

Technology:

Motion analysis tools such as video cameras, motion analysis software, and force plates will be used in this course.

Diversity:

Diversity will not be specifically addressed in this course.

Disability statement:

It is the policy of Mississippi State University to accommodate students with special needs and learning disabilities as per the MSU Student Support Services policy. Students seeking accommodations on the basis of a disability or special need must identify themselves to the Office of Student Support Services (325-3335) to verify eligibility. Additional documentation guidelines may be obtained by contacting the Office of Student Support Services directly, or via the web at http://www.msstate.edu/dept/audit/91130.html. Academic accommodations and services are based upon an individual's needs. All documentation is confidential.

Field Component: This course does not have a field component.

Evaluation:	**Total Points = 500**
Three exams (includes the final exam)	100 x 3 = 300 points
Quizzes and Homework	100 points
Motion Analysis Project	100 points

Grading Scale: A = 90 - 100%, B = 80 - 89, C = 70 - 79, D = 60 - 69, F = 59 - below

Project: Students will work individually on a motion analysis project. Each student will choose a specific motion/skill and analyze the skill using correct biomechanical and anatomical terminology. The purpose of the project is to apply the materials covered in class to a real world setting. If the correct terminology is used, there is no right or wrong way to format the project. It may be presented as a typed paper or students have the option of creating a PowerPoint presentation of their topic to be turned in on a CD to the professor. More details of the project will be covered in class and examples will be posted on the class website. Each student will present the project to the class at the end of the semester.

Exams: Exams will consist of multiple choice and math questions. There will be three to four exams given throughout the semester, including a comprehensive final exam. Exams will be announced one week in advance, and a portion of the class period before the exam will be devoted to a review. You will not be allowed to make-up a missed exam without a documented medical excuse.

Bibliography:

Enoka, R.M. (1997). Neural adaptations with chronic physical activity. (1997). *Journal of Biomechanics, 30*, 447-455.

Fleisig, G., Chu, Y., Weber, A., & Andrews, J. (2009). Variability in baseball pitching biomechanics among various levels of competition. *Sports Biomechanics, 8*¸ 10-21.

Mok, K.M., Fong, D.T., Krosshaug, T., Engebresten, L., Hung, A.S., Yung, P.S., Chan, K.M. (2011). Kinematics analysis of ankle inversion Ligamentous sprain injuries in sports: 2 cases during the 2008 Beijing Olympics. *American Journal of Sports Medicine, 39*, 1548-1552.

Myers, C.A., & Hawkins, D. (2010). Alterations to movement mechanics can greatly reduce anterior cruciate ligament loading without reducing performance. *Journal of Biomechanics, 43*, 2657-2664.

Niu, W., Wang, Y., He, Y., Fan, Y., & Zhao, Q. (2011). Kinematics, kinetics, and electromyogram of ankle during drop landing: A comparison between dominant and nondominant limb. *Human Movement Science, 30,* 614-623.

Ristanis, S., Tsepis, E., Giotis, D., Stergiou, N., Cerulli, G., & Georgoulis, A.D. (2009). Electromechanical delay of the knee flexor muscles is impaired after harvesting hamstring tendons for anterior cruciate ligament reconstruction. *American Journal of Sports Medicine, 37*, 2179-2186.

Sell, T.C., Ferris, C.M., Abt, J.P., Tsai, Y.S., Myers, J.B., Fu, F., & Lephart, S. (2006). The effect of direction and reaction on the neuromuscular and biomechanical characteristics of the knee during tasks that simulate the noncontact anterior cruciate ligament injury mechanism. *American Journal of Sports Medicine, 34,* 43-54.

Weinhandl, J.T., Joshi, M., & O'Conner, K.M. (2010). Gender comparisons between unilateral and bilateral landings. *Journal of Applied Biomechanics, 26,* 444-453.