Midwestern State University
Department of Athletic Training and Exercise Physiology
EXPH 5043 Advanced Biomechanics (3 Credit)

Instructor: Michael W. Olson, Ph.D.
Email: michael.olson@msutexas.edu
Office: Ligon Coliseum 215
Phone: 940-397-4053
Office Hours: M /W: 1:00-2:00 pm; T/TH: 11:00-1:00pm

Course Meeting Time: Tuesday 6:00 – 8:30pm; Room 223 Ligon Coliseum

Important Dates:

First day of Class:	Tuesday, August 24
Exam I (midterm):	Tuesday, October 5
Exam II (Final):	Tuesday, December 7 (8-10pm)

Texts/Materials:

There will be no specified text required for the course. Relevant reading materials for each class session will be provided in the form of research articles and selected book chapters through Desire2Learn.

Attendance

Attendance at class is **compulsory** if you intend on performing well in this course. Attendance will be taken for both face to face and virtual meetings.

While in the classroom, social distancing will be practiced as assigned seating will be in place. The classroom will have stickers denoting where students will be able to sit. Wearing masks is mandatory while in the classroom and the building. If a student does not follow these safety precautions then he/she will be asked to leave the face to face classroom.

Course Description:

The purpose of this course is to familiarize graduate level students in the application of mechanics to biological systems. The course is intended to further your knowledge of the basic concepts introduced in the undergraduate biomechanics. Quantitative and qualitative analyses of movement will be discussed. Importance will be placed on application of mechanical principles when analyzing basic human movements. Each student will pick a topic of his/her choosing to research and discuss how biomechanical principles influence the biological system.

Course Objectives:

There are five objectives to this course:

- Introduction of underlying theories and concepts
- Application of theories and concepts to real-world situations
- Familiarize students with the biomechanics literature
- Provide understanding of the role of biomechanics in everyday life
- Introduce instrumentation and how it is used to measure biomechanical variables

Course Evaluation:

Exam I	25%
Exam II	25%
Project	25%
Oral presentation	15%
Participation	10%

Grading Scale: A: ≥ 90; B: 89.99 – 80; C: 79.99 – 70; D: 69.99-60; F: ≤ 59.99

Examinations:

There will be two examinations during the semester, a midterm and a final. The format of these examinations will be primarily essay incorporating material from previously presented lectures/discussions. Application questions may also be included to test each student's critical thinking.

Research Project/presentation:

A self-selected, pre-approved topic will be chosen within the first two weeks of the course. A systematic timetable to track the progression of each individual will be enforced to ensure the requirements of the assignment are attained. This timetable includes the selection of a research question or hypothesis, compilation of relevant research articles, and due date for rough drafts. At the end of the semester, students will be allotted 10 minutes to orally present their research topics. There will be a 5 minute time period for questions/answers and group discussion. In general, this project is an assessment of the students abilities to apply biomechanical concepts.

The format of the project report will include an Introduction, Methods, Results, and Discussion/Conclusion. The Introduction will include a brief literature review/background of the problem, the purpose of the project, and the hypotheses you want answered. The Methods section will include the demographic information of the participants, the instruments used to collect data, and a stepwise process of the procedures performed to collect the data. If statistical analyses are used, they will belong in this section, as well. The Results section is where you will report the findings of your research. Typically, you will structure this based upon the variables you chose to examine. The Discussion section is used to reiterate your purpose and hypotheses, and to write about whether or not the data support or do not support your hypotheses.

The length of the report, not including title page and reference page(s), should be 7-8 pages, double spaced, 12 point Times New Roman or Ariel (or similar) font, with 1" (2.54 cm) margins on top and bottom, with 1.25" (3.18 cm) right and left margins.

For the oral presentation you will need to highlight the major points of your project. The presentations will be Power Point slide presentations. Remember, pictures provide more information than words. Inundation of the slide with too many words will overload your audience.

The following rubric will be followed when assessing your presentation and/or paper:

Presentation:

1. Content (30%): is the information valuable to explore
2. Clarity (15%): how well are you presenting the information
3. Competency (40%): are you communicating that you understand and can use the biomechanical terminology applied to the research review
4. Overall Presentation (10%): were the main themes (introduction, systematic presentation, and discussion/conclusion) included in your presentation
5. Slide Show (5%): how well did you prepare the presentation and make use of technology

Report:

1. Background (20%): is the information valuable to explore, supported by the literature
2. Purpose and Hypotheses (20%): do these fit with gaps in the literature
3. Methods/Procedures (20%): how well were the procedures performed for data collection
4. Results (20%): are all data reported appropriately and clearly identified for the reader
5. Discussion (20%): do the data support the hypotheses and how well is the section written to support the findings and how they can be applied

Participation:

The format of the course is a mix of lecture and group discussion of the assigned readings and presented materials. It is expected that each person will contribute to the group discussion. The class will meet 15 times during the semester. Thirteen of those weeks will consist of lecture/discussion, one week will be focused on the midterm examination, and the last week will be tailored to your presentations. In addition, you will be expected to contribute weekly on a Discussion Board on Desire2Learn. The instructor will post a question or comment regarding the topic from either the pervious class or the next class period, and each student will be required to post responses relevant to the original post at least three (3) times during that week. I want relevant posts, not just "I agree with that statement". It is expected that additional thoughts regarding the materials from the original post will be posted. Additionally, you can also pose your own questions to the class and begin a new discussion thread.

Week	Topic	Readings
1 (Aug. 25)	Introduction to the course, and Theories of Motion	Hansen et al. (2017)
2 (Sept. 1)	Linear Kinematics	Hamill & Knutzen (Chapter 8)
3 (Sept. 8)	Linear Kinematics – Projectile Motion	Hamill & Knutzen (Chapter 8)
4 (Sept. 15)	Angular Kinematics – Connections with Linear Movement	Hamill & Knutzen (Chapter 9)
5 (Sept. 22)	Linear Kinetics – Newton's Laws	Kinetics Worksheet, and Hay (Chapter 5)
6 (Sept. 29)	Linear Kinetics – Impulse-Momentum and Collisions	Hay (Chapter 5)
7 (Oct. 6)	EXAM I (online)	

8 (Oct. 13)	Angular Kinetics – Newton's Laws	Hay (Chapter 6)
9 (Oct. 20)	Angular Kinetics - Torque	Hay (Chapter 6) Griffiths (Chapter 8)
10 (Oct. 27)	Mechanical Work, Energy, & Power	Hay (Chapter 5)
11 (Nov. 3**)**	Muscle Mechanics I	Herzog et al (2003)
12 (Nov. 10)	Muscle Mechanics II	TBD
13 (Nov. 17)	Neuromuscular Control	Enoka (Chapters 6 & 7)
14 (Nov. 24)	Center of Mass and Center of Gravity: Equilibrium, Balance, & Stability	Chapman (Chapter 4)
15 (Dec. 1)	Student Presentations	
16 (Dec. 8)	EXAM II (FINAL) (Online)	

Research Paper/Presentation

Week	**Project Focus**
3 (Sept. 7)	Topic approval deadline (email your topic to me)
5 (Sept. 21)	Sample of literature due for approval to instructor (please stop by my office the week prior)
15 (Nov. 30)	**Final Draft Due (NO EXCUSES!!)** **Electronic copies via D2L!!**

REFERENCES

Chapman, A. E. (2008). *Biomechanical analysis of fundamental human movements*. Champaign, IL: Human Kinetics.

Enoka, R.M. (2002). *Neuromechanics of Human Movement, Third Edition*, Champaign, IL: Human Kinetics

Griffiths, I. W. (2006). *Principles of biomechanics & motion analysis*. Baltimore, MD: Lippincott Williams & Wilkins.

Hamill, J., & Knutzen, K. M. (2009). *Biomechanical basis of human movement, Third Ed*. Baltimore, MD: Lippincott Williams & Wilkins.

Hansen, E. A., Kristensen, L. A. R., Nielsen A. M., Voigt M., & Madeleine, P. (2017). The role of stride frequency for walk-to-run transition in humans. Scientific Reports, 7; 2010, doi: 10.2038/s41598-017-0972-1.

Hay, J. G. (1993). *The Biomechanics of Sports Techniques, Fourth Edition*, Englewood Cliffs, NJ: Pretince Hall.

Herzog, W., Schachar, R., & Leonars, T. R. (2003). Characterization of the passive component of force enhancement following active stretching of skeletal muscle. *The Journal of Experimental Biology, 206*, 3635-3643.