

**ME 7100 – ADVANCED ERGONOMICS & OCCUPATIONAL BIOMECHANICS**



University of Utah  
Department of Mechanical Engineering  
Lecture: Tuesday & Thursday 2:00-3:20 pm  
Lecture Location: WEB L122  
Lab Location: MEB 2215

**COURSE INSTRUCTOR:**

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Office: MEK 1674
Office Hours: T/TH 4-5pm (and by appointment)

**CREDITS:** 3 semester credit hours

**TEXT:** Occupational Biomechanics – 4<sup>th</sup> Ed., Chaffin, Andersson, and Martin. ISBN 0-471-72343-6

**SUGGESTED REFERENCE MATERIAL**

- Biomechanics in Ergonomics 2<sup>nd</sup> Edition, Shrawan Kumar.
- Biomechanics and Motor Control of Human Movement 3<sup>rd</sup> Edition, David A. Winter
- Joint Structure & Function-A Comprehensive Analysis, Pamel K Levangie & Cynthia C. Norkin

**COURSE DESCRIPTION:** Application of engineering statics and dynamics in determining biomechanical stresses on humans in the work environment; anthropometric measurement methodologies, determination of physiological stresses during work, and biomechanical modeling of determinate and indeterminate systems. Manual work methods are classified and evaluated. Manual material handling recommendations and limits are discussed and analyzed. Computational models of the musculoskeletal system are introduced and used to understand stress as a function of posture, force and anthropometry.

**COURSE OBJECTIVES:** Upon completion of this course, students will:

1. Have an understanding of basic musculoskeletal system and how the body performs work.
2. Understand basic musculoskeletal injury causation theory.
3. Be able to estimate resultant moments and muscle forces given external loads and body postures.
4. Understand techniques used to solve indeterminate biomechanical systems.
5. Understand implications of muscle forces and the corresponding joint compressive forces on the body, particularly the low back.
6. Understand the relationship between work anthropometry and resultant muscular loads and corresponding compressive forces.
7. Understand the significance of dynamic motions and the inherent limitations of static biomechanical models.
8. Be able to calculate the energy expenditure rate for various tasks and compute appropriate work/rest cycles based on those expenditure rates and the individual population's physical capabilities.

9. Be able to design or redesign a manual manipulation tasks to minimize biomechanical stresses associated with that task.
10. Demonstrate the ability to collect data in a motion analysis laboratory and build a model to analyze kinematics and kinetics of motion.
11. Understand the significance of whole body and segmental vibration on human health and performance.
12. Demonstrate the ability to think critically by solving a research problem related to occupational biomechanics.
13. Prepare and deliver a public presentation to address a concern dealing with contemporary issues in Occupational Biomechanics.

### **EVALUATION OF STUDENT PERFORMANCE:**

Evaluation:

HOMEWORK (6)

LAB (3)

PROJECT PRESENTATION

PROJECT REPORT

EXAM 1

EXAM 2

**HOMEWORK (15%):** The homework assignments will emphasize material covered in lecture. You are encouraged to work in groups to complete the homework, but must prepare individual assignments to be handed in.

**LABS (20%):** Lab work will consist of participating in lab activities to setup equipment, collect data, analyze data, and draw conclusions by creating a summary memo for each exercise. Memos must include summarized data, figures, graphs, and tables of the work that was performed.

**EXAMS (40%):** Exams are open book, closed notes, and closed homework. Any course notes or material handed out in class may not be used during the exam unless specified by the instructor. Do not bring other outside reference material. The exams will cover all text/handout material and all material/information discussed in class.

**PROJECTS (25%):** Projects will represent a group effort of 2 students (for exceptions please speak with the instructor). The purpose of the semester project is to conduct an in depth investigation and analysis of a topic related to biomechanics. The written report is designed to help students develop technical writing and research skills, and the presentation provides an opportunity to improve public speaking and presenting skills. Each student is encouraged to think about a project that requires data collection and analysis using hardware and instrumentation available for biomechanics data acquisition. Example projects from previous years are provided on the course website.

**LATE WORK POLICY:** Students may submit assignments for grading within one week of their original due date. A score will be reduced by 10% for each day beyond the due date up to 7 days. After 7 days, the score will be recorded as a zero.

Approximate Grade Ranges

93-100%    A

89-92	A-
87-89%	B+
83-86%	B
80-82%	B-
77-79%	C+
73-77%	C
69-72%	C-
<69%	E – D+

**Academic Honesty:** All students are responsible for their own work. Please review the University of Utah’s [“Rights & Responsibilities of Students \(Student Code/Misconduct\)”](#) policies for details about the consequences of misconduct. Students must also complete the Canvas Module for Academic Integrity before accessing other materials on the course Canvas site.

Violations include, but are not limited to:

Cheating on an examination, such as copying from another’s paper, using unauthorized notes, calculators, etc., or giving or receiving unauthorized aid, such as trading examinations, whispering answers, passing notes, or using electronic devices to transmit or receive information.

Plagiarism. This is using someone else's work without giving credit. It is, for example, using ideas, phrases, papers, laboratory reports, computer programs, data - copied directly or paraphrased - that you did not arrive at on your own. Sources include published works such as book, movies, Websites, and unpublished works such as other students' papers or material from a research service. In brief, representing someone else's work as your own is academically dishonest. *The risk of plagiarism can be avoided in written work by clearly indicating, either in footnotes or in the paper itself, the source of any major or unique idea or wording that you did not arrive at on your own. Sources must be given regardless of whether the material is quoted directly or paraphrased.*

Unauthorized collaboration. This is working with or receiving help from others on graded assignments without the specific approval of the instructor. *If in doubt, seek permission from the instructor before working with others.* Students are encouraged to learn from one another: Form study groups, discuss assignments, BUT each assignment must be individual work unless specifically stated and turned in as a group assignment.

- Copying another student's assignment and putting your name on it is plagiarism.
- You are encouraged to talk to one another about your assignments; however, all assignments must be done by the student whose name is on it!

**Academic Integrity:** Engineering is a profession demanding a high level of personal honesty, integrity and responsibility. Therefore, it is essential that engineering students, in fulfillment of their academic requirements and in preparation to enter the profession, adhere to the Department of Mechanical Engineering Policy for Academic Misconduct. This policy is based upon the [University of Utah’s Policy 6-400: Code of Student Rights and Responsibilities](#). As part of the ME policy, students must review and acknowledge the “ME EN Academic Misconduct Policy” Both documents can be downloaded from the course Canvas page. **Students must provide acknowledgment of the MEEN Academic Misconduct**

**policy via the Canvas Academic Integrity Module for this course before the end of the second week of class or they will be unable to access course content through the Canvas modules.**

**COLLEGE OF ENGINEERING GUIDELINES - <https://www.coe.utah.edu/students/academic-affairs/academics/semester-guidelines/>**

## **University Policies**

### **ADA Statement**

The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in this class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, (801) 581-5020. CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability Services.

**University Safety Statement.** The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit <https://safeu.utah.edu/>

**Addressing Sexual Misconduct.** Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

**Wellness Statement.** Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural difference, etc. can interfere with a student's ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness at [www.wellness.utah.edu](http://www.wellness.utah.edu) or 801-581-7776.

*For Drop/Withdrawal dates and any other helpful University related information, please contact your Academic Advisor.*

**COURSE SCHEDULE**

<b>Date</b>	<b>Chapters</b>	<b>KEY TOPIC</b>
11-Jan	1,2	Introduction, Structure and the Musculoskeletal System
13-Jan		
18-Jan	2,3	Anthropometry and Statistics (HW 1 Assigned)
20-Jan		
25-Jan	4	Mechanical Work Capacity
27-Jan		Bioinstrumentation for Occupational Biomechanics (HW 2 Assigned) <b>(HW 1 Due*)</b>
1-Feb	5	<b>Lab 1 Preparation</b>
3-Feb		<b>Lab 1-Motion Analysis Basics and Model Creation</b>
8-Feb	6	Occupational Biomechanics Models
10-Feb		<b>(HW 2 Due*)</b>
15-Feb	7	Methods of Classifying and Evaluating Work (HW 3 Assigned)
17-Feb		<b>(Project Summary Due*)</b>
22-Feb	8	Manual Material Handling <b>(Lab 1 Due*)</b>
24-Feb		<b>(HW 3 Due*, HW 4 Assigned)</b>
1-Mar		<b>Exam 1 Review</b>
3-Mar		<b>Exam 1 (Chapters 1-8)</b>
8-Mar		<b>Spring Break</b>
10-Mar		
15-Mar		<b>Lab 2 Preparation (HW 4 Due*)</b>
17-Mar		<b>Lab 2-Dynamic Motion Capture and Model Analysis</b>
22-Mar	9	Guidelines for Work in Seated Posture
24-Mar	Handouts, 12	Metabolic Analysis, Guidelines for Whole Body and Segmental Vibration
29-Mar		<b>Lab 3 Preparation (Lab 2 Due*)</b>
31-Mar		<b>Lab 3 - Musculoskeletal Modeling</b>
5-Apr	10,11	<i>Biomechanical Considerations in Workplace Design, Hand tool Design (HW 5 Assigned)</i>
7-Apr		
12-Apr	13, Handouts	Worker Selection, Training, and PPE, Summary <b>(HW 5 Due*)</b> (HW 6 Assigned)
14-Apr		<b>(Lab 3 Due*)</b>
19-Apr	Handouts	Contemporary Issues in Occupational Biomechanics <b>(HW 6 Due*)</b>
21-Apr		NORA Symposium (No Class) - Participate in Symposium on April 17th
26-Apr		<b>Exam 2 (Material After Exam 1), (Written Project Reports Due*)</b>
3-May	Final Exam	<b>Project Presentations (1-3pm)</b>

\*\*Dates subject to change as needed

\* Indicates Due Dates