

# Biomechanical Basis of Movement

APK3220C | Class # 10559, 10560, 18808 | 3 Credits | Fall 2022

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## INSTRUCTOR

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## TEACHING ASSISTANTS

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## INSTRUCTOR OFFICE HOURS

M | Period 5 (11:30 AM – 12:35 PM)

T | Period 3 (9:30 AM – 10:30 PM)

## MEETING TIME/LOCATION

### **Class Number: 10559**

T | Periods 5-6 (11:45 AM - 1:40 PM)

R | Period 6 (12:50 PM - 1:40 PM)

Primarily Classroom/Traditional – Room: FLG 245

12/15/2022 @ 5:30 PM - 7:30 PM

### **Class Number: 10560**

M,W,F | Period 4 (10:40 AM - 11:30 AM)

Primarily Classroom/Traditional – Room: MCCA 1142

12/14/2022 @ 3:00 PM - 5:00 PM

### **Class Number: 18808**

T | Period 1 (7:25 AM - 8:15 AM)

R | Periods 1-2 (7:25 AM – 9:20 AM)  
Primarily Classroom/Traditional – Room: FLG 220  
12/13/2022 @ 8:00 PM - 10:00 PM

## Course Info

### COURSE DESCRIPTION

Fundamentals of kinematics and kinetics related to human movement. Basics of biomechanics applied to the concepts of injury prevention and performance improvement. Overview of various biomechanical data collection and analysis.

### PREREQUISITE KNOWLEDGE AND SKILLS

Junior or senior standing; (APK 2100C or BSCX094+L or BSCX086+L or PETX322+L or ZOO3733c) and MAC 1140 with minimum grades of C); or PHY 2048 or PHY 2053 with minimum grade of C

*\* Having already taken Physics 1 and Anatomy will be **very helpful** in this course. You can be successful in this course if you have not taken physics and anatomy, but it will require significantly more effort to get comfortable with the physics concepts intrinsic to biomechanics and learn the structure and function of the musculoskeletal system.*

### REQUIRED AND RECOMMENDED MATERIALS

#### Required Textbook:

*Basic Biomechanics* by Susan Hall 9<sup>th</sup> Edition

#### Required Software:

- Microsoft Word and Excel 2010 or later
- Muscles and Motion (online application – Login for you is provided)
- Imagej: free image analysis obtained at <https://imagej.nih.gov/ij/download.html>
- TopHat

### COURSE FORMAT

This course meets live for 3 period per week. 2-3 sessions per week will be lecture based presentation of material which will comprise most of the testable content for exams. 0-1 session per week will include in class activities/assignments, review games, and discussions.

There will be some mandatory videos (i.e., containing testable content not covered directly in class) which will be noted overtly on the module page on Canvas).

### COURSE LEARNING OBJECTIVES:

1. Identify biomechanical principles/concepts and describe the impact of biomechanics research on daily life
2. Describe the basic technology behind biomechanical instrumentation with a focus on motion capture
3. Identify the planes of motion and axes of rotation involved in a given human movement pattern
4. Solve biomechanical problems related to exercise, sport, and health using calculations related to:
  - a. Linear and angular kinematic variables (including position, velocity, acceleration)

- b. Linear and angular kinetic variables (including force, torque, momentum, impulse, work, power, and energy)
  - c. Estimating the center of mass position
  - d. Fluid mechanics
5. Describe how fluid forces influence human motion involving liquids and air
  6. Explain the basic mechanical properties, interactions, and functions of bones, tendons, ligaments, muscle, joints, and cartilage

## Course & University Policies

### ATTENDANCE POLICY

Attendance is expected and participation via TopHat will be reflected in your course grade. Excused absences will be considered in accordance with the University of Florida's policies and guidelines.

### PERSONAL CONDUCT POLICY

Students are expected to exhibit behaviors that reflect highly upon themselves and our University. Outline for them exactly what that means in the context of your course

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obliged to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult the instructor or TA in this class.

### EXAM MAKE-UP POLICY

A student experiencing an illness should visit the UF Student Health Care Center or their preferred healthcare provider to seek medical advice and obtain documentation. If you have an illness, family emergency or death, please contact the Dean of Students Office ([www.dso.ufl.edu](http://www.dso.ufl.edu)) and follow the DSO Care Team procedures for documentation and submission of a request for make-up assignment (<https://care.dso.ufl.edu/instructor-notifications/>). The DSO will contact the instructor. Do not provide any documentation to the instructor regarding illness or family emergency. This is your personal and protected information. The DSO is qualified to receive and verify the documents you provide. The instructor will follow the recommendations from the DSO.

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found in the online catalog at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>.

### ACCOMMODATING STUDENTS WITH DISABILITIES

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the Disability Resource Center by visiting their Get Started page at <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

## COURSE EVALUATIONS

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

## Getting Help

### HEALTH & WELLNESS

- U Matter, We Care: If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) or 352 392-1575
- Counseling and Wellness Center: <https://counseling.ufl.edu/>, 352-392-1575
- Sexual Assault Recovery Services (SARS) - Student Health Care Center, 392-1161
- University Police Department, 392-1111 (or 9-1-1 for emergencies) <http://www.police.ufl.edu/>

### ACADEMIC RESOURCES

- E-learning technical support, 352-392-4357 (select option 2) or e-mail to [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu). <https://lss.at.ufl.edu/help.shtml>
- Career Connections Center, Reitz Union, 392-1601. Career assistance and counseling. <https://career.ufl.edu/>
- Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.
- Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <http://teachingcenter.ufl.edu/>
- Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <http://writing.ufl.edu/writing-studio/>
- Student Complaints On-Campus: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/> On-Line Students Complaints: <http://distance.ufl.edu/student-complaint-process/>

### CLASS LEARNING ENVIRONMENT

It is important to me that you feel welcome and safe in this class; and that you are comfortable participating in class discussions and communicating with me on any issues related to the class. Please let me know if you are having a tough time in any capacity so that we can work together to generate a solution.

Together as a class we have a responsibility and opportunity to create a space that is inviting and respectful to every individual and create a learning environment that affords equal opportunity for all students to learn and succeed.

Additionally, if your preferred name is not the name listed on the official UF roll, please let me know as soon as possible by e-mail or otherwise. Please let me know how you would like to be addressed in class. You may also change your "Display Name" in Canvas. Canvas uses the "Display Name" as set in myUFL. The Display Name is what you want people to see in the UF Directory, such as "Ally" instead of "Allison." To update your display name, go to [one.ufl.edu](http://one.ufl.edu), click on the dropdown at the top right, and select "Directory Profile." Click "Edit" on the right of the name panel, uncheck "Use my legal name" under "Display Name," update how you wish your name to be displayed, and click "Submit" at the

bottom. This change may take up to 24 hours to appear in Canvas. This does not change your legal name for official UF records. <https://elearning.ufl.edu/student-help-faqs/>

## Grading

Grades will be based on a point system of 1000 total points coming from quizzes, exams, and assignments.

Once a grade is posted students have **two weeks** to dispute an error in grading.

Table 1: Grade Point Category				
Item	Qty.	Points Per	Category Points	Percent of Final Grade
Lecture Exams	2	120	240	24 %
Final Exam	1	160	160	16 %
Homework	7	20-30	170	17 %
Quizzes	10	20-30	220	22 %
TopHat, Attendance, and Participation	N/A	N/A	120	12 %
Labs	3	30	90	9 %
Extra Credit	2	10	20	2 %
<b>Course Total</b>	<b>N/A</b>	<b>N/A</b>	<b>1020</b>	<b>102 %</b>

**Lecture Exams** (Please carefully review the course schedule and note when your section is scheduled to take exams)

There will be 2 lecture exams which may consist of multiple-choice, true-false, short answer and free response problem solving questions. Students are not permitted access to any kind of materials or notes during these exams; however, a formula sheet will be provided. Exam questions are generated by the course instructor and the majority of focus should be given to the lecture notes, labs, muscle and motion videos, and problem sets when studying although supplementary readings/resources will also be helpful. Students will take exams in the same room where weekly meetings are held and will be allowed 50 minutes to complete the exam. A **SCIENTIFIC** calculator will be permitted during exams.

### Homework

These homework assignments will be assessed via a Canvas Quiz submission but will be multiple attempts permitted to give you the opportunity to work through the problems to hone your quantitative skills. These homework assignments will contain problems regarding the current week's topics in the content lectures and may also include movement analysis using imagej and/or Excel.

### Quizzes

Module quizzes based on lecture content and Muscles and Motion videos listed for the module. These are individual (i.e., not group) quizzes. Although typically you will not have questions beforehand, the quizzes are

open notes/book/videos and will have a relatively relaxed time constraint. These quizzes are to be taken as an INDIVIDUAL and 1 attempt will be permitted. Some larger (multi-week) modules may have more than one quiz associated with it.

**Labs** – Assignments based on in class interactive activities. The deliverables for will be specific to each lab but may include a canvas quiz. Attendance of the lab is mandatory for full credit on the assignment.

### ***Attendance, Participation, and TopHat***

Top Hat questions will be mainly administered during class time, and you must be in attendance of class to answer these questions. New content questions will be mainly participation based, but review questions may include an accuracy component in grading. Top Hat may also be used to facilitate in class discussions/assignments and to take attendance.

Check the TopHat.com gradebook regularly to ensure your responses are being recorded. Technical issues with TopHat should be noted and resolved as they arise. If you have an issue during class with submission you need to talk to me at the end of class and ALSO send me an email to correct the error. Persistent issues should be addressed with TopHat support <https://success.tophat.com/s/contact-main>.

### ***Comprehensive Final***

The final exam is a comprehensive for the semester but with a strong focus on the material after exam 2. The final will be longer than the individual lecture exams and will be scheduled during your sections assigned timeslot during finals week. This exam will be in the same style as the preceding 3 lecture exams but cover content from across the semester.

### ***Extra Credit***

Students can earn up to 20 points of extra credit in this course. Extra credit opportunities will be offered and detailed in class but will involve demonstrating a deeper investigation of a biomechanical topic(s) related to human movement. Each assignment or experience will be worth up to 10 points. A maximum of 2 assignments/experiences may be counted towards your final grade.

## **GRADING SCALE**

Grades will be based on a point system of 1000 total points coming from quizzes, exams, and assignments.

Once a grade is posted students have **two weeks** to dispute an error in grading. Grading disputes or alleged technical issues with TopHat will not be considered after this point.

More detailed information regarding current UF grading policies can be found here:

<https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/>.

*Any requests for additional extra credit or special exceptions to these grading policies will be interpreted as an honor code violation (i.e., asking for preferential treatment) and will be handled accordingly.*

Letter Grade	Points Needed to Earn Each Letter Grade	Percent of Total Points Associated with Each Letter Grade	GPA Impact of Each Letter Grade
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A	≥ 900	90.00-100%	4.0
A-			3.67
B+	870-899	87.00-89.99%	3.33
B	830-869.99	83.00-86.99%	3.0
B-	800-829.99	80.00- 82.99%	2.67
C+	770-799.99	77.00-79.99%	2.33
C	730-769.99	73.00-76.99%	2.0
C-	700-729.99	70.00-72.99%	1.67
D+	670-699.99	67.00-69.99%	1.33
D	600-679.99	60.00-66.99%	1.0
D-			0.67
E	≤ 599.99	0-59.99%	0

## Weekly Course Schedule

This syllabus and schedule are intended to give the student guidance in what may be covered during the semester and will be followed as closely as possible. However, the professor reserves the right to modify, supplement and make changes as the course needs arise. This includes exam dates and lecture topics that may change depending on class progress.

## EXAM SCHEDULE

Please note the exam schedule based on your section. Exams 1 & 2 are 50-minute exams administered during class time. The final exam is a 2-hour exam.

### Exam 1

- Section: 10559 - Exam 1: 9/22/2022 R | Period 6 (12:50 PM - 1:40 PM)
- Section 10560 - Exam 1: 9/23/2022 F | Period 4 (10:40 AM - 11:30 AM)
- Section 18808 - Exam 1: 9/22/2022 R | Periods 1 (7:25 AM – 8:15 AM)

### Exam 2

- Section: 10559 - Exam 2: 10/25/2022 T | Period 5 (11:45 AM - 12:35 PM)
- Section 10560 - Exam 2: 10/24/2022 M | Period 4 (10:40 AM - 11:30 AM)
- Section 18808 - Exam 2: 10/25/2022 T | Period 1 (7:25 AM - 8:15 AM)

### Final Exam (Exam 3)

- APK 3220C – Section: 10559 - Final Exam: 12/15/2022 @ 5:30 PM - 7:30 PM
- APK 3220C – Section 10560 - Final Exam: 12/14/2022 @ 3:00 PM - 5:00 PM
- APK 3220C – Section 18808 - Final Exam: 12/13/2022 @ 8:00 PM - 10:00 PM

## WEEKLY SCHEDULE

Module	Week	Dates	Module	Daily Schedule
1	1	8/24/2022 - 8/26/2022	Introduction to Biomechanics	No Class Monday and Tuesday

				Introduction to Biomechanics
				Approach to analyzing movement
2	2	8/29/2022 - 9/2/2022	Fundamental Tools and Concepts	Kinematic Variables - Vector Dot Product
				Kinetic Variables - Vector Cross Product
				Degrees of Freedom + Anatomical Terminology
2	3	9/5/2022 - 9/9/2022	Fundamental Tools and Concepts No Class Monday 9/5 - Labor Day	Monday ONLY - No Class
				Mechanical Representation of Joints
				Puppet Master - DOF (R/F)
3	4	9/12/2022 - 9/16/2022	Muscle Biomechanics	Muscle Biomechanics 1 - Muscles
				Muscle Biomechanics 2 - Mechanical Arrangements
				Muscle Biomechanics 3 - Torque and Components of Force
Exam 1	5	9/19/2022 - 9/23/2022	Exam 1 (R/F)	Puppet Master - Animation (M/T)
				Share out and Review
				Exam 1 (R/F)
4	6	9/26/2022 - 9/30/2022	Tissue Loading and Spine Mechanics	Squatting and Spine Biomechanics
				Squat Lab (T/W)
				Stress and Strain
5	7	10/3/2022 - 10/7/2022	Hip Joint Biomechanics	Hip Complex Biomechanics - Part 1
				Hip Complex Biomechanics - Part 2
				Hip Complex Biomechanics - Part 3
6	8	10/10/2022 - 10/14/2022	Knee Complex Biomechanics	Knee Complex Biomechanics Part 1



				Knee Complex Biomechanics Part 2
				Ankle and Foot Biomechanics Part 1
7	9	10/17/2022 - 10/21/2022	Ankle and Foot Complex Biomechanics	Ankle and Foot Biomechanics Part 2
				Running Shoes Selections and Design
8				Upper Extremity Joint Mechanics
Exam 2	10	10/24/2022 - 10/28/2022	Exam 2 (M/T)	Exam 2 (M/T)
8	Upper Extremity Biomechanics			Upper Extremity Biomechanics  Handstand Lab (R/F)
9	11	10/31/2022 - 11/4/2022	Kinematics	Linear Kinematics - Derivatives and Numerical Methods  Linear Kinematics - Equations of Constant Acceleration  Linear Kinematics - Gait and Movement Variability
9	12	11/7/2022 - 11/11/2022	Kinematics No Class Friday 11/11 Veterans Day	Angular Kinematics - Part 1 - Linear to Angular Translations  Angular Kinematics - Part 2 - Constant Acceleration  No Class Friday Only - Veterans Day
10	13	11/14/2022 - 11/18/2022	Kinetics	Angular Kinematics - Part 3 - General Motion and Gait  Linear Kinetics - Impulse and Momentum  Linear Kinetics - Impulse and Momentum
10	14	11/21/2022 - 11/25/2022	Kinetics	Acroyoga Lab or Jump Lab (M/T)  No Class - Thanksgiving  No Class - Thanksgiving
10	15	11/28/2022 - 12/2/2022	Kinetics	Linear Kinetics - Energy Work and Power

				Linear Kinetics - Equilibrium and Inverse Dynamics
				Linear Kinetics - Equilibrium and Inverse Dynamics
10	16	12/5/2022 - 12/9/2022	Kinetics No Class - Thurs and Friday - Reading Days	Angular Kinetics
				Angular Kinetics
				No Class Thursday and Friday - Reading Days
Finals	17	12/12/2022 - 12/16/2022	Final Exam	Final Exam

## SUCCESS AND STUDY TIPS

- Do the Homework and hone a solution process for types of problem
- Come to class prepared and don't fall behind
- Come to office hours when you have questions/challenges
- Generate study questions to test yourself on conceptual information without the information in front of you
- Review old quizzes and homework (do NOT resubmit them as they will show up as late)
- (Re)watch recorded lectures as needed

## PRIVACY

Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized sharing of recorded materials is prohibited.

## RECORDINGS OF CLASS

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course.

A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.