PHYS 1130 : Physics of Sports
Summer Session III
July 17 2023
Updated July 11

Summer Session III
Monday July 17, 2023 – Friday Aug 11, 2023
For details on Summer Session 2023 go to the link
Overview

This course is a study of the physics concepts (forces, momentum, acceleration, etc.) and equations relating them behind the motion of flying and spinning projectiles (humans too) in sports such as soccer, tennis, basketball, baseball, football, track and field, etc. We will also include rolling/sliding objects along flat surfaces such as in billiards and hockey. The focus will be on how to understand motion in sports and, perhaps, gain a competitive advantage through a better knowledge of the concepts and some mathematics, but not on physics derivations. Assignments and exams will be 30% numerical and 70% conceptual. There will a greater emphasis on concepts and less on problem solving by the students.

By the end of the course here are some of the important points in sports you will know better.

Know why dimples on a golf ball and stitches on a baseball reduce the drag.
Know how why a thrown baseball or kicked soccer ball curves.
Know how to manipulate your center of mass to gain an edge in certain sports.
Know how to punt a football to make your gunner happy.
Know why going low is the best option in blocking/tackling in football.
Know what is the best launch angle and velocity to make a three pointer.
Know why follow through is important in tennis or sports in general.
Know why the volley-ball motion in a float serve is similar to the knuckle-ball.
Know what factors affect your hangtime in basketball, punting, ballet dancing.

Required Textbook: The Physics of Sports, Michael Lisa, McGraw-Hill Education, Copywrite 2016, ISBN 978-0-07-351397-3 Softbound or digital copy is acceptable. College Level, Algebra based. You may purchase the e-version with Connect at UVa Bookstore for $40.05. Ask for the Inclusive Access package. All Test and Assignments will use the "Connect" platform and will be accessible from the Inclusive Access package. Instead of Collab, we will be using the new LMS system called Canvas. The link is https://canvas.its.virginia.edu/ For an additional $22.22, you can also get the printed loose-leaf. This is a great price. These prices may change by the time the course is actually given. The cover page is shown below.
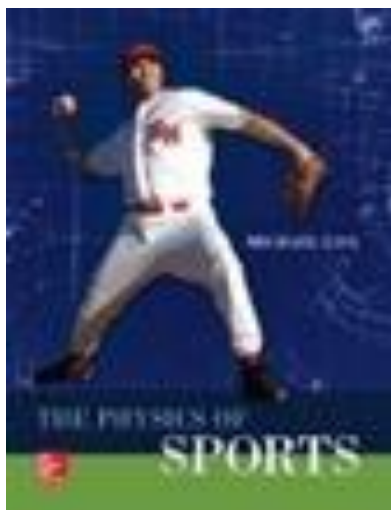
Course Organization

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Lecture Sessions	Lecture MWF 10:45 -11:40	5 min break
	Lecture MWF 11:45 - 12:45	
	Lecture T,R 10:45 - 11:40	Break 11:40 -11:45.
	Discussion T,R 11:45 - 12:45	Quiz on T and/or R
Instructor:	Richard A Lindgren.	ral5q@virginia.edu
	Emeritus Professor of Physics	Office is under renovation
Office Hours	T,R 7:00-8:00pm	Online (Zoom)

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Discussion	T,R 11:45 – 12:15	In person
Quiz	R 12:15 – 12:45	
Teaching Assistant	TBA	
Office Hours	TBA	TBA

About the instructor: The instructor has taught numerous introductory physics course, has published/co-published hundreds of articles in Nuclear Physics and given many professional talks in search of understanding the nuclear force; Co-Founder/First Director of the Master of Physics Education Program for Teachers, developed several physics courses for teachers, taught and organized many STEM summer workshops; and spent remaining recreational hours trying to improve his tennis, baseball (softball), basketball, eight-ball, table tennis, and dancing skills.

Course web page: Syllabus and Schedule can be found on Lou's List; Will also be available on Canvas soon.

Prerequisites: A good algebra/Trig-based course in mathematics at the high school or college level is required. No calculus needed. No previous physics course is required, but it would be helpful if you had at least high school level physics course. Algebra based physics courses at UVa such as PHYS2010 would be suitable and as well as any algebra-based physics or math course. If unsure about your math or physics background, contact the instructor at ral5q@virginia.edu.

Lecture Slide/Notes: Lectures will be on power point slides that you may download from Canvas before coming to class. However, my lecture slides will be presented to you using Notability on my Ipad. This allows me to use the stylus to sketch demonstration setups, to outline video presentations, and to outline solutions to homework problems during Lecture on the slides. A copy of the annotated slides will also be available on Canvas after class. You may take your own class notes if you use an Ipad or Tablet. All classes will be recorded and available for replay on Canvas.

Discussion: I will show video clip of various kinds of motion, discuss how physics explains the trajectory of the motion of the ball, etc, solve problems and give a short quiz.

Assignments: SmartBook reading modules, homework problems, quizzes, exams, etc use the McGraw-Hill platform "Connect" . Connect is part of the textbook package.

Final Exam: 3 hr exam. Approx. 30 questions. 30% numerical and 70% conceptual questions.

Midterm Exam: : 1 hr 15 min exam. Approx. 15-18 questions. 30% numerical and 70% conceptual questions.

Grading: Your grade is based on several components, so no one component makes or breaks it.
- **Final Exam – 30% If your final grade is greater than the midterm, I will weight the final at 35% and the midterm at 25%, otherwise they are weighted equally at 30%.**
- **Midterm – 30%**
- **Quizzes – 15%**
- **Homework Twice Weekly (Connect Platform or Gradescope -TBA) – 15%**
- **SmartBook Reading Assignments (Connect Platform) – 10%**
- **Total =100%**
- **Extra credit – Optional Sports Video with Physics Summary (see instructor for details)**

Quizzes: Each week an open book 20-30 minute quiz will be given on Thursday. Approximately **4-5 (MC)** questions on each quiz and 2 numerical and 3-4 conceptual questions.

Homework: Homework questions and problems will be selected from the end of chapter problems in the text. Problem numbers are randomized, assigned, and graded through the McGraw-Hill platform "Connect". Homework is due Tuesdays and Fridays at 11:59 pm and submitted on "Connect" or Gradescope. Homework help is available during office hours from the instructor 7:00 pm – 8:00 pm on TR and from the TA MWF 8:00 pm – 9:00 pm. Extra time may be spent by the instructor on selected homework problems during classes and during discussion.

SmartBook (SB) Reading Assignments: Read the sections listed on the schedule for each day and on Connect submit the SmartBook Module SB01 as you answer the multiple-choice questions. This is open book. The SmartBook Module is part of the "Connect" platform. This is an easy way to read the material and get credit towards your grade. You are expected to get 100 on all smartbook assignments if you do the assignment until you get it right.

Sports Video: You may submit a link to a 3-6 min sports video clip (YouTube is fine). Submit your video with 4 or 5 sentences discussing the relevance of the video to physics concepts discussed in class of your choosing. The ideas behind the sports video clip is to get you to think about the physics concepts that you see in athletics and to provide material that is interesting to you. Upload the video using features on Canvas. A very large list of a variety of sports YouTube video links are available. You can use this as extra credit to increase your grade up to 3 points say from C- to B, B- to B or B to B+ , but not B+ to A- or A- or A.

Calendar: A calendar of topics for class meetings, due dates for submitting reading modules, homework problems, and taking exams will be available on Canvas. This calendar will be updated from time to time.

Important Dates:

- Online Registration opens on SIS: Mar 29, 2023 for UVa Undergraduate students or Mar 30, 2023 for Visiting students. **(Dates below may be adjusted slightly)**
- For details on Online Registration go to the link [Registration and Academic Procedures](#)
- First Lecture: Monday July 17
- First Quiz: Thur July 21 12:15 pm. See calendar for other quiz dates.
- Midpoint: July 28
- Withdrawal deadline: August 4
- Last lecture: Aug 10 10:45 am
- Final exam: Aug 11 10:45 pm – 1:00 pm

University Honor System: An Honor Offense is defined in the link [honor.virginia.edu/overview](#) An honor offense would be any violation of the honor pledge, "On my honor, I pledge that I have neither given nor received help on this assignment." A pledged assignment means homework, exam, quiz, etc. or any written assignment that requires a grade unless otherwise noted. Your Professor can add to the pledge or document as he see fits. For example, an open book assignment means that you can only use your assigned textbook (digital or notebook versions). You cannot use notes compiled or summarized from other resources. I could change these rules if so desired. If I request you to take an exam with your video unmuted, then you are expected to do so. It could be considered an honor violation if you refused. If you knowingly obtain a copy of a future exam by accident or intent, I would consider that an honor violation. You should report such an incidence to your instructor. I am required to report any suspected violation of the honor code to the honor committee. If you are uncertain about any future action that you might commit, don't hesitate to contact me to ask for advice on whether or not it is an honor violation.

Satisfying General Education Requirements: Physics 1130 is an introductory-level physics course serving a broad range of students. It satisfies the requirements for courses in the [The Chemical, Mathematical & Physical Universe](#) category. It may also satisfy the requirements for disciplines Living Systems and Science and Society. The following excerpt is taken from the University General Education requirements in the Discipline category: A liberal education should develop in students a knowledge of past and present attempts to identify the material composition and mathematical structure of the physical world and universe and the forces that govern their interaction. Such knowledge is crucial to understanding the environment in which we live and inspiring the technologies we have developed to navigate and function in that environment. Courses in this category should introduce students to the concepts, facts, and theoretical principles of the mathematical and physical sciences and help students relate them to their lives as citizens and apply them to contemporary problems.

Students With Disabilities: Students needing the services provided by the Students Disability Access Center (SDAC) will need to be certified by that office. The center is located at 400 Brandon Ave. P.O. Box 800760, Charlottesville, VA 22908-0760, Phone 434-924-5362,
Email [studenthealth@virginia.edu](#)
Website [student health](#)

PHYS 1130 The Physics of Sport
Nau Hall Room 142
Summer Session III
Calendar – Updated July 11, 2023

Date	Time-Day	Lecture	Topics	Reading CONNECT Chapters	SB / HW CONNECT Due
			PHYS 1130 The Physics of Sport		
			Topics and times may be adjusted as we go		
7-17	10:45 -Mon	1	Overview, scientific notation, speed, velocity, acceleration, and center of mass	Ch 1.1-1.3, p 3-11	**SB1.1-1.3 9 am**
7-17	11:45-Mon	2	Bolt running, average velocity, instantaneous velocity, and acceleration	1.3, 2.1, 2.2 p 14-20	
7-18	10:45-Tue	3	Gravity, Falling Objects, and Hangtime	2.3, p 20-33	**SB2.1-2.3 9 am**
7-18	**11:15-Tue**	**No Quiz**	**Video Clip, Problem solution and Discussion**	**Review 1.1-2.2**	
7-19	10:45-Wed	4	How does hangtime of a basketball player differ from a thrown ball or does it?	2.3 p 27-33	**HW01 11:59**
7-19	11:45-Wed	5	What force and velocity does Dwight Howard need to jump 40" off the floor?	3.1 - 3.3 p 39-53	**SB3.1-3.3 9 am**
7-20	10:45-Thu	6	What is Howard's landing velocity? Why do you bend your knees?	3.2.4, 3.2.5, p 53-55	
7-20	**11:45-Thu**	**QZ01**	**Video Clip, Problem solution, Discussion, and Quiz QZ01 12:15 – 12:45**	**Review 2.3-3.2**	
7-21	10:45-Fri	7	Sideways traction–Static, kinetic friction, pushing a football sled.	3.3 p 50-63	**SB3.4-3.5 9 am**
7-21	11:45-Fri	8	Crouching in football, the low man wins, applications involving friction.	3.4, p 59-64	
7-24	10:45 -Mon	9	Centripetal force, the rotor, car turning a corner, throwing the discuss, tug of war.	3.5 p. 63-75	**HW02 11:59**
7-24	11:45-Mon	10	Punting in football. What is the timing between the gunner and the punter?	4.1 – 4.2	**SB4.1-4.4 9 am**
7-25	10:45-Tue	11	Humans in flight, Ballet dancer, Beamon's Long jump record.	4.3-4.4	
7-25	**11:15-Tue**	**QZ02**	**Video Clip, Problem solution and QZ02 12:15 – 12:45**	**Review 3.3-4.4**	
7-26	10:45-Wed	12	Buoyancy in water and air?	5.1 - 5.2 p 105-110	**SB5.1-5.3 9 am**
7-26	11:45-Wed	13	The Drag Force and terminal velocity.	5.3 p 110-115	
7-27	10:45-Thu	14	Effect of the Drag Force on a baseball.	5.3 p 111-115	**HW03 11:59**
7-27	**11:45-Thu**	**Midterm**	**Midterm Exam 11:45 -12:45**	**Ch 1 – Ch 4**	
7-28	10:45-Fri	15	Drag Crisis: Variation of C_D with velocity.	5.3 p 111-115	
7-28	11:45-Fri	16	Effect of Magnus force on the range of a batted baseball.	5.4.2-5.5.1p 117-125	**SB5.4-5.7 9 am**
7-31	10:45 -Mon	17	Why is the trajectory of a spinning soccer ball part of a spiral or a banana curve?	5.5.3, 5.7 p 135-139	
7-31	11:45-Mon	18	On calculating the deflection of a spinning curveball due to the Magnus force.	5.5.2-5.5.5,p126-129	**HW04 11:59**
8-01	10:45-Tue	19	How to shoot a basketball to maximize your field goal percentage from anywhere	Notes	
8-01	**11:15-Tue**	**QZ03**	**Video Clip, Problem solution and QZ03 12:15 – 12:45**	**Review 5.4-5.5**	
8-02	10:45-Wed	20	Non-spinning effects: cricket swing, knuckleball, and float serve; start collisions	5.4.1, 5.6.1	**SB6.1-6.3 9 am**
8-02	11:45-Wed	21	Finding the momentum change in a total inelastic collision in football tackling	6.1-6.2 pg. 145-154	
8-03	10:45-Thu	22	Examples in finding momentum and energy change in tackling; safety helmets	6.1-6.2 pg 145-154	**HW05 11:59**
8-03	**11:45-Thu**	**QZ04**	**Video Clip, Problem solution, Discussion and Quiz QZ04 12:15 – 12:45**	**Review Ch 5.5.2-5.7**	
8-04	10:45-Fri	23	Sweet spot in a baseball bat or racquet, nodes, COP, and COR in collisions	6..4 p.167-172	
8-04	11:45-Fri	24	Examples on how to use COR in collisions	6.4 p.167-172	
8-07	10:45 -Mon	25	Elastic collisions, billiards and improving your game	6.3.4 and slides	**SB6.4-6.5 9am**
8-07	11:45-Mon	26	Effects of friction on the motion of the cue ball and object ball in billiards	6.3.4 and slides	**HW06 11:59**
8-08	10:45-Tue	27	The effects of spin and friction on the motion of bouncing balls and in collisions	6.4 pg. 167-181	
8-08	**11:45-Tue**	**QZ05**	**Video Clip, Problem solution, Discussion and Quiz QZ05 12:15 – 12:45**	**Review 6.1-6.4**	
8-09	10:45-Wed	28	The drop shot and the lob in tennis and the fuzz	Notes	
8-09	11:45-Wed	29	Review		
8-10	10:30-Thu	30	Study on your own		**HW07 6:00 pm**
8-10	11:35-Thu	31	Study on your own		
8-11	**2:00-Fri**	**Final**	**Final Exam 10:30 – 1:00 pm**		
	Textbook		The Physics of Sports, Michael Lisa, McGraw-Hill Education	Copywrite	2016
			ISBN ISBN 978-0-07-351397-3		

HW due 11:59 PM
SB due at 9:00 am
QZ due at 12:05 pm
Midterm due at 12:45 pm
Final due at 5:00 pm