"The Mechanics of Sports"
(A hybrid course with in-class and live online sessions)

AS.360.173.21

Summer 2018
Last updated: Tuesday, April 17, 2018

Meeting Days:	(Mon and Fri on campis + online component, explained below)
Course website:	http://pages.jh.edu/~maliyou1/Mechanics_of_Sports/
Instructor:	Dr. Muhammad Ali Yousuf
Email:	mali@jhu.edu
Office:	5801 McAuley Hall, Room #474, Mt. Washington, Baltimore 21209
Phone:	410-735-6523
Office Hours:	By appointment only
Pre-requisites:	None

Textbook (Electronic copy required):

Title: The Physics of Sports
Author: Michael Lisa
Publisher: McGraw-Hill Education
Year: 2015
ISBN-13: 978-1259315244 (The Connect version, with online assignments)
Online registration: https://connect.mheducation.com/class/m-ali-yousuf-summer-2018

Supplementary book (**NOT** required):

Title: Gliding for Gold: The Physics of Winter Olympics
Author: Mark Denny
Publisher: Johns Hopkins University Press
Year: 2011
ISBN-13: 978-1421402154

Top Hat (Required): We will be using the Top Hat (www.tophat.com) classroom response system in class. You will be able to submit answers to in-class questions using Apple or Android smartphones and tablets, laptops, or through text message.

You can visit the Top Hat Overview (https://success.tophat.com/s/article/Student-Top-Hat-Overview-and-Getting-Started-Guide) within the Top Hat Success Center which outlines how you will register for a Top Hat account, as well as providing a brief overview to get you up and running on the system.

An email invitation will be sent to you by email, but if you don't receive this email, you can register by simply visiting our course website: https://app.tophat.com/e/920003
Note that the **Course Join Code is 920003**.

Top Hat will require a paid subscription, and a full breakdown of all subscription options available can be found here: www.tophat.com/pricing.

Should you require assistance with Top Hat at any time, due to the fact that they require specific user information to troubleshoot these issues, please contact their Support Team directly by way of email (support@tophat.com), the in app support button, or by calling 1-888-663-5491.

I. Course Description

While watching sports you must have felt that your knowledge of physics is just not enough to understand all aspects of them. In this course, you will learn which additional forces are at play in different sports and why a curve ball curves? or why a ping pong ball dunks? You will learn how a tacit knowledge of the physics of projectile motion helped athletes Bob Beamon and Dick Fosbury made their place in Olympics history. You will also understand the use of energy and power in baseball, basketball, cycling etc. You will discover how, by keeping the temperature of the Velodrome at London Olympics at 84F, the planners had given cyclist an edge over the others. These days, athletes are competing for fractions of a second, or even a millimeter to win, and science is hard at work in improving their performance. Learning these concepts will not only allow you to understand the interplay between these two fields of science and sports; you will also be able to contribute to the field later.

II. Course Goals

This course starts with the assumption that you know only introductory / high school physics. By the end of the course, you will:

1. Develop a deeper understanding of basic physics concepts via their applications to sports.
2. Learn image, video and sound analysis (using free software) to help you extract useful data from sporting events.
3. Develop an appreciation for science and engineering that goes into sports, from the training of players to the design of equipment and playing fields, etc.

III. Format and Procedures

The course will be interactive with class activities and question answer sessions. Students are encouraged to bring laptops/tablets to the class and use them if needed. Presentations will be mostly PowerPoint based, with embedded interactive media such as photos, videos,

etc. The online component will use a similar format. Students will be expected to do some work before coming to the class.

There will be a short, 10 minutes break during the class. Class participation will be evaluated through attendance and class work. Taking part in discussions and attention are required of all students for every class meeting.

IV. Course Etiquette

The course will use Active Learning methodology and student participation will be strongly encouraged. Projects will extend ideas and will give a chance to dig deeper. Attention and respect is expected from, and for, all students.

V. Course Requirements:

1. Students are expected to attend all class (campus+online) meetings and view/complete online work for satisfactory completion of this course. The instructor is to be given notice of any planned absence and a courtesy email before class if sick or ill. Student participation is key and any absences will impact class dynamics.
2. Course readings: There is a required textbook for this course from which sections will be assigned for self-study.
3. Lecture notes and a lot of supplementary information will be uploaded to the course website / TopHat.

VI. Grading Procedures

The distribution of points is as follows:

Class participation	10
Problem sets	30
Group project	10
One Mid-Term Exam	20
Final Exam	30
Total	100

VII. Academic Integrity

The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition. Report any violations you witness to the instructor.

VIII. Accommodations for students with disabilities

In compliance with the JHU policy and equal access laws, appropriate academic accommodations that may be required for student with disabilities can be discuss and arranged on a case by case basis. Requests for academic accommodations are to be made prior to the first class or immediately afterward, except for unusual circumstances. Students are encouraged to register with Student Disability Services to verify their eligibility for appropriate accommodations. Please contact the Office of Student Disability Services at studentdisabilityservices@jhu.edu or call 410-516-4720.

IX. Course Schedule and Topics to be covered (subject to minor changes and adjustments) (Based on 5-week format)

The course will have multiple components, with the following approximate division of hours (45 total for a 3 credit hours course):

Modality	Hours
In-class sessions, to be conducted at Homewood campus	15
Live online sessions, to be conducted via instructor's adobe connect classroom https://connect.johnshopkins.edu/muhammadaliyousuf	15
Pre-recorded videos, readings, and problem sets will be available via http://pages.jh.edu/~maliyou1/ or JHU Blackboard	15
Total	45

Please note that 2/3rd of the course (30 hours out of 45, will be conducted live, either in a real class room or in a virtual classroom with video capabilities.). The remaining 1/3 will be available online.

Weekly Plan (subject to minor changes)

Week	Theme	Physics/Sport Topics to be covered
1	Setting up the scene	A. Warm-Up: Basic Concepts (Scientific Notation, Units and Conversions) B. Estimation methods based on sport photos C. Racing, Mathematically (Speed, velocity, acceleration and their graphical representations, Phelps in Beijing, Bolt in Berlin, rope climbing, etc.) D. Introduction to sport video analysis (Tracker).
2	One and Two-dimensional kinematics, Forces	A. Net Force: Dwight Howard Illustrates (How things interact, the physics of Dwight Howard Dunk, sideways traction, imaginary forces) B. Punts, the Fosbury Flop, and Other Projectile Motions (What are punts, football punt's range, hang time, etc. Shot-put. a comprehensive study of projectile motion and human projectiles.)
3	Rotations and collisions	A. Curveballs, Foul Shots, and Bent Kicks (Buoyancy, drag, sideward forces, aerodynamic forces, more complicated aerodynamics in sports.)

		B. Game Changers: Collisions in Sports (Collisions, physics of a football tackle, gentler pursuits: Bowling, dribbling and driving, etc)
4	Energy and Elasticity	A. Energy in Sports: Bursts of Power (Bouncing basketball, efficiency, energy accounting in sports, Behdad Salimikordsiabi's clean and jerk, etc) B. Energy and Timing in Elastic Equipment (The physics of archery, Zdeno Chara's slap, Bungee-Jumping)
5	Rotational Dynamics and Winter Sports	A. The Physics of Cycling (Rotational Motion, sustained human power, Talansky drives the bike, power output.) B. Physics of ice and snow C. Figure skating, curling

Division of Class Modality between In-class and Online Formats

Summer - 2018

Session II (Monday 2nd July - Friday 3rd August)

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	2-Jul-18	3-Jul-18	4-Jul-18	5-Jul-18	6-Jul-18	7-Jul-18
	1.5		1.5		1.5	3
8-Jul-18	9-Jul-18	10-Jul-18	11-Jul-18	12-Jul-18	13-Jul-18	14-Jul-18
	1.5		1.5		1.5	3
15-Jul-18	16-Jul-18	17-Jul-18	18-Jul-18	19-Jul-18	20-Jul-18	21-Jul-18
	1.5					
22-Jul-18	23-Jul-18	24-Jul-18	25-Jul-18	26-Jul-18	27-Jul-18	28-Jul-18
	1.5		1.5		1.5	3
29-Jul-18	30-Jul-18	31-Jul-18	1-Aug-18	2-Aug-18	3-Aug-18	
	1.5		1.5	1.5	1.5	
					Total Hours	**30**

15 Hours	On-campus classes, 6:30-8:00 PM Mon & Fri
15 Hours	Live online lectures (will be recorded and available for offline viewing), 6:30-8:00 PM Wed / 9:00 AM - 12:00 Noon Sat
15 Hours	Pre-recorded online video lectures and readings
	Instructor is out of state (July 17 - July 21)