APA 2314
Final exam preparation - Biomechanics portion 2022

Information regarding the final exam: The exam will take place as scheduled on April 22nd, 2022 from 2:00pm to 5:00pm. The exam will be completed online via Brightspace and will be proctored via Zoom. You will need to log in to Brightspace and Zoom prior to 2:00pm on April 22nd to ensure you begin the exam promptly at 2:00pm. More detailed information on how the exam will be managed will be posted on Brightspace.

The exam will consist of two parts: one part will focus on exercise physiology while the other part will focus on biomechanics. Each portion of the exam lasts 1.5 hours, for a total of 3 hours. The exercise physiology portion will start at 2:00pm and the biomechanics portion will start at 3.30pm. You will not be able to access the biomechanics portion before this time. You will need to complete and submit the exercise physiology portion of the exam before you may begin the biomechanics portion. The exam will be worth 50% of your final mark and each section will be weighted the same (i.e. 25% is allotted to Exercise Physiology, 25% to Biomechanics).

The Biomechanics portion of the exam will consist of the following types of questions: multiple choice, short answer, and calculations. Questions will be randomly selected from a bank of questions. Each exam will be unique and will include questions on each of the topics seen in the lab. You will be entitled to use your lab manuals during the exam, and their entire contents are testable on the exam. To be successful on the exam, you will need to understand the material seen in the labs, be able to do the calculations and be able to apply the concepts learned.

A Biomechanics equation sheet will be provided to you. It has been posted to Brightspace to help in your preparation

Here are some examples of what to review for each lab:

Anatomy, movement & math review
- Be able to differentiate between the various **directional terms**
- Know the **planes and axes**
- Know the basic **joint movements** possible at each axis of rotation
- During various movements, be able to discuss the **joint action(s), planes and axes** associated with the movement
- Be able to **convert between units**

***Math review** will not be tested on its own, but you will be expected to answer higher level math questions using the basic math listed in the lab manual (for example, solving kinematic problems may involve trigonometry and algebra)

Electromyography (& the gait cycle)
- Understand what **EMG measures**
- Be able to explain **how** and **why the skin is prepared** for surface EMG
- Be able to **design a research project** to evaluate which muscles are active during a given movement
- Be able to describe the steps necessary to get **from raw data to processed data**
- Be able to discuss **clinical applications** of EMG
- Know the major **events, periods,** and **phases of the gait cycle** and their relative **timings** and **intervals**
- Be able to **develop hypotheses** for the roles of various muscles during the gait cycle

Forces
- Know **Newton's three laws** and be able to **apply** the laws to different activities
- Be able to **define force** and know the **characteristics of a force**
- Be able to draw a complete **free body diagram**
- Be able to **calculate forces**
- Be able to **define static equilibrium** and be able to **apply** knowledge of static equilibrium to solve force problems
- Be able to differentiate between **static** and **kinetic friction**
- Be able to **calculate the coefficient of static friction** via the Force Platform Method and the Incline Plane Method
- Be able to describe some **sources of error** associated with each method

- Know the **effects of weight** and **surface** on the coefficient of static friction
- Be able to **design a research project** in order to calculate the coefficient of static friction
- Understand the **standard model of friction** (ideal friction curve)
- Be able to **locate and draw normal and frictional forces** from a photograph of a sporting activity and be prepared to **explain what the forces are acting on and what purpose they serve**
- Be able to compute the **variables associated with friction**

Moments of force
- Be able to **define moment of force**
- Be able to distinguish between the **(de)stabilizing component** and **turning component** of a muscular force
- Be able to **calculate moments of force, muscle forces** and **other variables associated with moments of force** (via direct or inverse dynamics) and understand how **modifying one variable affects other variables**
- Be able to **calculate the centre of gravity of a person** using the reaction board method
- Understand **how centre of gravity changes** with varying body positions
- Be able to describe the **limitations** associated with the centre of gravity board method and what affects its **precision**
- Be able to distinguish between the three **types of levers** and know all their parts
- Be able to identify **levers in the human body** and **levers used in various activities/tasks**
- Be able to calculate **mechanical advantage** and understand which **factors are gained or reduced** with each type of advantage
- Be able to compute the **variables associated with levers**

Kinematics
- Be able to **define kinematics** and **projectile motion**
- Know how to **calculate kinematic variables** using the equations of motion
- Be able to **calculate % difference** and **mean**
- Be able to describe how to maximize **vertical height** and **horizontal displacement** by modifying the throwing technique
- Understand which projectile motion variable that horizontal displacement is most **sensitive** to
- Be able to discuss **coaching techniques** used to optimize horizontal displacement (in terms of biomechanical variables)
- Know how an athlete's **height and strength can affect their shot putting performance**

Motion analysis
- Be able to **design a research project** which evaluates the effect of a given device (e.g. a knee immobilizer, an ankle brace, etc.) on the gait pattern of a subject using VICON and xsens
- Be able to **list examples of what motion capture systems are used for**
- Be able to list the **important subject measurements** required for motion analysis
- Be able to explain **how the Vicon cameras work** and **how the xsens sensors work**
- Be able to explain **why static and dynamic calibrations** are performed
- Be able to explain **why a static trial** with the participant is collected when using VICON
- Be able to explain **why a marker/sensor placement system** is used
- Be able to compare and contrast the **pros and cons** of the VICON and xsens systems

Anthropometry & moment of inertia
- Be able to calculate the **moment of inertia** of a pendulum through the pendulum's axis of rotation
- Be able to calculate the **radius of gyration** and the **centre of percussion** of a pendulum
- Be able to **define** moment of inertia, radius of gyration and centre of percussion
- Understand how moment of inertia, radius of gyration and centre of percussion are **related**
- Be able to calculate **body segment parameters** using **anthropometric tables**
- Know the **limitations** associated with using anthropometric tables
- Be able to **calculate muscle forces** and **moments of force** from anthropometric data
- Understand the **relationship** between moment of inertia and angular velocity
- Be able to describe what happens in each of the **angular momentum** examples provided in the lab document

Impulse, momentum & coefficient of restitution

- Be able to **define impulse, momentum,** and **coefficient of restitution**
- Understand the **impulse curves** for the two jumping conditions seen in the lab (in the z-axis) and be able to locate all **pertinent phases of a jump**
- Understand the **impulse patterns** for jogging, running and sprinting (in the y- and z-axes) and be able to locate all **pertinent impulse phases**
- Be able to **draw** and **read** the results of an impulse curve
- Be able to **calculate coefficient of restitution**

→*Ensure you understand significant figure rules as outlined in the laboratory. The same rules apply for the final exam.*