UNICUSANO
ROME

Italian code: ING-INF/06 **Credits: 6**
Course: Basics of Biomechanics
Main language of instruction: Italian
Other language of instruction: English

Head instructor
Professor Riccardo BORZUOLA - riccardo.borzuola@unicusano.it

Objectives

The course on Basics of Biomechanics aims to outline the experimental and analytical methodologies of biomechanics in relation to the practice of physical and sports activities. The course therefore requires knowledge of the basic elements of biomechanics to be used in optimizing programs and workload loads associated with physical and sports activities.

Course structure

- Introduction and Fundamentals of Mathematics and Geometry
- Measurement and Estimation of Physical Quantities
- Centre of Mass
- Kinematics
- Linear and Angular Dynamics
- Ergometry

Competencies

KNOWLEDGE AND UNDERSTANDING: The student will have acquired knowledge and understanding of the fundamental principles of biomechanics, the methods for characterizing movement, and the calculation methodologies.

APPLYING KNOWLEDGE AND UNDERSTANDING: The student will be able to address common biomechanics problems.

MAKING JUDGEMENTS: The student will be able to interpret results obtained from solving biomechanical problems to optimize exercise programs. Furthermore, the student will be able to identify high-risk movements and will have the ability to plan a safe physical activity program by optimizing exercise routines.

COMMUNICATION SKILLS: The student will have acquired appropriate technical language, enabling them to clearly express the technical knowledge gained in relation to the topics proposed and analyzed.

LEARNING SKILLS: The student will be able to effectively use the acquired knowledge to study, analyze, and apply experimental and analytical methodologies of biomechanics applied to motor sciences.

Syllabus

MODULE I – INTRODUCTION AND FUNDAMENTALS OF MATHEMATICS AND GEOMETRY

Definition of the concept of biomechanics
Applications of biomechanics in the international context
Application of biomechanics in sports
Mathematical foundations
Scalar and vector quantities
Operations with vectors
Pythagorean theorem
Trigonometry and solving right triangles

MODULE II – MEASUREMENT AND ESTIMATION OF PHYSICAL QUANTITIES

Concepts of measurement, estimation, and units of measurement
International System of Units (SI)
Fundamental and derived quantities of the SI system
Measurement errors and types of errors
Types of error
Characteristics of a measuring instrument

MODULE III – CENTER OF MASS

Center of mass of the human body
Definition and properties of the center of mass of a body

Determining the mass and center of mass of a human body segment and the entire human body

MODULE IV – KINEMATICS OF A POINT

Position, velocity, and acceleration vectors (linear and angular)
Uniform rectilinear motion
Uniformly accelerated motion
Projectile motion (ballistic)
Uniform circular motion

MODULE V – LINEAR AND ANGULAR DYNAMICS OF A POINT

Definition of dynamics and direct and inverse problems of dynamics
Definition of force, mass, and inertia
First, second, and third laws of dynamics
Principle of superposition of effects
Relevant forces in biomechanics: weight and reaction forces
Impulse of a force
Momentum and its relationship with the impulse of a force
Conservation of momentum and applications in sports activities
Definition of moment of a force and moment of inertia
Laws of motion
Angular momentum
Conservation of angular momentum

MODULE VI – ERGOMETRY

Definition of energy, mechanical work, and mechanical power
Work as a change in energy
Definition of kinetic energy
Kinetic energy theorem
Definition of gravitational potential energy and elastic potential energy
Total mechanical energy
Work of non-conservative forces (frictional forces and muscle forces)

Evaluation system and criteria

The exam will generally consist of either a written test or an oral exam (a verification method that can be conducted at the main campus in Rome), aimed at assessing analytical skills, command of language, and the ability to re-elaborate acquired concepts.

The written test includes 30 multiple-choice questions covering the entire course syllabus. Each correct answer to the multiple-choice questions is worth 1 point.

The oral exam consists of an interview designed to assess the student's level of preparation. This typically involves 3 questions (theoretical and/or applied in nature) covering the entire course syllabus. Each question is equally weighted, with a maximum score of 10 points per question.

In both exam formats, particular attention is given to evaluating the student's ability to re-elaborate, apply, and present the material available on the platform with proper use of technical language.

In addition, one e-tivity, consisting of reviewing a scientific paper regarding sport biomechanics, is compulsory. This needs to be sent to the instructor in advance of the examination. The e-tivity will contribute a maximum of 3 points toward the total score of 30 points.

Bibliography and resources

1. *Materials to consult*

Notes written by the instructor are available in Italian (part of the notes are also available in English).

2. *Recommended bibliography*

Suggested readings are:

1. Sports Biomechanics: The Basics: Optimising Human Performance. A.Blazevich, A. & C. Black, 2019 edition.

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