Università degli Studi di Verona
Corso di Laurea in Scienze delle attività motorie e sportive
A.A. 2016/2017

M-EDF/01 ***Metodi e didattiche delle attività motorie*** ***BIOMECHANICS***	***Professor*** *Paola Zamparo*

Course Objectives

The course aims to provide cultural and operational instruments for the biomechanical analysis of human movement, of sport activities and of human locomotion. The mechanical determinants of sports activities (e.g. athletic events) and the mechanical and energetic determinants of "cyclic" sports such as walking, running, cycling, swimming and cross-country skiing will be examined in detail. Part of the program will be carried out in the form of practical exercises of data analysis to enable the students to verify, from a practical point of view, the theoretical knowledge acquired and to familiarize with biomechanical calculations.

Program

1- Biomechanics of Sports

Muscle mechanics. Force-velocity and force-length relationships. Muscle architecture and its effects on muscle force. Mechanical proprieties of different muscle fibers (type I and II). Mechanics of tendons and ligaments: stress and strain, the Young's modulus.
Statics. Forces in biomechanics: external and internal forces; normal and shear forces; the distribution of forces and pressure. Frictional forces. Torque and levers. The center of mass. Joint biomechanics.
Linear kinematics. Linear displacement, speed and acceleration (average and instantaneous values). Projectile motion (jumps and throws).
Kinetic / Nonlinear dynamics. Force, work and power. Kinetic, potential and elastic energy. The principle of conservation of energy. Impulse and linear momentum. Impacts and collisions.
Angular kinematics. Polar coordinates. Angular displacement, velocity and acceleration. Uniform circular motion.
Kinetics / Dynamics corner. Moment of inertia. Rotational kinetic energy. Angular work and power. Conservation of angular momentum.

2- Biomechanics of locomotion

Efficiency and energy cost. Aerodynamic and non-aerodynamic energy cost. Muscle efficiency, transmission efficiency and locomotion efficiency.
Cycling. Aerodynamic drag and rolling friction. Normal and effective force applied to the pedals. The "man-bicycle" arrangement. The HPV (human-powered vehicles).
Walking and running. Step/stride phases, duty factor, ground reaction forces. Internal and external mechanical work. Positive work, negative work and mechanical efficiency. Biomechanics of running on gradients and with applied loads. The transition between walking and running. The Froude number.
Cross-country skiing and ice skating. Resistant forces and propulsive forces.
Swimming. Statics and dynamics of fluids: applications to swimming. The static and dynamic position of the body in water. The hydrodynamic resistance (active and passive drag). Propelling and Froude efficiency.

Recommended readings

- *Any Physics textbook*
- *Sport Biomechanics. A. Blazevich, A&C Black, London*

Lecture notes will be provided after each lesson.

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Assessment Method: *Written test with open questions and numerical calculations followed by an oral examination.*