

## UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	Metode za proučevanja dolgotrajnega napora
<b>Course title:</b>	Methods for researching prolonged exercise

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Doktorski študijski program		1	1 ali 2
Doctoral study program		1	1 ali 2

Vrsta predmeta / Course type Izbirni/elective

Univerzitetna koda predmeta / University course code:  

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
25	20	15		65		5

Nosilec predmeta / Lecturer: prof. dr. Anton Ušaj

Jeziki / Languages:	Predavanja / Lectures:	Slovenski/slovene
	Vaje / Tutorial:	Slovenski/Slovene

### Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Izpolnjevanje pogojev za vpis na doktorski študij Kineziologija in napredna znanja iz Biokemije in Fiziologije športnega napora, Temeljev športnega treniranja.

### Prerequisites:

General conditions for enrolment into the Doctoral Programme of Kinesiology and advanced knowledge of Biochemistry and Physiology of sports exercise, and Basic principles of sports training.

### Vsebina:

1. **Nekatere metode za proučevanje vzdržljivosti pri izometričnem in dinamičnem krčenju mišice**
  - Nekateri problemi proučevanja
  - Opazovanje stiska roke v zapestju
  - Temelji merjenja:
    - MRS (pH, CrP, Pi)
    - NIRS (O<sub>2</sub>Hb, HHb, TOTHb, TOI)
  - Analiza podatkov
  - Izkušnje in nekateri rezultati
- **Nekatere metode za proučevanje napora, povezanega s hitrostno vzdržljivostjo**
  - Nekateri problemi proučevanja
  - Opazovanje napora pri teku in kolesarjenju
  - Temelji merjenja:
    - Hitrost, ventilacija, privzem kisika, tvorba CO<sub>2</sub>, vsebnost laktata, pH,

### Content (Syllabus outline):

- **Selected methods for researching endurance during isometric and dynamic muscular contractions**
  - Basic research problems
  - Observations of muscle contraction during forearm muscles contractions
  - Basic principles of measuring:
    - MRS (pH, CrP, Pi)
    - NIRS (O<sub>2</sub>Hb, HHb, TOTHb, TOI)
  - Data analysis
  - Experiences and selected results
- **Selected methods for researching anaerobic (speed) endurance**
  - Basic research problems
  - Observations during running and cycling
  - Basic principles of measuring:
    - Velocity, ventilation, oxygen uptake, CO<sub>2</sub> production, lactate

<p>Po<sub>2</sub> in Pco<sub>2</sub> krvi, oksigenacija, frekvenca srca</p> <ul style="list-style-type: none"> <li>○ Analiza podatkov</li> <li>○ Izkušnje in nekateri rezultati</li> </ul> <ul style="list-style-type: none"> <li>● <b>Nekatere metode za proučevanje dolgotrajnega napora</b> <ul style="list-style-type: none"> <li>○ Nekateri problemi proučevanja</li> <li>○ Opazovanje napora pri teku, plavanju, smučarskem teku, triatlonu</li> <li>○ Temelji merjenja: <ul style="list-style-type: none"> <li>Hitrost, ventilacija, poraba kisika, tvorba CO<sub>2</sub>, vsebnost laktata, pH, Po<sub>2</sub> in Pco<sub>2</sub> krvi, oksigenacija, frekvenca srca</li> </ul> </li> <li>○ Analiza podatkov</li> <li>○ Izkušnje in nekateri rezultati</li> </ul> </li> <li>● <b>Nekatere metode za proučevanje super-dolgotrajnega napora</b> <ul style="list-style-type: none"> <li>○ Nekateri problemi proučevanja</li> <li>○ Opazovanje napora pri maratonskem teku, supermaratonih, adventure races, dolgotrajnih triatlonih, alpinističnih odpravah, reševalnih akcijah</li> <li>○ Temelji merjenja: <ul style="list-style-type: none"> <li>Hitrost, ventilacija, poraba kisika, tvorba CO<sub>2</sub>, vsebnost laktata, oksidacija ogljikovih hidratov in maščob, stabilni izotopi pri proučevanju presnove, frekvenca srca, glukoza v krvi</li> </ul> </li> <li>○ Analiza podatkov</li> <li>○ Izkušnje in nekateri rezultati</li> </ul> </li> <li>● <b>Nekatere metode za proučevanje učinkov vzdržljivostne vadbe</b> <ul style="list-style-type: none"> <li>○ Nadzorovane okoliščine</li> <li>○ Športna vadba</li> </ul> </li> <li>● <b>Proučevanje vzdržljivosti v ekstremnih okoliščinah</b> <ul style="list-style-type: none"> <li>○ Visoka nadmorska lega in vzdržljivost</li> <li>○ Višinska vadba in vzdržljivost</li> </ul> </li> </ul>	<p>concentration, blood pH, Po<sub>2</sub> and Pco<sub>2</sub>, oxygenation, heart rate</p> <ul style="list-style-type: none"> <li>○ Data analysis</li> <li>○ Experiences and selected results</li> </ul> <ul style="list-style-type: none"> <li>● <b>Selected methods for researching aerobic (long duration) endurance</b> <ul style="list-style-type: none"> <li>○ Basic research problems</li> <li>○ Observations during running, XC ski running, swimming and cycling</li> <li>○ Basic principles of measuring: <ul style="list-style-type: none"> <li>Velocity, ventilation, oxygen uptake, CO<sub>2</sub> production, lactate concentration, blood pH, Po<sub>2</sub> and Pco<sub>2</sub>, oxygenation, heart rate</li> </ul> </li> <li>○ Data analysis</li> <li>○ Experiences and selected results</li> </ul> </li> <li>● <b>Selected methods for researching aerobic (extreme duration) endurance</b> <ul style="list-style-type: none"> <li>○ Basic research problems</li> <li>○ Observations during marathon running, alpinist expeditions</li> <li>○ Basic principles of measuring: <ul style="list-style-type: none"> <li>Velocity, ventilation, oxygen uptake, CO<sub>2</sub> production, lactate concentration, blood pH, Po<sub>2</sub> and Pco<sub>2</sub>, oxygenation, heart rate, oxydaion rate of carbohydrates and fats, using stable isotopes, concentration of blood glucose</li> </ul> </li> <li>○ Data analysis</li> <li>○ Experiences and selected results</li> </ul> </li> <li>● <b>Selected methods for researching adaptations on endurance training</b> <ul style="list-style-type: none"> <li>○ Controlled experiments</li> <li>○ Sports training.</li> </ul> </li> <li>● <b>Selected methods for researching during extreme environmental conditions</b> <ul style="list-style-type: none"> <li>○ High altitude and endurance performance</li> <li>○ Altitude training and endurance</li> </ul> </li> </ul>
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**Temeljni literatura in viri / Readings:**

Ušaj A.: Nekatero metode za proučevanje vzdržljivosti (v pripravi)

UŠAJ, Anton, STARC, Vito. Blood pH and lactate kinetics in the assessment of running endurance. *Int. j. sports med.*, 1996, let. 17, št. 1, str. 34-40

FRIEDLANDER, Anne L., CASAZZA, Gretchen A., HORNING, Michael A., UŠAJ, Anton, BROOKS, George A. Endurance training increases fatty acid turnover, but not fat oxidation, in young men. *J Appl Physiol*, 1999, letn. 86, št. 6, str. 2097-2105

Brooks, G.A.: The lactate shuttle during exercise and recovery. *Med. And Sci in Sports and Exercise*: 3; 360-368, 1986

Wassermann, K., Beaver, K., Whipp, B.: Mechanisms and patterns of blood lactate increase during exercise in man. *Med and Sci in Sports and Exercise*: 3; 244-352, 1986

Katz, J.: The application of isotopes to the study of lactate metabolism. *Med and Sci n Sports and Exercise*; 3: 353-355, 1986

Coogan AR, Kohrt W.M., Spina R.S., Bier, D.M., Holloszy, J.O\_ Endurance training decreases plasma glucose turnover oxydation during moderate – intensity exercise in man. *J.A.P.*, 68 (3= 990-996, 1990)

Kralj A.: OSNOVE MEDICINSKE ELEKTROTEHNIKE. Univerzum, Ljubljana 1983

Montoye H.J., Kemper C.G., Saris W.H., Washburn R.A.: MEASURING PHYSICAL ACTIVITY AND ENERGY EXPENDITURE. Human Kinetics, Champaign IL, 1996

#### **Cilji in kompetence:**

Razviti sposobnost izbire ustreznih obremenilnih protokolov, uporabe ustreznih merilnih metod, izbire in uporabe ustreznih metod za analizo podatkov in referenc iz literature, glede na idejo in hipotezo pri raziskovanju vzdržljivosti.

#### **Objectives and competences:**

To develop specific performances and skills in the selection of appropriate testing protocols, measurement methods, methods for data analysis and using references from literature when specific idea and hypothesis were testing in the field of endurance.

#### **Predvideni študijski rezultati:**

Znanje in razumevanje:

- Uporabe različnih načinov obremenjevanja preiskovancev glede na zastavljen cilj opazovanja
- Uporabe metod merjenja in analiz podatkov
- Povečanje specifičnega vedenja na področju fiziologije vzdržljivosti.

#### **Intended learning outcomes:**

Knowledge and understanding:

- Selection and using of different exercise tests according the aim of research
- Selection and using of measurements and data analysis
- Increase of specific knowledge of Exercise Physiology related to endurance performance.

#### **Metode poučevanja in učenja:**

Predavanja  
Demonstracije v laboratoriju ali s pomočjo filmov in slikovnega materiala dela v laboratoriju.  
Uporaba izbranih rezultatov in demonstracija analiz

#### **Learning and teaching methods:**

Lectures  
Demonstrations ni laboratory or by usng filmed or photo materials about work in laboratory.  
Using selected data for demonstarting data analyses.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
<p>Način (pisni izpit, ustno izpraševanje, naloge, projekt)</p> <p>Teoretični izpit v obliki izpraševanja, po pozitivno ocenjeni seminarski nalogi. Ocenjevalna lestvica: 6-10 (pozitivno) oz. 1-5 (negativno).</p>	<p><b>100 %</b></p>	<p>Type (examination, oral, coursework, project):</p> <p>Oral theoretical examination, which can be acceded upon a positive review of a seminar. Assessment scale: 6-10 (positive) and 1-5 (negative).</p>

**Reference nosilca / Lecturer's references:**

UŠAJ, Anton, JEREB, Blaž, PRITRŽNIK, Robert, DUVILLARD, Serge P. von. The influence of strength-endurance training on the oxygenation of isometrically contracted forearm muscles. *European journal of applied physiology*. [Print ed.], 2007, vol. 100, no 6, str. 685-692

FRIEDLANDER, Anne L., CASAZZA, Gretchen A., HORNING, Michael A., UŠAJ, Anton, BROOKS, George A. Endurance training increases fatty acid turnover, but not fat oxidation, in young men. *J Appl Physiol*, 1999, letn. 86, št. 6, str. 2097-2105

UŠAJ, Anton, STARC, Vito. Blood pH and lactate kinetics in the assessment of running endurance. *Int. j. sports med.*, 1996, let. 17, št. 1, str. 34-40

UŠAJ, Anton. The influence of endurance training on brain and leg blood volumes translocation during an orthostatic test. V: JARM, Tomaž (ur.), KRAMAR, Peter (ur.), ŽUPANIČ, Anže (ur.). *11th Mediterranean Conference on Medical and Biological Engineering and Computing 2007, 26-30 June, 2007, Ljubljana, Slovenia*, (IFMBE proceedings, vol. 16). New York: Springer: International Federation for Medical and Biological Engineering, 2007

UŠAJ, Anton, KANDARE, Franc. Changes in pulmonary ventilation and blood [H+] when the exercise intensity passes maximal lactate steady state. V: 10th Annual Congress [of the] European College of Sport Science, July 13-16, 2005, Belgrade, Serbia.