

## UČNI NAČRT PREDMETA / COURSE SYLLABUS

**Predmet:** BIOLOŠKO AKTIVNI KOVINSKI KOMPLEKSI  
**Course Title:** BIOLOGICALLY ACTIVE METAL COMPLEXES

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	/	1.	2.
USP Biochemistry, 2 <sup>nd</sup> Cycle	/	1 <sup>st</sup>	2 <sup>nd</sup>

**Vrsta predmeta / Course Type:**

izbirni strokovni / Elective Professional

**Univerzitetna koda predmeta / University Course Code:**

BI2116

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
15	15	45 LV	/	/	75	5

**Nosilec predmeta / Lecturer:**

prof. dr. Iztok Turel / Dr. Iztok Turel, Full Professor

**Jeziki / Languages:**

**Predavanja / Lectures:** slovenski / Slovenian

**Vaje / Tutorial:** slovenski / Slovenian

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

Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.

**Prerequisites:**

The course has to be assigned to the student.

**Vsebina:**

**PREDAVANJA:**  
 Uvod in razlaga osnovnih pojmov.  
 Vpliv kovinskih ionov na oksidativni stres in nastanek prostih radikalov. Fentonova reakcija. Interakcije kovinskih ionov in antioksidantov. Koordinacijske spojine kot mimiki nekaterih encimov. Modelne spojine. Primeri uporabe (vezava dušika; vezava reaktivnih kisikovih zvrsti; fotosinteza, itd.).  
 Vezava kovinskih ionov na biološko pomembne makromolekule (proteine, DNA, itd). Vloga kovin pri agregaciji proteinov (npr. prionov). Pregled kovin, ki tvorijo biološko aktivne koordinacijske spojine in so že v klinični rabi ali pa v fazi preizkusov. Kovinski kompleksi, ki se

**Content (Syllabus outline):**

**LECTURES**  
 Introduction and explanation of general terms. Oxidation stress induced by metal ions, formation of radical species. Fenton's reaction. Interactions of metal ions and antioxidants. Coordination compounds as mimics of enzymes. Model compounds. Examples of applications (nitrogen fixation; binding of reactive oxygen species; photosynthesis, etc.).  
 Binding of metals to biologically important macromolecules (proteins, DNA, etc). Role of metals in aggregation of proteins (e.g. prions).  
 The review of metals that form biologically active coordination compounds and are already used in clinical practice or are potential

uporabljajo v diagnostične namene.

**VSEBINA SEMINARJEV:**

Študentje bodo individualno ali v skupini pripravili projekt z določeno specifično tematiko s poudarkom na najnovejših dognanjih. Praktični del projekta bodo izvedli pri laboratorijskih vajah.

**VSEBINA LABORATORIJSKIH VAJ:**

Študentje bodo načrtovali in izvedli sinteze biološko aktivnih koordinacijskih spojin. Sestavo in druge lastnosti kovinskih kompleksov bodo določali z različnimi spektroskopskimi metodami ( NMR spektroskopijo, IR spektroskopijo, UV spektroskopijo), s termogravimetrično analizo (TGA, DSC), visokotlačno tekočinsko kromatografijo (HPLC).

Pri tem delu študent spozna tudi praktične znanstvene probleme s katerimi se ukvarjamo na Katedri za anorgansko kemijo.

therapeutics. Metal complexes that are used as diagnostic agents.

Seminars: Preparation (in group or individually) of certain specific up to date projects. The practical project will be performed in the lab. Practical course: The student will prepare a plan of isolation of biologically active coordination compound that is later practically performed. Composition and properties of isolated product will be studied by various methods (spectroscopic (NMR, IR, UV-vis), X-ray, thermal (TGA, DSC), chromatography (HPLC)). During this work the students are also informed with practical examples which are studied at the chair of Inorganic chemistry.

**Temeljna literatura in viri / Readings:**

**Temeljna literatura: / Main source:**

- A.E. Shilov, Metal Complexes in Biomimetics Chemical reactions, CRC, 1997, 300 strani / pages (10%).

**Poglavja iz: / Chapters from:**

- N. Hadjiladis, E. Sletten, (Eds.), Metal complex - DNA interactions, John Wiley & Sons, Inc.: Hoboken, NJ, 2009, 544 strani / pages (10 %).

- Macromolecules containing metal and metal-like elements, Vol 3, A.S. Abd-El-Azoz, C.E. Carraher Jr., C.U. Pittman Jr., J.E. Sheats, M. Zeldin, Wiley Interscience, 2004, 208 strani / pages (15 %).

- Mechanisms of Metallocenter Assembly, R.P. Hausinger, G.L. Eichhorn, L.G. Marzilli, VCH, 1996, 260 strani / pages, (10 %).

**Cilji in kompetence:**

**Cilji predmeta:**

Nadgraditi in poglobiti znanje in razumevanje pomena kovinskih ionov v živih sistemih, seznaniti študente z nekaterimi sintetičnimi makromolekulskimi kovinskimi kompleksi, ki simulirajo delovanje naravnih bioaktivnih substance.

**Predmetno specifične kompetence:**

Pri predmetu študent utrjuje strategijo reševanja problemov in nadgradi svoje znanje

**Objectives and Competences:**

- To upgrade knowledge and understanding of importance of metal ions in living systems
- To study synthetic (model) macromolecular metal complexes which simulate natural bioactive substances
- A student is strengthening knowledge of strategy of solving problems and upgrade knowledge in interpretation of data
- Student is able to connect theoretical data with experimental data.

o zbiranju in interpretaciji podatkov ter povezovanju teorije in eksperimentalnega dela.

### **Predvideni študijski rezultati:**

#### Znanje in razumevanje

Študent razume pomen in delovanje kovin v organizmu.

#### Uporaba

Znanje in razumevanje osnovnih kemijskih zakonitosti vezave kovinskih ionov na biološko pomembne sisteme so pomembni pri nadgradnji nekaterim predmetom pri nadaljnjem študiju.

#### Refleksija

Študent je sposoben oceniti pomen kovinskih ionov za razlago nekaterih pomembnih procesov, ki potekajo v organizmih.

#### Prenosljive spretnosti

Študent zna poiskati podatke iz strokovne literature, podatke iz virov medmrežja pa zna kritično oceniti; zna uporabljati strokovni jezik, tako pisno kot ustno.

### **Intended Learning Outcomes:**

#### Knowledge and Comprehension

To understand the importance and activity of metals in organism.

#### Application

To comprehend the binding of metal ions in biological important systems in connection with other topics in his/her further study.

#### Analysis

To be able to evaluate the importance of metal ions in explanation of some important processes in organisms.

#### Skill-transference Ability

Ability of finding and usage of the literature and internet data, interpretation of data, critical analysis of texts relating the topics. Oral and written use of professional language.

### **Metode poučevanja in učenja:**

Predmet se izvaja v obliki seminarjev, seminarskih vaj in praktičnih vaj, ki jih študentje v skupinah izvedejo v laboratorijih. Študentje pripravijo seminarje o izbranih temah, ki jih nato predstavijo pred svojimi kolegi. Praktični del predmeta je zasnovan izrazito projektno. Študentom se zastavi konkretni problem, ki ga nato na osnovi zbranih podatkov iz literature in z aktivnim sodelovanjem s pedagoškim osebjem, tudi rešijo. Svoje delo opišejo v poročilu in ga tudi predstavijo.

### **Learning and Teaching Methods:**

- Seminar work, discussion, practical group lab work, project work.
- Each student chooses a specific topic related with the biomimetic and prepares a non-research project work (seminar) and presents it to the group.
- Students work on a specific problem, which is solved by using literature data with help of pedagogical assistant.
- Preparation of written laboratory report and oral presentation.

Delež (v %) /

### **Načini ocenjevanja:**

Weight (in %) **Assessment:**

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Opravljenе vaje; kolokvij	40 %	Successfully finished practical lab course
Seminarska naloga	10 %	Seminar work
Ustni izpit	50 %	Oral examination

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

1. R. Hudej, J. Kljun, W. Kandioller, U. Repnik, B. Turk, C. G. Hartinger, B. K. Keppler, D. Miklavčič,

1. **I. Turel**, Synthesis and Biological Evaluation of the Thionated Antibacterial Agent Nalidixic Acid and its Organoruthenium(II) Complex, *Organometallics*, 31, 5867–5874 (2012).
2. **I. Turel**, J. Kljun, Interactions of metal ions with DNA, its constituents and derivatives, which may be relevant for anticancer research, *Current Topics in Medicinal Chemistry*, 11, No. 21, 2661-2687 (2011).
3. D. Rehder, J. Costa Pessoa, C.F.G.C. Geraldes, M.M.C.A Castro, T. Kabanos, T. Kiss, B. Meier, G. Micera, L. Petterson, M. Rangel, A. Salifoglou, **I. Turel**, D. Wang, In vitro study of the insulin-mimetic behaviour of vanadium(IV, V) coordination compounds, *J. Biol. Inorg. Chem.*, 7, 384-396 (2002).

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