

## UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	KEMIJA NARAVNIH SPOJIN
<b>Course Title:</b>	CHEMISTRY OF NATURAL COMPOUNDS

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

**Vrsta predmeta / Course Type:**

obvezni / Mandatory

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

IZO217

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	30	15 LV	/	/	75	5

**Nosilec predmeta / Lecturer:**

prof. dr. Bogdan Štefane / Dr. Bogdan Štefane, 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 potekajo po naslednjih tematskih sklopih:

- Naravna barvila
- Lipidi
- Eterična olja
- Ogljikovi hidrati
- Alkaloidi
- Antibiotiki naravnega izvora
- Citostatiki naravnega izvora

Vsak tematski sklop obsega utrditev osnov, pregled sistema značilnih spojin po kriterijih strukture, prepoznavanje relacij med strukturo in lastnostmi, opredelitev naravnih virov, funkcij in lastnosti v živih organizmih, metabolizem in vplivi na zdravje, pregled

**Content (Syllabus outline):**

Lectures consists of the following themes:

- Natural dyes
- Lipids
- Essential Oils
- Carbohydrates
- Alkaloids
- Antibiotics of natural origin
- Anti-cancer compounds of natural origin

Each topic comprises the consolidation of the basic principles, a review of specific compounds according to the criteria of chemical structure, identification of relationships between structure and properties, identification of natural sources, functions and properties in living organisms, metabolism and effects on

uporabe v medicini, farmaciji, prehrani in drugih panogah, pregled industrijskih postopkov in tržnih izdelkov na osnovi naravnih učinkovin.

V okviru seminarjev študenti poglobljeno obravnavajo ožje izbrane teme, ki se navezujejo na gornje vsebine. Pri vajah preizkušajo in izpopolnjujejo eksperimente ekstrakcije in izolacije naravnih spojin, ki so primerni za delo v šolskem laboratoriju.

health, a review of medical, pharmaceutical, food and other applications, and an overview of industrial processes and market products based on natural ingredients.

In the seminars, students prepare individual in-depth reviews of the selected topics related to the above themes. In the experimental laboratory work, students test and optimise methods of extraction and isolation of natural compounds, and adapt them for a school laboratory.

#### Temeljna literatura in viri / Readings:

1. Bernd Schaefer, *Natural products in the Chemical Industry*, Springer-Verlag, Berlin Heidelberg, 2014.
2. Charles S. Sell, *A Fragrant Introduction to Terpenoid Chemistry*, The Royal Society of Chemistry, Cambridge, 2003.
3. Uroš Grošelj, Krištof Kranjc, Bogdan Štefane, *Bioorganska kemija – vaje*, Univerza v Ljubljani, Fakulteta za kemijo in kemijsko tehnologijo, 2019.
4. Uroš Grošelj, Krištof Kranjc, Franc Požgan, *Biološko pomembne spojine*, Univerza v Ljubljani, Fakulteta za kemijo in kemijsko tehnologijo, 2019.

#### Cilji in kompetence:

##### Cilji:

1. Pridobiti znanje in razumevanje na področju naslednjih skupin naravnih spojin: naravna barvila, lipidi, eterična olja, ogljikovi hidrati, antibiotiki naravnega izvora, citostatiki naravnega izvora, alkaloidi.
2. Pridobiti znanje o pomenu in uporabi naravnih spojin v industriji, zlasti živilski in farmacevtski.
3. Razviti multidisciplinarno razmišljanje in sposobnost povezovanja znanja kemije, biologije in fizike za razumevanje izbranih naravnih spojin, pojavov in procesov v živih organizmih in industriji.

##### Specifične kompetence:

1. Poznavanje, razumevanje in uporaba pojmov stroke in njihovih povezav in teorij.
2. Razvijanje sposobnosti naravoslovnega mišljenja in interdisciplinarnega povezovanja vsebin.
3. Sposobnost vrednotenja, interpretacije ter povezovanja informacij na področjih naravnih spojin.

#### Objectives and Competences:

##### Objectives:

1. Acquire knowledge and understanding in the field of natural compounds of the following groups: natural dyes, lipids, essential oils, carbohydrates, antibiotics of natural origin, anti-cancer compounds natural origin, alkaloids.
2. Acquire knowledge on the importance and use of natural compounds in the industry, particularly in the food and pharmaceutical fields.
3. Develop a multi-disciplinary thinking and the ability to integrate and apply knowledge of chemistry, biology, and physics, for better understanding of selected natural compounds, phenomena and processes in living organisms and in the industry.

##### Specific competences:

1. Knowledge, understanding and application of concepts, their connections and theories.
2. Developing the skills of scientific thinking and interdisciplinary understanding of the contents.
3. Ability to evaluate, interpret and integrate information in the field of natural compounds.

4. Sposobnost reševanja preprostejših problemov v vsakdanjem življenju, vključno s skrbjo za uravnoteženo zdravo prehrano, skrbjo za zdravje, boljšim razumevanjem metabolnih in fizioloških procesov.

5. Poznavanje vpliva, pomena in uporabe naravnih spojin v industriji, medicini in razvoju družbe.

4. Ability to solve simple problems in everyday life, related to a healthy balanced nutrition, health concerns, and better understanding of metabolic and physiological processes.

5. Knowing the impacts, importance and uses of natural compounds in industry, medicine and in the society.

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

##### Znanje in razumevanje

Poznavanje strukturnih značilnosti in relacij med strukturo in lastnostmi naravnih spojin. Poznavanje naravnih virov, razumevanje funkcij in lastnosti v živih organizmih, metabolizma in vplivov na zdravje. Poznavanje uporabe v medicini, farmaciji, prehrani in drugih panogah. Poznavanje industrijskih postopkov in tržnih izdelkov na osnovi naravnih učinkovin.

##### Uporaba

Študent zna multidisciplinarno logično povezovati znanja iz kemije, biologije in fizike za poglobljeno razumevanje pomena in funkcij naravnih spojin v živih sistemih in industriji. Pridobljeno znanje in razumevanje uporablja v vsakdanjih življenjskih situacijah, zlasti pri odločanju in izboru uravnotežene zdrave prehrane, pri skrbi za zdravje, pri okoljski problematiki ter v razumevanju industrijskih postopkov. Prepoznati in ovrednotiti zna tržne izdelke, ki vsebujejo naravne spojine.

##### Refleksija

Študent zna kritično vrednotiti pozitivne in tudi negativne učinke posameznih tipov naravnih spojin na metabolizem in zdravje. Pozna pomen naravnih antioksidantov, esencialnih maščobnih kislin in vitaminov za zdravje človeka. Pozna tudi toksične naravne spojine zlorabe naravnih strupov in halucinogenov v zgodovini in v današnjem času. Seznanjen je s pomenom naravnih spojin v industrijskih postopkih in izdelkih.

#### **Intended Learning Outcomes:**

##### Knowledge and Comprehension

Knowledge of the structural characteristics and structure-properties relationships of natural compounds. Knowledge of natural resources, understanding of functions and features of living organisms, metabolism and effects on health. Knowledge of medical, pharmaceutical, food and other industries, industrial processes, and market products based on natural ingredients.

##### Application

The student is able to make multidisciplinary logical connections within chemistry, biology and physics, for in-depth understanding of the importance and functions of natural compounds in living systems and the industry. Acquired knowledge and understanding is applied in everyday life situations, especially in a decision-making regarding the selection of a balanced healthy diet, health in environmental issues, and in understanding of industrial processes. The student is able to identify and evaluate market products that contain natural compounds.

##### Analysis

The student is able to critically evaluate the positive and negative effects of natural compounds regarding the metabolism and health. He/she knows the importance of natural antioxidants, essential fatty acids and vitamins for human health. He/she is aware of the toxicity of some natural compounds, and of possible abuse of natural toxins and hallucinogens in history and in the present time. He/she knows the importance of natural compounds in industrial processes and products.

### Prenosljive spretnosti

Predmet razvija multidisciplinarno razmišljanje, sposobnosti načrtovanja laboratorijskih eksperimentov, analitičnega mišljenja in reševanja problemov, samostojnega kritičnega razmišljanja ter ustne in pisne strokovne komunikacije.

### Skill-transference Ability

The subject develops multidisciplinary thinking, the ability to design laboratory experiments, the ability of analytical thinking and problem solving, independent critical thinking, and oral and written professional communication.

### **Metode poučevanja in učenja:**

Predavanja, demonstracijski eksperimenti, problemski pristop, reševanje problemov, sodelovalno učenje, laboratorijsko delo, ekskurzije.  
Izdelava seminarских nalog s samostojnim individualnim delom ob pomoči učitelja.  
Predstavitev seminarских nalog v obliki nastopa na študentski konferenci.

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

Lectures, demonstrations of experiments, problem based learning, problem-solving, cooperative learning, laboratory experimental work, excursions.  
Students' seminars based on individual work, in consultations with a teacher. Presentation of seminar works on a students' conference.

### **Načini ocenjevanja:**

**Delež (v %) /**

**Weight (in %) /**

**Assessment:**

Pisni izpit	50 %	Written exam
Predstavitev seminarске naloge	50 %	Seminar work with a presentation
Opravljene vaje so pogoj za pristop k izpitu. Ocene od 6-10 (pozitivno) oz. 1-5 (negativno)		Completed laboratory work is a prerequisite for the exam Ratings 6-10 (positive) and 1-5 (negative)

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

- **ŠTEFANE, Bogdan**. Selective addition of organolithium reagents to BF<sub>2</sub>-chelates of  $\alpha$ -ketoesters. Organic letters, ISSN 1523-7060, 2010, vol. 12, no. 13, str. 2900-2903, doi: 10.1021/ol100620j. [COBISS.SI-ID 34162181]
- WANG, Jingxin, **ŠTEFANE, Bogdan**, JABER, Deana, SMITH, Jacqueline A. I., VICKERY, Christopher, DIOP, Mouhamed, SINTIM, Herman O. Remote C-H functionalization : using the N-O moiety as a atom-economical tether to obtain 1,5- and the rare 1,7-C-H insertions. Angewandte Chemie, ISSN 1433-7851. [Print ed.], 2010, vol. 49, no. 23, str. 3964-3968, doi: 10.1002/anie.201000160. [COBISS.SI-ID 34061573]
- Uroš Grošelj, Krištof Kranjc, **Bogdan Štefane**, Bioorganska kemija, Univerza v Ljubljani, Fakulteta za kemijo in kemijsko tehnologijo, 2019.