## BIOTEHNOLOGIJA – TEORETIČNI PREDMETI

# UČNI NAČRT PREDMETA/COURSE SYLLABUS

| | |
|---|---|
| Predmet: | Animalna biotehnologija |
| Course title: | Animal biotechnology |

| Študijski programi in stopnja | Študijska smer | Letnik | Semestri |
|---|---|---|---|
| Bioznanosti, tretja stopnja, doktorski | biotehnologija | | Celoletni |

| | |
|---|---|
| Univerzitetna koda predmeta/University course code: | 3782 |

| Predavanja | Seminar | Vaje | Klinične vaje | Druge oblike študija | Samostojno delo | ECTS |
|---|---|---|---|---|---|---|
| 20 | 20 | 0 | 0 | 25 | 185 | 10 |

| | |
|---|---|
| Nosilec predmeta/Lecturer: | Peter Dovč |

| | |
|---|---|
| Izvajalci predavanj: | Peter Dovč, Gregor Gorjanc, Tanja Kunej, Mojca Narat |
| Izvajalci seminarjev: | |
| Izvajalci vaj: | |
| Izvajalci kliničnih vaj: | |
| Izvajalci drugih oblik: | |
| Izvajalci praktičnega usposabljanja: | |

| | |
|---|---|
| Vrsta predmeta/Course type: | teoretični/theoretical |

| | | |
|---|---|---|
| Jeziki/Languages: | Predavanja/Lectures: | Angleščina, Slovenščina |
| | Vaje/Tutorial: | Angleščina, Slovenščina |

| Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti: | Prerequisites: |
|---|---|
| splošni pogoji za vpis na doktorski študij | general requirement for the enrollment to the doctoral programme |

| Vsebina: | Content (Syllabus outline): |
|---|---|
| Predmet obsega najpomembnejša področja animalne biotehnologije, njihov razvoj in aktualne raziskovalne probleme. Vsebina predmeta je razdeljena na pet poglavij: 1. Pregled razvoja animalne biotenologije s poudarkom na razvoju metod transgeneze in | The subject addresses the most important areas of animal biotechnology, their development and present research problems. The content is organized in five chapters: 1. Review of development in animal biotechnology with special accent on |

| | |
|---|---|
| molekularnih markerjev za upravljanje z živalskimi genskimi viri. 2. Imunske tehnologije v animalni biotehnologiji. 3. Epigenetski mehanizmi, ki uravnavanjo izražanje genov. 4. Razvoj živalskih modelov za biomedicinske študije. 5. Upravljanje velikih podatkovnih zbirk in genomska selekcija. | technology of transgenesis. 2. Immune technologies in animal biotechnology. 3. Epigenetic mechanisms regulating gene expression. 4. Development of animal models for biomedical research. 5. Management of big datasets and genomic selection. |

| Temeljna literatura in viri/Readings: |
|---|
| • Paterson, A.H.: Molecular Dissection of complex traits.CRC Press, 1998, New York<br>• Liu, B.H.: Statistical Genomics. CRC Press, 1998, New York<br>• Hofman M., Anne J.: Biotechnology in Animal Husbandry. Kluwer Academic Publishers, 2001, Dordrecht<br>• Babiuk, L., Phillips, J.P.: Animal Biotechnology, Pergamon press, 1989, Oxford<br>• revijalni članki s področja, tekoča periodika, druga učna gradiva…« |

| Cilji in kompetence: | Objectives and competences: |
|---|---|
| Pridobiti pregled nad najpomembnejšimi področji raziskav v animalni biotehnologiji in seznanitev z osnovnimi metodološkimi pristopi. Študentje naj bi tako dobro poznali področje, da bi lahko kompetentno presojali različne raziskovalne pristope in bili sposobni prepoznati možnosti za tehnološki preboj. | Gaining the overview in the most important areas of research in animal biotechnology and getting acquinted with the basic methodological approaches. Students should be able to judge critically different research approaches and to develop the ability to recognize possibilities for technologicah break through. |

| Predvideni študijski rezultati: | Intended learning outcomes: |
|---|---|
| Znanje in razumevanje:<br>Temelječ na znanju genetike, molekularne biologije, fiziologije in statistike naj bi se študent seznanil s stanjem v animalni biotehnologiji in se usposobil za sledenje razvoja tega znanstvenega področja. | Knowledge and understanding:<br>Based on their knowledge in genetics, moleculr biology, physiology and statistics should students get informed about the research challenges in animal biotechnology and develop skills to follow advancements in this field of research. |

| Metode poučevanja in učenja: | Learning and teaching methods: |
|---|---|
| Predavanja (pet predavateljev, skupno 20 ur predavanj).<br>Prirava seminarskega dela pri enem od predavateljev, konzultacije za pripravo seminarja.<br>Samostojen študij | Lectures (five lecturers, cummulative 20 hours of lectures)<br>Preparation of the seminar under the guidance of one of the lecturers, consultations during the preparation of the seminar.<br>Individual study |

| Načini ocenjevanja: | Delež/Weight | Assessment: |
|---|---|---|
| Pisni izpit | 40,00 % | Exam |
| Seminar (pisni izdelek) | 40,00 % | Seminar (written version) |
| Predstavitev in zagovor seminarja | 20,00 % | Presentation and defence of the seminar |

Reference nosilca/Lecturer's references:

Nosilec, P. DOVČ:

1. BENČINA, Mateja, CIZELJ, Ivanka, BERČIČ, Rebeka Lucijana, NARAT, Mojca, BENČINA, Dušan, DOVČ, Peter. Shared epitopes of avian immunoglobulin light chains. *Veterinary Immunology and Immunopathology*, ISSN 0165-2427. [Print ed.], 2014, in press.
2. JEVŠINEK SKOK, Daša, GODNIČ, Irena, ZORC, Minja, HORVAT, Simon, DOVČ, Peter, KOVAČ, Milena, KUNEJ, Tanja. Genome-wide in silico screening for microRNA genetic variability in livestock species. *Animal genetics*, ISSN 0268-9146, 2013, vol. 44, no. 6, str. 669-677.
3. SIMČIČ, Mojca, LENSTRA, J.A., BAUMUNG, R., DOVČ, Peter, ČEPON, Marko, KOMPAN, Drago. On the origin of the Slovenian Cika cattle. *Journal of animal breeding and genetics*, ISSN 0931-2668, 2013, vol. 130, no. 6, str. 487-495.
4. GODNIČ, Irena, ZORC, Minja, JEVŠINEK SKOK, Daša, CALIN, George Adrian, HORVAT, Simon, DOVČ, Peter, KOVAČ, Milena, KUNEJ, Tanja. Genome-wide and species-wide in silico screening for intragenic microRNAs in human, mouse and chicken. *PloS one*, ISSN 1932-6203, 2013, vol. 8, no. 6, str. 1-14, e-65165.
5. CIRKVENČIČ, Nina, NARAT, Mojca, DOVČ, Peter, BENČINA, Dušan. Distribution of chicken cathepsins B and L, cystatin and ovalbumin in extra-embryonic fluids during embryogenesis. *British Poultry Science*, ISSN 0007-1668, 2012, vol. 53, no. 5, str. 623-630.
6. ZORC, Minja, JEVŠINEK SKOK, Daša, GODNIČ, Irena, CALIN, George Adrian, HORVAT, Simon, JIANG, Zhihua, DOVČ, Peter, KUNEJ, Tanja. Catalog of MicroRNA seed polymorphisms in vertebrates. *PloS one*, ISSN 1932-6203, 2012, vol. 7, no. 1, str. 1-8, e30737.
7. OGOREVC, Jernej, DOVČ, Peter, KUNEJ, Tanja. Comparative genomics approach to identify candidate genetic loci for male fertility. *Reproduction in domestic animals*, ISSN 0936-6768, 2011, vol. 46, str. 229-239.
8. TERČIČ, Dušan, HOLCMAN, Antonija, DOVČ, Peter, MORRICE, D.R., BURT, David, HOCKING, Paul M., HORVAT, Simon. Identification of chromosomal regions associated with growth and carcass traits in an F3 full sib intercross line originating from a cross of chicken lines divergently selected on body weight. *Animal genetics*, ISSN 0268-9146, 2009, vol. 40, no. 5, str. 743-748.
9. IVANKOVIĆ, Ante, RAMLJAK, Jelena, DOVČ, Peter, KELAVA, Nikolina, KONJAČIĆ, Miljenko. Genetic structure of three Croatian horse breeds : implications for their conservation strategy. *Italian Journal of Animal Science*, ISSN 1594-4077, 2009, vol. 8, str. 677-689.
10. KAVAR, Tatjana, ČEH, Eva, DOVČ, Peter. A simplified PCR-based method for detection of gray coat color allele in horse. *Molecular and cellular probes*, ISSN 0890-8508, 2012, vol. 26, no. 6, str. 256-258.

Tanja Kunej, izvajalka:

1. FERDIN, Jana, NISHIDA, Naohiro, WU, X., NICOLOSO, Milena S., SHAH, Muhammad Yasin, DEVLIN, C., LING, H., SHIMIZU, Masayoshi, KUMAR, K., CORTEZ, Maria Angelica, FERRACIN, M., BI, Y., YANG, Decheng, CZERNIAK, Bogdan, ZHANG, Wei, SCHMITTGEN, T. D., VOORHOEVE, M. P., REGINATO, M. J., NEGRINI, M., DAVULURI, Ramana V., KUNEJ, Tanja, IVAN, M., CALIN, George Adrian. HINCUTs in cancer : hypoxia-induced noncoding ultraconserved transcripts. *Cell death and differentiation*, ISSN 1350-9047, 2013, vol. 20, no. 12, str. 1675-1687.
2. KUNEJ, Tanja, GODNIČ, Irena, FERDIN, Jana, HORVAT, Simon, DOVČ, Peter, CALIN, George A. Epigenetic regulation of microRNAs in cancer : an integrated review of literature. *Mutation Research*, ISSN 0027-5107.
3. NICOLOSO, Milena S., SUN, Hao, SPIZZO, Riccardo, KIM, Hyunsoo, WICKRAMASINGHE, Priyankara, SHIMIZU, Masayoshi, WOJCIK, Sylwia E., FERDIN, Jana, KUNEJ, Tanja, XIAO, Lianchun, MANOUKIAN, Siranoush, SECRETO, Giorgio, RAVAGNANI, Fernando, WANG, Xuemei, RADICE, Paolo, CROCE, Carlo M., DAVULURI, Ramana V., CALIN, George A. Single-nucleotide polymorphisms inside microRNA target sites influence tumor susceptibility. *Cancer research*, ISSN 0008-5472, 2010, vol. 70, no. 7, str. 2789-2798,
4. KUNEJ, Tanja, JEVŠINEK SKOK, Daša, HORVAT, Simon, DOVČ, Peter, JIANG, Zhihua. The glypican 3-hosted murine Mir717 gene : sequence conservation, seed region polymorphisms and putative targets. *International journal of biological sciences*, 2010, vol. 6, no.7, str. 769-772.
5. KUNEJ, Tanja, WU, Xiao-Lin, MICHAL, Jennifer J., MILOŠEVIČ BERLIČ, Tamara, JIANG, Zhihua, DOVČ, Peter. The porcine mitochondrial transcription factor a gene : molecular characterization, radiation hybrid mapping and genetic diversity among 12 pig breeds. *American journal of animal and veterinary sciences*, ISSN 1557-4555, 2009, vol. 4, no. 4, str. 129-135.

6. JIANG, Zhihua, MICHAL, Jennifer J., CHEN, Jie, DANIELS, Tyler F., KUNEJ, Tanja, GARCIA, Matthew D., GASKINS, Charles Thorne, BUSBOOM, Jan Roger, ALEXANDER, Leeson J., WRIGHT, Raymond W., MACNEIL, Michael D. Discovery of novel genetic networks associated with 19 economically important traits in beef cattle. *International journal of biological sciences*, 2009, vol. 5, no. 6, str. 528-542.

Mojca Narat, izvajalka

1. COLJA VENTURINI, Anja, BRESJANAC, Mara, VRANAC, Tanja, KOREN, Simon, NARAT, Mojca, POPOVIĆ, Mara, ČURIN-ŠERBEC, Vladka. Anti-idiotypic antibodies : a new approach in prion research. *BMC immunology*, ISSN 1471-2172, 2009, vol. 10, article 16, on line. http://www.biomedcentral.com/1471-2172/10/16, doi: 10.1186/1471-2172-10-16. [COBISS.SI-ID 2440072]
2. DUŠANIĆ, Daliborka, BENČINA, Dušan, OVEN, Irena, CIZELJ, Ivanka, BENČINA, Mojca, NARAT, Mojca. Mycoplasma synoviae induces upregulation of apoptotic genes, secretion of nitric oxide and appearance of an apoptotic phenotype in infected chicken chondrocytes. *Veterinary research*, ISSN 1297-9716, 2012, vol. 43, no. 7, str. 1-14. http://www.veterinaryresearch.org/content/pdf/1297-9716-43-7.pdf, doi: 10.1186/1297-9716-43-7. [COBISS.SI-ID3013768]
3. CIZELJ, Ivanka, BERČIČ, Rebeka Lucijana, DUŠANIĆ, Daliborka, NARAT, Mojca, KOS, Janko, DOVČ, Peter, BENČINA, Dušan. Mycoplasma gallisepticum and Mycoplasma synoviae express a cysteine protease CysP, which can cleave chicken IgG into Fab and Fc. *Microbiology*, ISSN 1350-0872, 2011, vol. 157, no. 2, str. 362-372. http://mic.sgmjournals.org/cgi/content/abstract/157/2/362?maxtoshow=&hits=10&RESULTFORMAT=&author1=CIyelj+&andorexactfulltext=and&searchid=1&FIRSTINDEX=0&sortspec= relevance&resourcetype=HWCIT, doi: 10.1099/mic.0.045641-0. [COBISS.SI-ID 2835848]
4. SLAVEC, Brigita, BERČIČ, Rebeka Lucijana, CIZELJ, Ivanka, NARAT, Mojca, ZORMAN-ROJS, Olga, DOVČ, Peter, BENČINA, Dušan. Variation of vlhA gene in Mycoplasma synoviae clones isolated from chickens. *Avian pathology*, ISSN 0307-9457, 2011, vol. 40, no. 5, str. 481-489, doi: 10.1080/03079457.2011.604840. [COBISS.SI-ID 2941832]
5. BENČINA, Mateja, CIZELJ, Ivanka, BERČIČ, Rebeka Lucijana, NARAT, Mojca, BENČINA, Dušan, DOVČ, Peter. Shared epitopes of avian immunoglobulin light chains. *Veterinary Immunology and Immunopathology*, ISSN 0165-2427. [Print ed.], 2014, in press. http://www.sciencedirect.com/science/article/pii/S016524271400004X, doi: 10.1016/j.vetimm.2014.01.003. [COBISS.SI-ID 3341192]
6. DUŠANIĆ, Daliborka, BERČIČ, Rebeka Lucijana, CIZELJ, Ivanka, SALMIČ, Simona, NARAT, Mojca, BENČINA, Dušan. Mycoplasma synoviae invades non-phagocytic chicken cells in vitro. *Veterinary Microbiology*, ISSN 0378-1135. [Print ed.], 2009, issues 1-2, vol. 138, str. 114-119. http://www.sciencedirect. com/science?_ob=ArticleURL&_udi=B6TD6-4VRX66J-2&_user=4776866&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&_acct=C000033658&_version=1&_urlVers ion=0&_userid=4776866&md5=1ba21383c610c8913d8f625752ab6509, doi: 10.1016/j.vetmic.2009.02.014. [COBISS.SI-ID 2439560]

Gregor Gorjanc, izvajalec

1. Genetic prediction of complex traits: integrating infinitesimal and marked genetic effects
C Carré, F Gamboa, D Cros, JM Hickey, G Gorjanc, E Manfredi (2013)
Genetica 141 (4-6), 239-246

2. Genomic evaluations using similarity between haplotypes
JM Hickey, BP Kinghorn, B Tier, SA Clark, JHJ Werf, G Gorjanc (2013)
Journal of Animal Breeding and Genetics 130 (4), 259-269

3. Genotype Imputation to Increase Sample Size in Pedigreed Populations
JM Hickey, MA Cleveland, C Maltecca, G Gorjanc, B Gredler, A Kranis (2013)
Methods in Molecular Biology 1019, 395-410

4. Simulated Data for Genomic Selection and Genome-Wide Association Studies Using a Combination of Coalescent and Gene Drop Methods

JM Hickey, G Gorjanc (2012)
G3: Genes| Genomes| Genetics 2 (4), 425-427

5. Inference of genotype probabilities and derived statistics for PrP locus in the Jezersko–Solcava sheep
G Gorjanc, M Kovač, D Kompan (2010)
Livestock Science 129 (1), 232-236

6. Congenic and bioinformatics analyses resolved a major-effect Fob3b QTL on mouse Chr 15 into two closely linked loci
Z Prevoršek, G Gorjanc, B Paigen, S Horvat (2010)
Mammalian Genome 21 (3-4), 172-185

# UČNI NAČRT PREDMETA/COURSE SYLLABUS

| | |
|---|---|
| Predmet: | Biodiagnostiki in biosenzorji |
| Course title: | Biodiagnostics and biosensors |
| Članica nosilka/UL Member: | |

| Študijski programi in stopnja | Študijska smer | Letnik | Semestri |
|---|---|---|---|
| Bioznanosti, tretja stopnja, doktorski | Ni členitve (študijski program) | | Celoletni |

| | |
|---|---|
| Univerzitetna koda predmeta/University course code: | 0037281 |
| Koda učne enote na članici/UL Member course code: | 3783 |

| Predavanja | Seminar | Vaje | Klinične vaje | Druge oblike študija | Samostojno delo | ECTS |
|---|---|---|---|---|---|---|
| 10 | 15 | 0 | 0 | 10 | 90 | 5 |

| | |
|---|---|
| Nosilec predmeta/Lecturer: | Janko Kos |

| | |
|---|---|
| Izvajalci predavanj: | Janko Kos |
| Izvajalci seminarjev: | |
| Izvajalci vaj: | |
| Izvajalci kliničnih vaj: | |
| Izvajalci drugih oblik: | |
| Izvajalci praktičnega usposabljanja: | |

| | |
|---|---|
| Vrsta predmeta/Course type: | teoretični/theoretical |

| | | |
|---|---|---|
| Jeziki/Languages: | Predavanja/Lectures: | Angleščina, Slovenščina |
| | Vaje/Tutorial: | Angleščina, Slovenščina |

| | |
|---|---|
| Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti: | Prerequisites: |
| Splošni pogoji za vpis na doktorski študij. | General conditions for enrolement into doctoral course. |

| Vsebina: | Content (Syllabus outline): |
|---|---|
| • Biološke makromolekule v analitiki<br>• DNA/RNA testi<br>• Imunski testi<br>• Biosenzorji<br>• Avtomatizirani procesi v diagnostiki | • Biological macromolecules in analytical processes<br>• DNA/RNA assays<br>• Immunoassays<br>• Biosensors |

| | |
|---|---|
| • Mikrosfere, mikromreže, mikrofluidika<br>• Razvoj novih diagnostičnih sredstev v laboratorijskem in industrijskem merilu<br>• Kontrola in zagotavljanje kakovosti diagnostičnih sredstev | • Automated processes in diagnostics<br>• Microspheres, Microarrays, Microfluidics<br>• Development of new diagnostic assays on laboratory and industrial scale<br>• Quality control and assurance of diagnostic assays |

| Temeljna literatura in viri/Readings: |
|---|
| 1. Wild D: The Immunoassay Handbook. Fourth Edition, Elsevier, Ltd., ©2013, ISBN 978-0-08-097037-0<br>2. Barth FG, Humphrey JAC: Sensors and sensing in Biology and Engeneering. Springer, 2003, ISBN 321183771X<br><br>Najnovejši pregledni članki s področja /The latest review articles from the field. |

| Cilji in kompetence: | Objectives and competences: |
|---|---|
| Predmet seznanja študente z uporabo bioloških makromolekul v različnih laboratorijskih diagnostičnih metodah in sredstvih. Študent spozna lastnosti bioloških makromolekul, njihovo sposobnost vezave ligandov in dejavnike, ki določajo njihovo specifičnost. Podani so načini njihovega pridobivanja in priprava stabilnih oblik. Seznani se z vrstami diagnostičnih testov in biosenzorjev. Predstavljeno je njihovo delovanje, metodika priprave testov v laboratorijskem in industrijskem merilu in načini kontrole in zagotavljanja njihove kakovosti. | The students will learn about the application of biological macromolecules in laboratory diagnostoc methods and devices. They will be informed on properties of biological macromolecules, their ability to bind ligands and on factors defining their specificity. The methods for their isolation and the preparation of stabile forms will be presented. Students will be acquainted with types of diagnostic assays and biosensors. Their functioning, technologies for laboratory and large scale production and methods for quality control and assurance will be presented |

| Predvideni študijski rezultati: | Intended learning outcomes: |
|---|---|
| Znanje in razumevanje:<br>Poznavanje delovanja biodiagnostikov in biosenzorjev omogoča uporabo teh testov za samozdravljenje, v kliničnih ter industrijskih biotehnoloških laboratorijih in s tem optimizacijo zdravljenja in biotehnoloških postopkov. i. | Knowledge and understanding:<br>Understanding of biodiagnostics and biosensors enables the application for self treatment, in clinical and industrial biotechnological laboratories optimising the treatment and biotechnological processes.. |

| Metode poučevanja in učenja: | Learning and teaching methods: |
|---|---|
| Predavanja, seminarji, vodena diskusija, problemsko osnovano učenje, skupinsko delo. | Lectures, seminars, tutorial discussions, problem based learning, group learning. |

| Načini ocenjevanja: | Delež/Weight | Assessment: |
|---|---|---|
| 1. opravljena seminarska naloga | 40,00 % | 1. Seminar |
| 2. ustni izpit | 60,00 % | 2. oral exam |

| Reference nosilca/Lecturer's references: |
|---|

**Janko Kos**

1. PLAVEC, Tina Vida, MITROVIĆ, Ana, PERIŠIĆ, Milica, ŠTRUKELJ, Borut, **KOS, Janko**, BERLEC, Aleš. Targeting of fluorescent Lactococcus lactis to colorectal cancer cells through surface display of tumour-antigen binding proteins. *Microbial biotechnology*. [Online ed.]. 2021, str.14. ISSN 1751-7915. DOI: 10.1111/1751-7915.13907.
2. BOŽIĆ, Biljana, LONČAR, Goran, VIŽIN, Tjaša, RADOJIČIĆ, Zoran, POPOVIĆ BRKIĆ, Vera, **KOS, Janko**. Relationship of high circulating cystatin C to biochemical markers of bone turnover and bone mineral density in elderly males with a chronic heart failure : *Journal of Medical Biochemistry*. 2019, vol. 38, no. 1, str. 53-62, ilustr. ISSN 1452-8258. https://content.sciendo.com/view/journals/jomb/38/1/article-p53.xml, DOI: 10.2478/jomb-2018-0011.
3. MITROVIĆ, Ana, PEČAR FONOVIĆ, Urša, **KOS, Janko**. Cysteine cathepsins B and X promote epithelial-mesenchymal transition of tumor cells. *European journal of cell biology*. 2017, vol. 96, iss. 6, str. 622-631, ilustr. ISSN 0171-335. http://www.sciencedirect.com/science/article/pii/S0171933516302771, DOI: 10.1016/j.ejcb.2017.04.003.
4. JAKOŠ, Tanja, PIŠLAR, Anja, PEČAR FONOVIĆ, Urša, **KOS, Janko**. Lysosomal peptidases in innate immune cells : implications for cancer immunity. *Cancer immunology and immunotherapy*. 2020, vol. 69, iss. 2, str. 275-283, ilustr. ISSN 0340-7004. https://link.springer.com/article/10.1007/s00262-019-02447-0, DOI: 10.1007/s00262-019-02447-0.
5. **KOS, Janko**, PERIŠIĆ, Milica, PRUNK, Mateja, SABOTIČ, Jerica, DAUTOVIĆ, Esmeralda, JEWETT, Anahid. Cystatin F as a regulator of immune cell cytotoxicity. *Cancer immunology and immunotherapy*. Dec. 2018, vol. 67, iss. 12, str. 1931-1938, ilustr. ISSN 0340-7004. https://link.springer.com/article/10.1007/s00262-018-2165-5, DOI: 10.1007/s00262-018-2165-5. [COBISS.SI-ID 31384359]
6. PRUNK, Mateja**, KOS, Janko**. Nanoparticle based delivery of protease inhibitors to cancer cells. *Current medicinal chemistry*. 2017, vol. 24, iss. 42, str. 4816-4837, ilustr. ISSN 0929-8673. https://benthamscience.com/journals/current-medicinal-chemistry/article/145725/, http://www.eurekaselect.com/node/145725/article, DOI: 10.2174/0929867323666160922162811.

# UČNI NAČRT PREDMETA/COURSE SYLLABUS

| | |
|---|---|
| Predmet: | Bioprocesno inženirstvo bioloških makromolekul, virusov in celic |
| Course title: | Bioprocess engineering of biologic macromolecules, viruses and cells |

| Študijski programi in stopnja | Študijska smer | Letnik | Semestri |
|---|---|---|---|
| Bioznanosti, tretja stopnja, doktorski | biotehnologija | | Celoletni |

| | |
|---|---|
| Univerzitetna koda predmeta/University course code: | 3784 |

| Predavanja | Seminar | Vaje | Klinične vaje | Druge oblike študija | Samostojno delo | ECTS |
|---|---|---|---|---|---|---|
| 10 | 10 | 20 | 0 | 0 | 85 | 5 |

| | |
|---|---|
| Nosilec predmeta/Lecturer: | Aleš Podgornik |

| | |
|---|---|
| Izvajalci predavanj: | Igor Plazl, Aleš Podgornik, Polona Žnidaršič Plazl |
| Izvajalci seminarjev: | |
| Izvajalci vaj: | |
| Izvajalci kliničnih vaj: | |
| Izvajalci drugih oblik: | |
| Izvajalci praktičnega usposabljanja: | |

| | |
|---|---|
| Vrsta predmeta/Course type: | teoretični/theoretical |

| | | |
|---|---|---|
| Jeziki/Languages: | Predavanja/Lectures: | Angleščina, Slovenščina |
| | Vaje/Tutorial: | Angleščina, Slovenščina |

| Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti: | Prerequisites: |
|---|---|
| Vpis na doktorski študij;<br>zaključen drugostopenjski ali star univerzitetni študij biotehnologije, kemijskega inženirstva, biokemije, kemije, farmacije, mikrobiologije, živilske tehnologije in sorodnih programov | Enrollment to the doctoral study; completed **Bologna** 2nd Cycle **Study** Program or university study in biotechnology, chemical engineering, biochemistry, chemistry, chemistry, pharmacy, microbiology, food technology or related studies |

| Vsebina: | Content (Syllabus outline): |
|---|---|
| Predstavljeni bodo sodobni inženirski trendi pridobivanja in izolacije bioloških makromolekul (kot so encimi, monoklonska protitelesa, plazmidna DNA), virusov (bakteriofagov in humanih virusov) in celic (matične celice) ter | State of the art engineering approaches for production and isolation of biologic macromolecules (like enzymes, monoclonal antibodies and plasmid DNA), viruses (bacteriophages and human viruses) and cells |

| | |
|---|---|
| biokatalitskih procesov, ki so in bodo pomembni na področju varnosti, prehrane in zdravja. Podrobno bodo predstavljene sodobne tehnike pridobivanja bioloških makoromolekul, virusov in celic, ter biokatalitskih procesov z encimi in celicami s povdarkom na mikroreaktorjih in kontinuirnih procesih. Glavni poudarek predmeta bo na različnih tehnikah izolacije obravnavanih bioproduktov na osnovi obarjanja, kristalizacije, ekstrakcije, različnih membranskih separacij in kromatografije, ter sodobni trendi kot so kontinuirna ekstrakcija in kromatografija. Študentje bodo seznanjeni z osnovami načrtovanja eksperimentov s poudarkom na QbD (Quality by Design), regulatornimi aspekti pridobivanja farmacevtskih učinkovin npr. PAT (Process Analytical Technology) in s tem povezano specifično analitiko. Poseben sklop bodo tehnologije za enkratno uporabo (angl. single use ali disposable) ter integrirani procesi in razlogi za njihovo uporabo. Predstavljeni bodo tudi konkretni primeri procesov**.**<br><br>Ker je predmet izrazito aplikativno naravnan, bodo znaten del predmeta predstavljale laboratorije vaje v obliki delavnice, ki bodo soorganizirane s centrom odličnosti COBIK in farmacevtskimi podjetji iz Slovenije in tujine. Namen je, da bo vsak študent praktično izvedel procese izolacije bioloških makromolekul, virusov ter celic z različnimi tehnikami in se tako seznanil s ključnimi praktičnimi izzivi. | (stem cells) together with biocatalytic processes being important for safety, food and health are elaborate.<br><br>Furthermore, various techniques, including microreactors and continuous processes, for production of biologic macromolecules, viruses and cells as well as biocatalytic processes are discussed. This includes precipitation, extraction, various membrane separations and chromatography. Basics of experimental design are presented especially QbD (Quality by Design), regulatory aspects of pharmaceutical production (PAT -Process Analytical Technology) and related analytics.<br><br>Additional topics are single use or disposable technology and integrated processes. Several case studies of existing processes will be presented to elucidate advantages of proposed approaches.<br><br>Due to applied oriented nature of the course an important part consists of practical laboratory training organized together with the centre of excellence COBIK and pharmaceutical companies from Slovenia and abroad. Each student will have a chance to practice isolation of biologic macromolecules, viruses and cells using different techniques facing in this way practical challenges encountered in industry. |

| Temeljna literatura in viri/Readings: |
|---|
| Izbrana poglavja iz Carta G., Jungbauer A. Protein Chromatography: Process Development and Scale-Up, Wiley-VCH, Weinheim, 2010<br>Izbrana poglavja iz Subramanian G. (Eds.). Biopharmaceutical production technology. Weinheim: Wiley-VCH, 2012<br>Izbrana poglavja iz Hessel, V., Renken, A., Schouten, J.C., Yoshida, J.-I. (2009) editors, Micro Process Engineering: A Comprehensive Handbook, Vol. 1-3, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany<br>Izbrana poglavja iz Buchholz K., Kasche V., Bornscheuer U.T. (2012) Biocatalysts and Enzyme Technology, 2nd Edition<br><br>Znanstveni članki iz tekoče znanstvene perodike. |

| Cilji in kompetence: | Objectives and competences: |
|---|---|

| | |
|---|---|
| • Razumevanje teoretičnih principov tehnologij uporabljenih pri pridobivanju in izolacijah bioloških makromolekul, virusov in celic<br>• Razumevanje koncepta kontinuirnih procesov in mikroreaktorjev<br>• Razumevanje načrtovanja in vodenja biokatalitskih procesov<br>• Razumevanje regulatornih konceptov<br>• Razumevanje tehnologij za enkratno uporabo ter integriranih procesov | • Understanding theoretical principles of techniques used for production of biologic molecules, viruses and cells<br>• Understanding concepts of microreactors and continuous processes<br>• Understanding design and performance of biocatalytic processes<br>• Understanding of regulatory concepts<br>• Understanding of single use technology and integrated processes |

| Predvideni študijski rezultati: | Intended learning outcomes: |
|---|---|
| • Sposobnost vključevanja pridobljenega znanja v projektu<br>• Izkazano doseganje izobraževalnih ciljev | • Implementation of acquired knowledge in projects<br>• Demonstrated achievement of educational goals |

| Metode poučevanja in učenja: | Learning and teaching methods: |
|---|---|
| • predavanja<br>• seminarji (v obliki rednih seminarskih predstavitev z diskusijami)<br>• praktične laboratorijske vaje v sodelovanju s strokovnjaki iz farmacevtskh podjetij ter znanstvenih institucij iz Slovenije in tujine | • lectures<br>• seminars (regular presentations with discussions)<br>• practical laboratory course in cooperation with experts from pharmaceutical industry and academic institutions from Slovenia and abroad |

| Načini ocenjevanja: | Delež/Weight | Assessment: |
|---|---|---|
| Preverjanje znanja poteka v obliki projektne naloge na realnih primerih iz raziskovalne prakse, v kateri študentje pripravijo rešitve za izbrani predlog raziskovalnega projekta. Projektne naloge oddajo v pisni obliki in jih zagovarjajo v ustni obliki, v diskusiji z nosilcem predmeta in sodelujočimi profesorji ter ostalimi študenti. | 50,00 % | During the course students prepare individual projects of real cases from research practice, where students prepare solutions for determined research project proposal. They prepare final project work and defend it in the classroom in discusion with professors and other students. |
| Študent pripravi tudi seminar iz tematike doktorata v povezavi z eno od vsebin predmeta. Pri tem sodelujeta mentor in nosilec predmeta oz. drugi izvajalci predmeta. Zagovor opravlja študent pred mentorjem in nosilcem in/ali drugim izvajalcem. | 50,00 % | Student prepares a doctoral seminar on the topic related to one of the course. In this cooperate menthor and lecturer or/and other professors. Student defend the seminar in front of mentor and lecturer and/or other professors. |

| Reference nosilca/Lecturer's references: |
|---|
| 1. Aleš Podgornik, Vida Smrekar, Peter Krajnc, Aleš Štrancar, "Estimation of methacrylate monolith binding capacity from pressure drop data", *J. chromatogr., A*, vol. 1272, str. 50-55, 11. Jan. 2013, doi: 10.1016/j.chroma.2012.11.057. [COBISS.SI-ID 16493846] |

2. Vida Smrekar, Franc Smrekar, Aleš Štrancar, Aleš Podgornik, "Single step plasmid DNA purification using methacrylate monolith bearing combination of ion-exchange and hydrophobic groups", *J. chromatogr., A*, vol. 1276, str. 58-64, 2013, doi: 10.1016/j.chroma.2012.12.029. [COBISS.SI-ID 4199288]
3. Urh Černigoj, Urška Vidic, Miloš Barut, Aleš Podgornik, Matjaž Peterka, Aleš Štrancar, "A multimodal histamine ligand for chromatographic purification of plasmid DNA", *J. chromatogr., A*, vol. 1281, str. 87-93, 2013, doi: 10.1016/j.chroma.2013.01.058. [COBISS.SI-ID 4263544]
4. Claire S. Burden, Jing Jin, Aleš Podgornik, Daniel G. Bracewell, "A monolith purification process for virus-like particles from yeast homogenate", *Journal of chromatography. B, Analytical technologies in the biomedical and life sciences*, vol. 880, str. 82-89, 2012, doi: 10.1016/j.jchromb.2011.10.044. [COBISS.SI-ID 4112760]
5. Nika Lendero Krajnc, Franc Smrekar, Aleš Štrancar, Aleš Podgornik, "Adsorption behavior of large plasmids on the anion-exchange methacrylate monolithic columns", *J. chromatogr., A*, vol. 1218, iss. 17, str. 2413-2424, 2011, doi: 10.1016/j.chroma.2010.12.058. [COBISS.SI-ID 3940984]
6. Franc Smrekar, Mateja Ciringer, Aleš Štrancar, Aleš Podgornik, "Characterisation of methacrylate monoliths for bacteriophage purification", *J. chromatogr., A*, vol. 1218, iss. 17, str. 2438-2444, 2011, doi: 10.1016/j.chroma.2010.12.083. [COBISS.SI-ID 3940728]
7. Franc Smrekar, Mateja Ciringer, Janez Jančar, Peter Raspor, Aleš Štrancar, Aleš Podgornik, "Optimization of lytic phage manufacturing in bioreactor using monolithic supports", *J. sep. sci.*, vol. 34, issue 16/17, str. 2152-2158, 2011. [COBISS.SI-ID 3942008]
8. Franc Smrekar, Aleš Podgornik, Mateja Ciringer, Sandra Kontrec, Peter Raspor, Aleš Štrancar, Matjaž Peterka, "Preparation of pharmaceutical-grade plasmid DNA using methacrylate monolithic columns", *Vaccine*, str. 2039-2045. [COBISS.SI-ID 3772280]
9. NOVAK, Uroš, ŽNIDARŠIČ PLAZL, Polona. Integrated lipase-catalyzed isoamyl acetate synthesis in a miniaturized system with enzyme and ionic liquid recycle. Green processing and synthesis, ISSN 2191-9542. [Print ed.], 2013, vol. 2, no. 6, str. 561-568, ilustr. http://www.degruyter.com/view/j/gps.2013.2.issue-6/gps-2013-0082/gps-2013-0082.xml?format=INT, doi: 10.1515/gps-2013-0082. [COBISS.SI-ID 1656111]
10. NOVAK, Uroš, POHAR, Andrej, PLAZL, Igor, ŽNIDARŠIČ PLAZL, Polona. Ionic liquid-based aqueous two-phase extraction within a microchannel system. Sep. purif. technol., 2012, vol. 97, no. 1, str. 172-178, doi: 10.1016/j.seppur.2012.01.033. [COBISS.SI-ID 35736325]
11. TIŠMA, Marina, ŽNIDARŠIČ PLAZL, Polona, VASIĆ-RAČKI, Đurđa, ZELIĆ, Bruno. Optimization of laccase production by Trametes versicolor cultivated on industrial waste. Appl. biochem. biotechnol., 2012, vol. 166, no. 1, 36-46, doi: 10.1007/s12010-011-9401-1
12. MARQUES, M. P. C., FERNANDES, P., CABRAL, Joaquim M. S., ŽNIDARŠIČ PLAZL, Polona, PLAZL, Igor. Continuous steroid biotransformations in microchannel reactors. New biotechnology, 2012, vol. 29, no. 2, 227-234, doi: 10.1016/j.nbt.2011.10.001.
13. CVJETKO, M., VORKAPIĆ-FURAČ, Jasna, ŽNIDARŠIČ PLAZL, Polona. Isoamyl acetate synthesis in imidazolium-based ionic liquids using packed bed enzyme microreactor. Process biochem., 2012, vol. 47, no. 9, 1344-1350, doi: 10.1016/j.procbio.2012.04.028
14. STOJKOVIČ, Gorazd, ŽNIDARŠIČ PLAZL, Polona. Immobilization of yeast cells within microchannels of different materials. Acta chimica slovenica, ISSN 1318-0207. [Tiskana izd.], 2010, vol. 57, no. 1, str. 144-149. http://acta.chem-soc.si/57/57-1-144.pdf. [COBISS.SI-ID 33807877],
15. LIU, Mingqiang, NOVAK, Uroš, PLAZL, Igor, FRANKO, Mladen. Optimization of a thermal lens microscope for detection in a microfluidic chip. International journal of thermophysics, ISSN 0195-928X, 12 str., doi: 10.1007/s10765-013-1515-y. [COBISS.SI-ID 2895867]
16. SKUBIC, Blaž, LAKNER, Mitja, PLAZL, Igor. Sintering behavior of expanded perlite thermal insulation board : modeling and experiments. Industrial & engineering chemistry research, ISSN 0888-5885. [Print ed.], 9. jul. 2013, vol. 52, no. 30, str. 10244-10249, ilustr. http://pubs.acs.org/doi/ipdf/10.1021/ie400196z, doi: 10.1021/ie400196z. [COBISS.SI-ID 1604399]
17. ŽNIDARŠIČ PLAZL, Polona, PLAZL, Igor. Development of a continuous steroid biotransformation process and product extraction within microchannel system. Catal. today., 2010, vol. 157, no. 1/4, 315-320, doi: 10.1016/j.cattod.2010.01.042.
18. MARQUES, M. P. C., FERNANDES, P., CABRAL, Joaquim M. S., ŽNIDARŠIČ PLAZL, Polona, PLAZL, Igor. On the feasibility of in-situ steroid biotransformation and product recovery in microchannels. Chem. eng. j., 2010, vol. 160, 708-714, doi: 10.1016/j.cej.2010.03.056.

19. ŽNIDARŠIČ PLAZL, Polona, PLAZL, Igor. Modelling and experimental studies on lipase-catalyzed isoamyl acetate synthesis in a microreactor. Process biochemistry, ISSN 1359-5113, 2009, vol. 44, no. 10, str. 1115-1121, doi: 10.1016/j.procbio.2009.06.003. [COBISS.SI-ID 3054541]
20. TIŠMA, Marina, ZELIĆ, Bruno, VASIĆ-RAČKI, Đurđa, ŽNIDARŠIČ PLAZL, Polona, PLAZL, Igor. Modelling of laccase-catalyzed L-DOPA oxidation in a microreactor. Chem. eng. j., 2009, vol. 149, no. 1/3, 383-388, doi: 10.1016/j.cej.2009.01.025.

# UČNI NAČRT PREDMETA/COURSE SYLLABUS

| | |
|---|---|
| Predmet: | Bioreakcijsko inženirstvo |
| Course title: | Bioreaction Engineering |

| Študijski programi in stopnja | Študijska smer | Letnik | Semestri |
|---|---|---|---|
| Bioznanosti, tretja stopnja, doktorski | biotehnologija | | Celoletni |

| | |
|---|---|
| Univerzitetna koda predmeta/University course code: | 3785 |

| Predavanja | Seminar | Vaje | Klinične vaje | Druge oblike študija | Samostojno delo | ECTS |
|---|---|---|---|---|---|---|
| 10 | 20 | 0 | 0 | 0 | 95 | 5 |

| | |
|---|---|
| Nosilec predmeta/Lecturer: | Igor Plazl |

| | |
|---|---|
| Izvajalci predavanj: | Igor Plazl |
| Izvajalci seminarjev: | |
| Izvajalci vaj: | |
| Izvajalci kliničnih vaj: | |
| Izvajalci drugih oblik: | |
| Izvajalci praktičnega usposabljanja: | |

| | |
|---|---|
| Vrsta predmeta/Course type: | teoretični/theoretical |

| | | |
|---|---|---|
| Jeziki/Languages: | Predavanja/Lectures: | Angleščina, Slovenščina |
| | Vaje/Tutorial: | Angleščina, Slovenščina |

| Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti: | Prerequisites: |
|---|---|
| splošni pogoji za vpis na doktorski študij | Enrollment to the doctoral study |

| Vsebina: | Content (Syllabus outline): |
|---|---|
| • biokemijska inženirska analiza in modeliranje;<br>• bioprocesna kinetika: rast mikroorganizmov (Monod, rast na več substratih, inhibicija,...), kinetika encimskih reakcij (Michaelis-Menten,...);<br>• snovne in energijske bilance: reakcijski in separacijski bioprocesi; entalpijske spremembe;<br>• osnove dinamike tekočin: idealni in neidealni tokovni modeli, napoved 3D hitrostnih profilov eno- in večfaznih sistemov; | • modelling and analysis of biochemical engineering processes;<br>• bioprocess kinetics: growth of microorganisms (Monod, growth on multiple substrates, inhibition, ...), enzyme kinetics (Michaelis-Menten,...);<br>• mass and energy balances: reaction and separation bioprocesses; enthalpy changes;<br>• basic fluid dynamics: ideal and nonideal flow models, 3D velocity profile prediction of single and multiphase flow; |

| | |
|---|---|
| • osnove numerične analize: reševanje navadnih diferencialnih enačb: analitična metoda, Eulerjeva metoda, Rungejeva trapezna metoda, Runge-Kutta-klasična metoda četrtega reda, sistem navadnih diferencialnih enačb, numerično integriranje; numerično reševanje parcialnih diferencialnih enačb: eksplicitna in implicitna metoda končnih razlik, analitična in numerična rešitev Laplaceove enačbe;<br>• zapis in reševanje ohranitvenih enačb;<br>• razvoj 2D in 3D matematičnih modelov, ki vključujejo tok tekočin in reakcijsko-difuzijske člene;<br>• uporaba računalniških orodij (npr.: Mathematica, Comsol, Matlab);<br>• izbrani primeri modeliranja bioprocesov (encimska reakcija z raztopljenim katalizatorjem v eno- ali dvofaznem sistemu; biotransformacija v mikroreaktorju s pritrjenimi encimi ali celicami; šaržni in kontinuirni proces biotransformacije progesterona z imobilizirano biomaso; modeliranje biološke čistilne naprave,…). | • numerical analysis basics: ordinary differential equations (exact solutions, Euler's method, Euler trapeze method, Runge-Kutta methods, systems of ordinary differential equations, numerical integration; numerical solution of partial differential equations: explicit and implicit finite difference methods, analytical and numerical solution of Laplace's equation;<br>• conservation equations;<br>• development of 2D and 3D mathematical models considering velocity profile and reaction diffusion dynamics terms;<br>• applications of computational tools (*Mathematica, COMSOL, Matlab*);<br>• bioprocess modelling of selected cases (modelling and experimental studies on enzyme-catalyzed reaction in a microreactor; biotransformation in a microreactor with surface immobilized enzymes or cells; batch and continuous steroid biotransformation process with immobilized biomass; modelling of a pilot wastewater treatment plant,..). |

| Temeljna literatura in viri/Readings: |
|---|
| • I. Plazl, M. Lakner, *Uvod v modeliranje procesov*, Založba FKKT, Univerza v Ljubljani, Ljubljana, 2004, 230 str.<br>• J. Nielsen, J.Villadsen, *Bioreaction Engineering Principles*, Plenum Press, New York, 1994.<br>• M-L.Shuler, F. Kargi, *Bioprocess Engineering: Basic Concepts*, Prentice-Hall, Upper Saddle River, NJ, 2002.<br>Tekoča znanstvena periodika / Current scientific periodicals. |

| Cilji in kompetence: | Objectives and competences: |
|---|---|
| pridobitev ali poglobitev znanja za samostojno delo na področju raziskav bioprocesov in njihovega teoretičnega opisa, ter načrtovanje in optimizacija bioprocesnih sistemov, s poudarkom na okolju in človeku sprejemljivejših tehnologijah. | • to develop skills for independent research work in the field of bio-processes, their theoretical description, design and optimization, with emphasis on environmentally acceptable biotechnologies |

| Predvideni študijski rezultati: | Intended learning outcomes: |
|---|---|
| kandidata usposobiti za izvedbo omenjenih raziskav, rezultati katerih bodo predstavljali pomembne prispevke temeljni ali aplikativni znanosti na področju biotehniških znanosti. | ability for solving various engineering tasks and problems of bioprocess technologies. |

| Metode poučevanja in učenja: | Learning and teaching methods: |
|---|---|
| Predavanja, seminarji, delo na projektih. | Lectures, seminars, project workshops. |

| Načini ocenjevanja: | Delež/Weight | Assessment: |
|---|---|---|

| | | |
|---|---|---|
| ustni izpit | 60,00 % | Project with public presentation |
| seminar | 40,00 % | oral examination. |

Reference nosilca/Lecturer's references:

1. LUBEJ, Martin, PLAZL, Igor. Theoretical and experimental study of iron catalyst preparation by chemical vapor deposition of ferrocene in air. *The chemical engineering journal*, ISSN 1385-8947. [Print ed.], str. 1-34, 2013; ilustr. http://www.sciencedirect.com/science/article/ pii/ S1385894713016197, doi: 10.1016/j.cej. 2013.12.038. [COBISS.SI-ID 1664303]
2. UNGERBÖCK, B., POHAR, Andrej, MAYR, T., PLAZL, Igor. Online oxygen measurements inside a microreactor with modeling of transport phenomena. *Microfluidics and nanofluidics*, ISSN 1613-4982, 2013, vol. 14, no. 3/4, str. 565-574, doi: 10.1007/s10404-012-1074-8. [COBISS.SI-ID 36271621]
3. POHAR, Andrej, LAKNER, Mitja, PLAZL, Igor. Parallel flow of immiscible liquids in a microreactor : modeling and experimental study. *Microfluidics and nanofluidics*, ISSN 1613-4982, 2012, vol. 12, no. 1/4, str. 307-316, doi: 10.1007/s10404-011-0873-7. [COBISS.SI-ID 35319813]
4. LEVSTEK, Meta, PLAZL, Igor. Influence of carrier type on nitrification in the moving-bed biofilm process. *Water sci. technol.*, 2009, 59, 875-882.
5. ŽNIDARŠIČ PLAZL, Polona, PLAZL, Igor. Modelling and experimental studies on lipase-catalyzed isoamyl acetate synthesis in a microreactor. *Process biochemistry*, ISSN 1359-5113, 2009, vol. 44, no. 10, str. 1115-1121, doi: 10.1016/j.procbio.2009.06.003. [COBISS.SI-ID 30545413]
6. POHAR, Andrej, PLAZL, Igor, ŽNIDARŠIČ PLAZL, Polona. Lipase-catalyzed synthesis of isoamyl acetate in an ionic liquid/n-heptane two-phase system at the microreactor scale. *Lab on a chip*, ISSN 1473-0197, 2009, vol. 9, no. 23, str. 3385-3390, doi: 10.1039/b915151f. [COBISS.SI-ID 30820357]

# UČNI NAČRT PREDMETA/COURSE SYLLABUS

| | |
|---|---|
| Predmet: | Interakcije med patogeni in gostitelji |
| Course title: | Host-pathogen interactions |

| Študijski programi in stopnja | Študijska smer | Letnik | Semestri |
|---|---|---|---|
| Bioznanosti, tretja stopnja, doktorski | biotehnologija | | Celoletni |

| | |
|---|---|
| Univerzitetna koda predmeta/University course code: | 3788 |

| Predavanja | Seminar | Vaje | Klinične vaje | Druge oblike študija | Samostojno delo | ECTS |
|---|---|---|---|---|---|---|
| 10 | 15 | 0 | 0 | 5 | 95 | 5 |

| | |
|---|---|
| Nosilec predmeta/Lecturer: | Mojca Narat |

| | |
|---|---|
| Izvajalci predavanj: | Peter Dovč, Mojca Narat |
| Izvajalci seminarjev: | |
| Izvajalci vaj: | |
| Izvajalci kliničnih vaj: | |
| Izvajalci drugih oblik: | |
| Izvajalci praktičnega usposabljanja: | |

| | |
|---|---|
| Vrsta predmeta/Course type: | teoretični/theoretical |

| | | |
|---|---|---|
| Jeziki/Languages: | Predavanja/Lectures: | Angleščina, Slovenščina |
| | Vaje/Tutorial: | Angleščina, Slovenščina |

| | |
|---|---|
| Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti: | Prerequisites: |
| Splošni pogoji za vpis na doktorski študij | General prerequisites for enrolment into doctoral studies. |

| Vsebina: | Content (Syllabus outline): |
|---|---|
| Proučevanje interakcij med različnimi gostitelji in različnimi patogeni poteka (H-P) na nivoju organizmov, celic gostitelja in mikroba ter na nivoju celične signalizacije in izražanje genov. Za to so v uporabi različne metode, s katerimi proučujemo dogajanja v gostitelju kot tudi v mikrobu. Namen študij je odkrivanje mehanizmov delovanja in/ali možna aplikacija. V okviru predmeta bodo predstavljeni različni | The study of interactions between different hosts and a variety of pathogens is carried out (H-P) at the level of organisms, host or pathogen cells and on the level of cell signaling and gene expression. Different methods and approaches are used to study the events that are very complex. The aim of studies of human or animal pathogens and specific hosts or of H-P interactions in animal models is to |

| | |
|---|---|
| primeri odnosa med gostiteljem in patogenom: vsakič bo predstavljena osnovna problematika in namen, nato pa pristop k proučevanju le te, vključno z metodami in analizo podatkov. Mikoplazme, kot primer mikrobov brez celične stene in interakcije z gostiteljem, ter vpliv gostiteljevega odziva na mikoplazme. Ali okužba z mikoplazmo inducira avtoimunsko bolezen? Učinek sočasnih okužb. Proučevanje naravne imunosti oz aktivacije imunskega odziva preko TLR . Okužbe mlečne žleze in tumorigeneza. Uporaba živalskih modelov (mišk) v proučevanju H-P interakcij. Okužba prebavnega trakta s Helicobacter pylori – vzrok za nastanek raka na črevesju? H-P interakcije pri rastlinah. | understand basic molecular mechanisms and/or possible applications. The course will present examples of H-P interactions: authors will present the background and the aim of the study they performed along with methods and results. Students are expected to have read the study (paper) first and participate actively in the discussion in course.<br>Topics: Mycoplasmas: microbes without cell wall. Can they induce autoimmune disease? How do they influence on simultaneous infections with viruses? Infections of the mammary gland and tumorigenesis. Animal models in H-P interactions research. Infection with Helicobater pylori and tumorigenesis. H-P interactions in plants. |

| Temeljna literatura in viri/Readings: |
|---|
| Vsebina bo temeljila na člankih, ki so jih objavili predavatelji in bodo slušateljem posredovani vsako leto v naprej. |

| Cilji in kompetence: | Objectives and competences: |
|---|---|
| Cilj je razviti<br>• spoznati kompleksnost interakcij med patogeni in gostitelji<br>• spoznati pristope za proučevanje<br>• spoznati možnosti in delo na tem področju v slovenskem in mednarodnem prostoru<br>• razviti sposobnosti razumevanja in analiziranja znanstvenih člankov in razviti sposobnost znanstvene diskusije na temo H-P interakcije | • to recognize the complexity of H-P interactions<br>• to recognize the approaches and methods<br>• to get the insight into the H-P research projects in SLO and international<br>• to develop the capability of understanding and analyzing of scientific papers as well as develop the capability of scientific discussion |

| Predvideni študijski rezultati: | Intended learning outcomes: |
|---|---|
| Znanje in razumevanje:<br>Poznavanje aktualnih problematik H-P in možnosti (sistemov, načinov, pristopov, metod) za študij le teh in za razvoj biotehnoloških aplikacij. Razumevanje pomena raziskovanja na področju H-P interakcij.<br>Sposobnost samostojnega študija problema z branjem znanstvene literature. | Knowledge and understanding:<br>Knowledge of up-to date problems of host-pathogen interactions (H-P) and possibilities (methods, approach) for research. They will understand the importance of the research of H-P interactions.<br>They should gain the ability to understand the problem and find the application/solution based on biotechnology approach.<br>Students should gain the ability of self-dependent studying scientific papers. |

| Metode poučevanja in učenja: | Learning and teaching methods: |
|---|---|
| Osnova so znanstveni članki (predvatelji so soavtorji), ki jih bodo kandidati prebrali/preštudirali v naprej. Posamezno | Scientific papers will be delivered in advance. Lecturer, which is a co-author of the paper, will present the background of the research. In the |

| | |
|---|---|
| predavanje bo namenjeno širši predstavitvi tematike, ki je obravnavana v posameznem članku. Sledil bo seminar, namenje diskusiji, kjer se predvideva aktivno sodelovanje študentov. | seminar students will take an active part. Additional explanation of methods/ results will be provided by lecturer. |

| Načini ocenjevanja: | Delež/Weight | Assessment: |
|---|---|---|
| Izpit | 80,00 % | Exam |
| Seminar | 20,00 % | Seminar |

Reference nosilca/Lecturer's references:

**Mojca Narat:**

1. DUŠANIĆ, Daliborka, BENČINA, Dušan, OVEN, Irena, CIZELJ, Ivanka, BENČINA, Mojca, NARAT, Mojca. Mycoplasma synoviae induces upregulation of apoptotic genes, secretion of nitric oxide and appearance of an apoptotic phenotype in infected chicken chondrocytes. *Veterinary research*, ISSN 1297-9716, 2012, vol. 43, no. 7, str. 1-14. http://www.veterinaryresearch.org/content/pdf/1297-9716-43-7.pdf, doi: 10.1186/1297-9716-43-7. [COBISS.SI-ID3013768]
2. DUŠANIĆ, Daliborka, BERČIČ, Rebeka Lucijana, CIZELJ, Ivanka, SALMIČ, Simona, NARAT, Mojca, BENČINA, Dušan. Mycoplasma synoviae invades non-phagocytic chicken cells in vitro. *Veterinary Microbiology*, ISSN 0378-1135. [Print ed.], 2009, issues 1-2, vol. 138, str. 114-119. http://www.sciencedirect. com/science?_ob=ArticleURL&_udi=B6TD6-4VRX66J-2&_user=4776866&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&_acct=C000033658&_version=1&_urlVers ion=0&_userid=4776866&md5=1ba21383c610c8913d8f625752ab6509, doi: 10.1016/j.vetmic.2009.02.014. [COBISS.SI-ID 2439560]
3. LAVRIČ, Miha, MAUGHAN, Michele N., BLISS, Travis W., DOHMS, John E., BENČINA, Dušan, KEELER, Calvin L., NARAT, Mojca. Gene expression modulation in chicken macrophages exposed to Mycoplasma synoviae or Escherichia coli. *Veterinary Microbiology*, ISSN 0378-1135. [Print ed.], 2008, letn. 126, št. 1/3, str. 111-121. [COBISS.SI-ID 2193032]
4. BOLHA, Luka, BENČINA, Dušan, CIZELJ, Ivanka, OVEN, Irena, SLAVEC, Brigita, ZORMAN-ROJS, Olga, NARAT, Mojca. Effect of Mycoplasma synoviae and lentogenic Newcastle disease virus coinfection on cytokine and chemokine gene expression in chicken embryos. *Poultry science*, ISSN 0032-5791, 2013, vol. 92, no. 12, str. 3134-3143. http://ps.fass.org/content/92/12/3134, doi: 10.3382/ps.2013-03332. [COBISS.SI-ID 3303304]
5. OVEN, Irena, RESMAN RUS, Katarina, DUŠANIĆ, Daliborka, KEELER, Calvin L., NARAT, Mojca. Diacylated lipopeptide from Mycoplasma synoviae mediates TLR15 induced innate immune responses. *Veterinary research*, ISSN 1297-9716, 2013, iss. 3, vol. 44. http://www.veterinaryresearch.org/content/44/1/99, doi: 10.1186/1297-9716-44-99. [COBISS.SI-ID 30945497]
6. BERČIČ, Rebeka Lucijana, CIZELJ, Ivanka, DUŠANIĆ, Daliborka, NARAT, Mojca, ZORMAN-ROJS, Olga, DOVČ, Peter, BENČINA, Dušan. Neuraminidase of Mycoplasma synoviae desialylates heavy chain of the chicken immunoglobulin G and glycoprotein of chicken tracheal mucos. *Avian pathology*, ISSN 0307-9457, 2011, vol. 40, no. 3, str. 299-308, doi: 10.1080/03079457.2011.565311. [COBISS.SI-ID 2859912]

**Peter Dovč:**

1. OGOREVC, Jernej, KUNEJ, Tanja, RAZPET, Andrej, DOVČ, Peter. Database of cattle candidate genes and genetic markers for milk production and mastitis. *Animal genetics*, ISSN 0268-9146, 2009, vol. 40, str. 832-851, doi: 10.1111/j.1365-2052.2009.01921.x. [COBISS.SI-ID 2462344]
2. PRPAR MIHEVC, Sonja, MARTIGNANI, Eugenio, DOVČ, Peter, BARATTA, Mario. Identification of goat mammary stem/progenitor cells. *Biology of reproduction*, ISSN 0006-3363, vol. 86, no. 4, str. 1-7. http://www.biolreprod.org/content/early/2012/01/09/biolreprod.111.095489.full.pdf+html, doi: 10.1095/biolreprod.111.095489. [COBISS.SI-ID 3095176]
3. ŠTIMPFEL, Martin, SKUTELLA, Thomas, CVJETIČANIN, Branko, MEZNARIČ, Marija, DOVČ, Peter, NOVAKOVIĆ, Srdjan, CERKOVNIK, Petra, VRTAČNIK-BOKAL, Eda, VIRANT-KLUN, Irma. Isolation, characterization and differentiation of cells expressing pluripotent/multipotent markers from adult

human ovaries. *Cell and tissue research*, ISSN 0302-766X, Nov. 2013, vol. 354, no. 2, str. 593-607, ilustr., doi: 10.1007/s00441-013-1677-8. [COBISS.SI-ID 30679001]
4. VIRANT-KLUN, Irma, ROŽMAN, Primož, CVJETIČANIN, Branko, VRTAČNIK-BOKAL, Eda, NOVAKOVIĆ, Srdjan, RÜLICKE, Thomas, DOVČ, Peter, MEDEN-VRTOVEC, Helena. Parthenogenetic embryo-like structures in the human ovarian surface epithelium cell culture in postmenopausal women with no naturally present follicles and oocytes. *Stem cells and development*, ISSN 1547-3287, 2009, vol. 18, no. 1, str. 137-149. [COBISS.SI-ID 714875]
5. The Bovine Genome Sequencing and Analysis Consortium, ELSIK, Christine G., DOVČ, Peter, RAZPET, Andrej, et al. The genome sequence of taurine cattle : a window to ruminant biology and evolution. *Science*, ISSN 0036-8075, 2009, vol. 324, no. 5926, str. 522-528. [COBISS.SI-ID 2460552]
6. KUNEJ, Tanja, GODNIČ, Irena, FERDIN, Jana, HORVAT, Simon, DOVČ, Peter, CALIN, George A. Epigenetic regulation of microRNAs in cancer : an integrated review of literature. *Mutation Research*, ISSN 0027-5107. [Print ed.], 2011, vol. 717, no. 1/2, str. 77-84. http://www.sciencedirect.com/science/article/pii/S0027510711000601, doi: 10.1016/j.mrfmmm.2011.03.008. [COBISS.SI-ID 2837128]

# UČNI NAČRT PREDMETA/COURSE SYLLABUS

| | |
|---|---|
| Predmet: | Mikrobna biotehnologija |
| Course title: | Microbial Biotechnology |

| Študijski programi in stopnja | Študijska smer | Letnik | Semestri |
|---|---|---|---|
| Bioznanosti, tretja stopnja, doktorski | biotehnologija | | Celoletni |

| | |
|---|---|
| Univerzitetna koda predmeta/University course code: | 3789 |

| Predavanja | Seminar | Vaje | Klinične vaje | Druge oblike študija | Samostojno delo | ECTS |
|---|---|---|---|---|---|---|
| 20 | 30 | 0 | 0 | 20 | 180 | 10 |

| | |
|---|---|
| Nosilec predmeta/Lecturer: | Hrvoje Petković |

| | |
|---|---|
| Izvajalci predavanj: | Mojca Benčina, Hrvoje Petković |
| Izvajalci seminarjev: | |
| Izvajalci vaj: | |
| Izvajalci kliničnih vaj: | |
| Izvajalci drugih oblik: | |
| Izvajalci praktičnega usposabljanja: | |

| | |
|---|---|
| Vrsta predmeta/Course type: | teoretični/theoretical |

| | | |
|---|---|---|
| Jeziki/Languages: | Predavanja/Lectures: | Angleščina, Slovenščina |
| | Vaje/Tutorial: | Angleščina, Slovenščina |

| | |
|---|---|
| Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti: | Prerequisites: |
| Splošni pogoji za vpis na doktorski študij. | General conditions for enrolment in doctoral studies apply. |

| Vsebina: | Content (Syllabus outline): |
|---|---|
| Pregled in osvežitev znanja na področju tradicionalnih metod in pristopov, kar vključuje različne aspekte mikrobne biotehnologije:<br><br>-klasični pristopi izolacije mikroorganizmov iz okolja, izboljševanja industrijskih sevov in razvoja bioprocesov za industrijsko proizvodnjo različnih bioproizvodov, proizvodnja primarnih in sekundarnih metabolitov, produktov | In the scope of the course an overview of traditional methods and various approaches of microbial biotechnology will be presented such as:<br>-classical approaches if isolation of microorganisms from natural environments, industrial strain and process development for industrial production of various bioproducts, production of primary and |

| | |
|---|---|
| proteinske narave, uporaba mikroorganizmov in encimov v živilski, kemijski in farmacevtski industriji. | secondary metabolites, proteins and enzymes for food chemical and pharmaceutical industry. |
| -uporaba mikroorganizmov in razvoj bioprocesov v živilski industriji, agrikulturi in okljevarstvu. | -application of microorganisms in the devlopment of bioprocesses in food, agriculture and environmental industry. |
| Nadalje se vsebina predmeta navezuje na novejše, v industriji široko uporabljane pristope metabolnega in biosinteznega in proteinskega inženirstva z uporabo rekombinantne DNA, razvoj izpopolnjenih bioprocesov za produkcijo generičnih proizvodov, in uvajanja novih bioproizvodov, npr. majhnih molekul z novim načinom delovanja, protiteles in drugih biofarmacevtskih produktov proteinske narave. | Further, the content of the subject is inter-connected with new and widely applied approaches of metabolic and biosynthetic engineering, where recombinant DNA methodology is applied, development of the advanced bioprocesses for production of generic products and introduction of novel bio-products, eg. small molecules with novel mode of action, antibodies and biopharmaceuticals. |
| Komparativni pregled najbolj pomembnih industrijskih mikroorganizmov in novih konceptov mikrobne biotehnologije, ki se nanašajo na izbor industrijskih gostiteljskih mikroorganizmov (ang. chassis), primernih za proizvodnjo širokega spektra bioproizvodov, tako tradicionalnih (generičnih) kot tudi novih bioproizvodov. | Comparative overview of the most important industrial microorganisms and recent concepts in microbial biotechnology, relating to the most advanced industrial hosts (chassis), suitable for the production of wide spectrum of bio-products, both, traditional (generic) as well as new bio-products. |
| Predstavitev novejši gostiteljskuh sevov, kot so npr. miksobakterije, cianobakterije, alge in arheje, ki se danes še ne uporabljajo pogosto v industijskem merilu, vendar so zaradi potencialnih prednosti, npr. vir novih učinkovin in encimov, izboljšane ekonomike bioprocesa in okoljevarstvenih razlogov danes predmet intenzivnih raziskav. | In the scope of the course, a number of novel hosts in current R&D will be presented, such as myxobacteria, cyanobacteria, algae, archaea, not yet used often in industrial environments, but show great potential for production of various bio-products of potentially high economic advantage and environmental value, currently being under intensive R&D development. |
| Komparativni pregled najnovejših metod in pristopov, ki so še v razvoju, vendar že prihajajo v industrijsko okolje, kot so to npr.: | In the scope of the subject »Microbial biotechnology«, comparative overview of the most recently developed methods and approaches, only recently reaching industrial environment will be discussed such as: |
| -metagenomika, podatkovno rudarjenje genomov, (ang. genome mining) ob hitrem razvoj in uporabi zmogljivih bioinformatskih orodji<br>-napredne metode sekvenciranja in sinteze DNA in napredne metode manipulacije mikroorganizmov<br>- uporaba »omskih« pristopov v razumevanju in razvoju industrijskih sevov in bioprocesov | -metagenomics and genome mining approaches, further fortified by the development of powerful bioinformatics approaches<br>- new powerful and affordable DNA sequencing, DNA synthesis and advanced gene manipulation methods |

| | |
|---|---|
| - razvoj pristopov t.i. sintezne biologije, konstukcija »ne-naravnih« biosinteznih poti in produktov, uporaba obnovljivih virov energije, razvoj novih biomaterialov (biopolimerov), biofarmacevtskih produktov, vključno s tistimi, ki niso mikrobnega izvora.<br><br>Predmet se bo vsebinsko dotaknil tudi dimenzij regulative, varnosti, etike, intelektuane lastnine in nasplošno družbeno-ekonomskih dimenzij, ki jih prinaša hiter razvoh biotehnologije. | - application of recently developed »omics« approaches for better understanding and development of industrial microorganisms and bioprocesses.<br>-further, development and application of »synthetic biology« approaches, construction of novel »non-natural« biosynthetic pathways and bio-products, the use of renewable sources of energy, development of advanced biomaterials (biopolymers) and biopharmaceutical products from heterologous sources.<br><br>Finally, the subject »Microbial biotechnology« will also deal with issues such as regulatory affairs, safety, ethics, intellectual property and other important issues of modern society, due to the rapid development of biotechnology. |

| Temeljna literatura in viri/Readings: |
|---|
| • Microbial Biotechnology: Principles and aplications, 2013, 3rd ed. (Ed.: Yuan Kun Lee). World Scientiffic Publishing, Co. Pte. Ltd. ISBN13: 978-9814366816 (Hardcover),<br>• Microbial Biotechnology: Fundamentals of Applied Microbiology (Hardcover),2007, Eds.: Alexander N. Glazer Hiroshi Nikaido, 2nd ed. ISBN 9780-521-84210-5 (Hardcover).<br><br>Druga učna gradiva: Drugi viri obsegajo novejše revialne in originalne znanstvene publikacije in izbrana patentna literatura |

| Cilji in kompetence: | Objectives and competences: |
|---|---|
| Študenti se bojo srečali in osvojili znanja, ki dajejo široko platformo razumevanja modernih pristopov v mikrobni biotehnologiji, ki slonijo na tradicionalnih pristopih biotehnologije.<br><br>Koncept predmeta komparativno združuje spekter komplementarni znanja, od področja mikrobiologije pa do biotehnološkega inženirstva, kar omogoča celovito razumevanje delovanja bioprocesov in njihovo obvladovanje v raziskovanem, razvojnem delu in prenosu v industrijsko delu.<br>Študenti se bojo srečali z novimi koncepti v mikrobni biotehnologiji, ki slonijo na modernih metodah, in zato bistveno spreminjajo pogled na razvoj in raziskave in industrijsko proizvodnjo na področju sodobne mikrobne biotehnologije. | Students will receive a new information and understanding related to wider platform of modern approaches in microbial biotechnology, originaly based on the traditional concepts in biotechnology.<br>The course is unifying complementary knowledge, from wider areas of microbiology to biotechnological engineering , thus ensuring comprehensive understanding on how bioprocesses are developed during research and development efforts and transferred to the industrial environment.<br>Students will meet a new concepts in modern microbial biotechnology, based on recently developed methods, which will clearly have great impact in the near future development in the area of microbial biotechnology. |

| Predvideni študijski rezultati: | Intended learning outcomes: |
|---|---|

| | |
|---|---|
| Znanja in razumevanje novih konceptov mikrobne biotehnologije, ki se naslanjajo predvsem na uporabo večnameskih industrijskih gensko manipuliranih gostiteljskih mikroorganizmov (ang. Chassis), ki slonijo na modernih metodah biosinteznega in metabolnega inženirstva, sintezne biologije, omskih pristopov, od katerih so nekatere še v razvoju, vendar že bistveno spreminjajo pogled na raziskovalno razvojne aktivnosti v mikrobni biotehnologiji.<br>Vsebinsko se bo predmet povezoval med teorijo in prakso metod dela z industrijskimi mikroorganizmi v laboratoriju in prenosu v industrijsko okolje in ima jasne vsebinske povezave do drugih vej biotehnologije, kot so npr. farmacevtska, medicinska, živilska, in okoljevarstvena biotehnologij. Zato bo predmet prinaša uporabna znanja in razumevanje tudi za študente, ki ne delujejo neposredno na področju mikrobne biotehnologije. | Student will gain knowledge and understanding of new concepts in microbial biotechnology, based on the use of multipurpose host organisms (chassis), where modern methods such as biosynthetic and metabolic engineering, synthetic biology and omics approaches are applied, some of which are still being developed, but will clearly have near future impact in R&D activities in strain and industrial process development.<br><br>Content of the course will interconnect between theoretical knowledge and practical methodologies, applied in the work with industrial microorganisms at the laboratory scale and their transfer to the industrial environment. The course has obvious connections to the other areas of biotechnology such as pharmaceutical, medical food and environmental biotechnology, thus bringing valuable knowledge to students not closely familiar with are of microbial biotechnology. |

| Metode poučevanja in učenja: | Learning and teaching methods: |
|---|---|
| Predavanja, osebne konzultacije in individualno delo v sklopu priprave seminarske naloge | Lecture, personal consultations and individual work on seminar-projects. |

| Načini ocenjevanja: | Delež/Weight | Assessment: |
|---|---|---|
| Seminar | 70,00 % | Seminar |
| Ustni Izpit | 30,00 % | Oral exam |

Reference nosilca/Lecturer's references:

**Prof. dr. Hrvoje Petković:**

1. Gordan Sladič, Matilda Urukalo, Matjaž Kirn, Urška Lešnik, Vasilka Magdevska, Neda Benički, Mitja Pelko, Aleš Gasparič, Peter Raspor, Tomaž Polak, Štefan Fujs, Paul A. Hoskisson and Hrvoje Petković (2014). Identification of Lipstatin Producing Ability in Streptomyces virginiae CBS 314.55 Using a Dereplication Approach. Food technology Biotechnology., In press.
2. KENDREW, Steven Gary, PETKOVIĆ, Hrvoje, GAISSER, Sabine, READY, Sarah J., GREGORY, Matthew Alan, COATES, Nigel, NUR-E-ALAM, Mohammad, WARNECK, Tony, SUTHAR, Dipen, FOSTER, Teresa A., MCDONALD, Leonard, SCHLINGMAN, Gerhard, KOEHN, Frank E., SKOTNICKI, Jerauld S., CARTER, Guy T., MOSS, Steven J., ZHANG, Ming-Qiang, MARTIN, Christine J., SHERIDAN, Rose M., WILKINSON, Barrie. Recombinant strains for the enhanced production of bioengineered rapalogs. Metabolic engineering, ISSN 1096-7176, 2013, vol. 15, str. 167-173, [COBISS.SI-ID 4189560]
3. KIRM, Benjamin, MAGDEVSKA, Vasilka, TOME, Miha, HORVAT, Marinka, KARNIČAR, Katarina, PETEK, Marko, VIDMAR, Robert, BAEBLER, Špela, JAMNIK, Polona, FUJS, Štefan, HORVAT, Jaka, FONOVIĆ, Marko, TURK, Boris, GRUDEN, Kristina, PETKOVIĆ, Hrvoje, KOSEC, Gregor. SACE_5599, a putative regulatory protein, is involved in morphological differentiation and erythromycin

production in Saccharopolyspora erythraea. Microbial cell factories, ISSN 1475-2859, 2013, vol. 12, str. 126-1-126-15. [COBISS.SI-ID 3005775]
4. LUKEŽIČ, Tadeja, LEŠNIK, Urška, PODGORŠEK, Ajda, HORVAT, Jaka, POLAK, Tomaž, ŠALA, Martin, JENKO, Branko, RASPOR, Peter, HERRON, Paul R., HUNTER, Iain S., PETKOVIĆ, Hrvoje. Identification of the chelocardin biosynthetic gene cluster from Amycolatopsis sulphurea : a platform for producing novel tetracycline antibiotics. Microbiology, ISSN 1350-0872, 2013, vol. 159, no. 12, str. 2524-2532, [COBISS.SI-ID 27043111]
5. BLAŽIČ, Marko, STARCEVIC, Antonio, LISFI, Mohamed, BARANASIC, Damir, GORANOVIČ, Dušan, FUJS, Štefan, KUŠČER, Enej, KOSEC, Gregor, PETKOVIĆ, Hrvoje, CULLUM, John, HRANUELI, Daslav, ZUCKO, Jurica. Annotation of modular PKS and NRPS gene clusters in the genome of Streptomyces tsukubaensis NRRL18488. Applied and environmental microbiology, ISSN 0099-2240, 2012, vol. 78, no. 23, str. 8183-8190, [COBISS.SI-ID 4142456]
6. GORANOVIČ, Dušan, BLAŽIČ, Marko, MAGDEVSKA, Vasilka, HORVAT, Jaka, KUŠČER, Enej, POLAK, Tomaž, SANTOS-ABERTURAS, Javier, MARTÍNEZ-CASTRO, Miriam, BARREIRO, Carlos, MRAK, Peter, KOPITAR, Gregor, KOSEC, Gregor, FUJS, Štefan, MARTÍN, Juan F., PETKOVIĆ, Hrvoje. FK506 biosynthesis is regulated by two positive regulatory elements in Streptomyces tsukubaensis. BMC microbiology, ISSN 1471-2180, 2012, vol. 12, [article no.] 238, str. 1-15, [COBISS.SI-ID 4146808]
7. KOSEC, Gregor, GORANOVIČ, Dušan, MRAK, Peter, FUJS, Štefan, KUŠČER, Enej, HORVAT, Jaka, KOPITAR, Gregor, PETKOVIĆ, Hrvoje. Novel chemobiosynthetic approach for exclusive production of FK506. Metabolic engineering, ISSN 1096-7176, 2012, vol. 14, str. 39-46, doi: 10.1016/j.ymben.2011.11.003. [COBISS.SI-ID 3988600]
8. GORANOVIČ, Dušan, KOSEC, Gregor, MRAK, Peter, FUJS, Štefan, HORVAT, Jaka, KUŠČER, Enej, KOPITAR, Gregor, PETKOVIĆ, Hrvoje. Origin of the Allyl group in FK506 biosynthesis. The Journal of biological chemistry, ISSN 0021-9258, 2010, vol. 285, no. 19, str. 14292-14300, [COBISS.SI-ID 3754104]
9. MAGDEVSKA, Vasilka, GABER, Rok, GORANOVIČ, Dušan, KUŠČER, Enej, BOAKES, Steve, DURAN ALONSO, Maria Beatriz, SANTAMARÍA, Ramon, RASPOR, Peter, LEADLAY, Peter Francis, FUJS, Štefan, PETKOVIĆ, Hrvoje. Robust reporter system based on chalcone synthase rppA gene from Saccharopolyspora erythraea. Journal of microbiological methods, ISSN 0167-7012. [Print ed.], 2010, vol. 83, str. 111-119, [COBISS.SI-ID 3811960]
10. LEŠNIK, Urška, GORMAND, Amelie, MAGDEVSKA, Vasilka, FUJS, Štefan, RASPOR, Peter, HUNTER, Iain S., PETKOVIĆ, Hrvoje. Regulatory elements in tetracycline-encoding gene clusters : the otcG gene positively regulates the production of oxytetracycline in Streptomyces rimosus. Food technology and biotechnology, ISSN 1330-9862, 2009, vol. 47, no. 3, str. 323-330. [COBISS.SI-ID 3608696].

**prof. dr. Mojca Benčina**

1. DUŠAK, Peter, BENČINA, Mojca, TURK, Martina, BAVČAR, Dejan, KOŠMERL, Tatjana, BEROVIČ, Marin, MAKOVEC, Darko. Application of magneto-responsive Oenococcus oeni for the malolactic fermentation in wine. Biochemical engineering journal, ISSN 1369-703X. [Print ed.], 15 June 2016, vol. 110, str. 134-142, doi: 10.1016/j.bej.2016.02.016. [COBISS.SI-ID 4977768]
2. BINDER, Ulrike, BENČINA, Mojca, FIZIL, Ádám, BATTA, Gyula, CHHILLAR, Anil K., MARX, Florentine. Protein kinase A signaling and calcium ions are major players in PAF mediated toxicity against Aspergillus niger. FEBS letters, ISSN 0014-5793. [Print ed.], May 2015, vol. 589, iss. 11, str. 1266-1271. doi: 10.1016/j.febslet.2015.03.037. [COBISS.SI-ID 5696026]
3. VALKONEN, Mari, PENTTILÄ, Merja, **BENČINA, Mojca**. Intracellular pH responses in the industrially important fungus Trichoderma reesei. Fungal genetics and biology, ISSN 1087-1845, Sep. 2014, vol. 70, str. 86-93, doi: 10.1016/j.fgb.2014.07.004. [COBISS.SI-ID 5533978]
4. VALKONEN, Mari, MOJZITA, Dominik, PENTTILÄ, Merja, **BENČINA, Mojca**. Non-invasive high-throughput single-cell analysis of the intracellular pH of yeast by ratiometric flow cytometry.

Applied and environmental microbiology, ISSN 0099-2240, 2013, vol. 79, no. 23, str. 7179-7187, doi: 10.1128/AEM.02515-13. [COBISS.SI-ID 5323802]
5. GABER, Rok, MAJERLE, Andreja, JERALA, Roman, **BENČINA, Mojca**. Noninvasive high-throughput single-cell analysis of HIV protease activity using ratiometric flow cytometry. Sensors, ISSN 1424-8220, Dec. 2013, vol. 13, iss. 12, str. 16330-16346, doi: 10.3390/s131216330. [COBISS.SI-ID 5383706]
6. BAGAR, Tanja, **BENČINA, Mojca**. Antiarrhythmic drug amiodarone displays antifungal activity, induces irregularcalcium response and intracellular acidification of "Aspergillus niger" - Amiodarone targets calcium and pH homeostasis of "A. niger". Fungal genetics and biology, ISSN 1096-0937, 2012, vol. 49, iss. 10, str. 779-791, doi: 10.1016/j.fgb.2012.07.007. [COBISS.SI-ID 5038618]

# UČNI NAČRT PREDMETA/COURSE SYLLABUS

| | |
|---|---|
| Predmet: | Načrtovanje raziskovalnega dela in priprava projekta |
| Course title: | Research planning and elaboration of a project proposal |
| Članica nosilka/UL Member: | UL BF |

| Študijski programi in stopnja | Študijska smer | Letnik | Semestri |
|---|---|---|---|
| Bioznanosti, tretja stopnja, doktorski (v postopku) | Ni členitve (študijski program) | | Celoletni |

| | |
|---|---|
| Univerzitetna koda predmeta/University course code: | 0643133 |

| Predavanja | Seminar | Vaje | Klinične vaje | Druge oblike študija | Samostojno delo | ECTS |
|---|---|---|---|---|---|---|
| 10 | 20 | 0 | 0 | 15 | 80 | 5 |

| | |
|---|---|
| Nosilec predmeta/Lecturer: | Damjana Drobne |

| | |
|---|---|
| Izvajalci predavanj: | Damjana Drobne |
| Izvajalci seminarjev: | |
| Izvajalci vaj: | |
| Izvajalci kliničnih vaj: | |
| Izvajalci drugih oblik: | |
| Izvajalci praktičnega usposabljanja: | |

| | |
|---|---|
| Vrsta predmeta/Course type: | teoretični/theoretical |

| | | |
|---|---|---|
| Jeziki/Languages: | Predavanja/Lectures: | Angleščina, Slovenščina |
| | Vaje/Tutorial: | Angleščina, Slovenščina |

| Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti: | Prerequisites: |
|---|---|
| Splošni pogoji za vpis na doktorski študij | General conditions for the enrolment |

| Vsebina: | Content (Syllabus outline): |
|---|---|
| -Podroben pregled raziskav in razpisov na prioritetnih področjih EU npr. Okolje in zdravje: | -A detailed overview of project calls withun EU priority areas e.g. Environment and Health: |

| | |
|---|---|
| • -Pregled projektov in rezultatov projektov, ki jih je razpasla in financirala EU v svojih programih<br>• -Seznanitev s strateškimi programi za raziskave in inovacije v okviru EU<br>• -Seznanitev z raziskavami in inovacije v podporo kemijski zakonodaji<br>• Seznanitev s strategijo za trajnostni razvoj ter raziskavami in inovacijami, ki podpirajo akcijski načrt za odpravo onesnaževanja<br>Seznanitev s pobudami in smernicami, ki so osnova vsem EU in (mnogim) nacionalnim razpisom projektov: To so:<br>• -Evropska zelena pogodba<br>• -Novi evropski Bauhaus<br>• -Evropska kemijska strategija za trajnost<br>• -Krožno gospodarstvo.<br>Predstavitev konceptov kot so:<br>• -SSbD »*Safe and susistainable by design*«<br>• -Transdisciplinaren pristop<br>• -Odprta znanost<br>• -FAIR podatki<br>Podroben pregled izbranega razpisa, pogojev razpisa in pregled primera ocene projekta ter seznanitev z načini poročanja. | -Overview of projects and results of projects funded by the EU in strategic programs<br>-Familiarisation with the EU's strategic research and innovation programs<br>-Familiarisation with research and innovation in support of chemical legislation<br>- Familiarisation with the Sustainable Development Strategy and the research and innovation supporting the Action Plan on Zero Pollution<br>Familiarisation with the initiatives and roadmaps that underpin all EU and (many) national calls for projects: These are:<br>-European Green Deal<br>-The new European Bauhaus<br>-European Chemical Strategy for Sustainability<br>-The Circular Economy.<br>Introducing concepts such as:<br>-SSbD "Safe and sustainable by design"<br>-Transdisciplinary approach<br>-Open Science<br>-FAIR data<br>Detailed analysis of one selected call, the call conditions and an overview of the project evaluation case study, as well as an introduction to the reporting requirements. |

| Temeljna literatura in viri/Readings: |
|---|
| https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en<br>https://www.consilium.europa.eu/en/press/press-releases/2021/03/15/council-approves-conclusions-on-the-eu-chemicals-strategy-for-sustainability/<br>https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/home<br>https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/programmes/horizon<br>Pregled razpisov na področju raziskav in inoviranja H2020 EU https://ec.europa.eu/research-and-innovation/en/horizon-magazine<br>Environment and health: Initiatives, projects, results and publications related to environment and health research and innovation. https://ec.europa.eu/info/research-and-innovation/research-area/health-research-and-innovation/environment-and-health_en |

| Cilji in kompetence: | Objectives and competences: |
|---|---|
| Slušatelj bo spodoben<br>• Pregledati spletne strani EU komisije in podobno in poiskati ustrezne razpise projektov<br>• Razumeti osnove komuniciranja med različnimi strokami, predvsem med naravoslovjem in družboslovjem<br>• Oblikovati zasnovo raziskovalnega projekta<br>• Razumeti pojem odprte znanosti, koncepta ponovne uporabe podatkov, razlikovati med podatki, informacijami in vedenjem, pomen upravljanja s podatki | The participant will get knowledge to:<br>• Check EU Commission websites for relevant calls<br>• Understand the basics of communication between different disciplines, in particular between the natural and social sciences<br>• Develop a research project design<br>• Understand the concept of open science, the concept of data re-use, the distinction between data, information and knowledge, the importance of data management |

| | |
|---|---|
| Razumeti koncept in pristope pri zagotavljanju FAIR podatkov, pomen digitalizacije pri laboratorijskem delu | Understand the concept and approaches in providing FAIR data, the importance of digitization in laboratory work |

| Predvideni študijski rezultati: | Intended learning outcomes: |
|---|---|
| Znanje in razumevanje:<br>• Poiskati projekti razpis<br>• Razumeti pogoje razpisa, princip poročanja o poteku raziskovalnem delu in o porabi sredstev skladno z razpisnimi pogoji<br>• Sposobnost dogovarjanja med partnerji in izbira načina komuniciranja in odločanja<br>• Sposobnost predstaviti rezultate raziskovalnega dela | Knowledge and understanding:<br>- Find projects call<br>- Understand the terms of the call, the principles of reporting on the progress of the research work and the use of funds in accordance with the terms of the call<br>- Ability to communicate with project partners to make decisions<br>- Understanding how to present and disseminate the results of the research work |

| Metode poučevanja in učenja: | Learning and teaching methods: |
|---|---|
| Predavanja in vodena razprava | Lectures and guided discussion |

| Načini ocenjevanja: | Delež/Weight | Assessment: |
|---|---|---|
| Sodelovanje v razpravi | 50,00 % | Participation in the discussion |
| Poročilo | 50,00 % | Report |

Reference nosilca/Lecturer's references:

1) **Damjana Drobne** je vodilna slovenka partnerica v v tekočih projektih na področju upravljanja s podatki:

1. 2019-2024 Horizont 2020, RIA NanoRIGO, (814530) (https://cordis.europa.eu/project/rcn/220129/factsheet/en)
2. 2021-2025 Horizont 2020, RIA PlasticFatE (965367), https://www.plasticsfate.eu/
3. 2022-2026 Horizont Europe, RIA NOVA

2) Članki, ki vsebujejo pregled področja:

- BALLARIN, Loriano, ...., **DROBNE, Damjana**. Stem cells and innate immunity in aquatic invertebrates : bridging two seemingly disparate disciplines for new discoveries in biology. Frontiers in immunology, ISSN 1664-3224, **2021**, vol. 12, str. 1-24.
- **DROBNE, Damjana.** Adding toxicological context to nanotoxicity study reporting using the nanotox metadata list. Small, ISSN 1613-6829,. **2021**, 2005622, str. 1-8.
- KRANJC, Eva, **DROBNE, Damjana**. Nanomaterials in plants: a review of hazard and applications in the agri-food sector. Nanomaterials, ISSN 2079-4991. **2019**, vol. 9, iss. 8, str. 1-33, ilustr. https://www.mdpi.com/2079-4991/9/8/1094.
- PINSINO, Annalisa, ...., **DROBNE, Damjana**,.... , et al. Probing the immune responses to nanoparticles across environmental species : a perspective of the EU Horizon 2020 project PANDORA. Environmental science, Nano, ISSN 2051-8153, **2020**, vol. 7, iss. 11, str. 3216-3232
- BALLARIN, ... **DROBNE, Damjana**, ..... VARELA COELHO, Ana. Maristem - stem cells of marine/aquatic invertebrates : from basic research to innovative applications. Sustainability, ISSN 2071-1050, **2018**, vol. 10, str. 1-21

# UČNI NAČRT PREDMETA/COURSE SYLLABUS

| | |
|---|---|
| Predmet: | Naravna zdravila iz gliv, rastlin in živali |
| Course title: | Natural medicines from fungi, plants and animals |
| Članica nosilka/UL Member: | |

| Študijski programi in stopnja | Študijska smer | Letnik | Semestri |
|---|---|---|---|
| Bioznanosti, tretja stopnja, doktorski | Ni členitve (študijski program) | | Celoletni |

| | |
|---|---|
| Univerzitetna koda predmeta/University course code: | 0037290 |
| Koda učne enote na članici/UL Member course code: | 3792 |

| Predavanja | Seminar | Vaje | Klinične vaje | Druge oblike študija | Samostojno delo | ECTS |
|---|---|---|---|---|---|---|
| 10 | 30 | 0 | 0 | 5 | 80 | 5 |

| | |
|---|---|
| Nosilec predmeta/Lecturer: | Kristina Sepčić |

| | |
|---|---|
| Izvajalci predavanj: | Andrej Gregori, Samo Kreft, Kristina Sepčić, Borut Štrukelj |
| Izvajalci seminarjev: | |
| Izvajalci vaj: | |
| Izvajalci kliničnih vaj: | |
| Izvajalci drugih oblik: | |
| Izvajalci praktičnega usposabljanja: | |

| | |
|---|---|
| Vrsta predmeta/Course type: | teoretični/theoretical |

| | | |
|---|---|---|
| Jeziki/Languages: | Predavanja/Lectures: | Angleščina, Slovenščina |
| | Vaje/Tutorial: | Angleščina, Slovenščina |

| | |
|---|---|
| Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti: | Prerequisites: |
| Končan univerzitetni ali drugostopenjski bolonjski študij iz širšega področja naravoslovja, matematike in računalništva oziroma ožjega področja Vede o živi naravi (klasifikacija po Klasius-u). | Completed university studies or bologna masters in natural sciences, mathematics and computer studies or the narrower field of life sciences (Klasius classification). |

| | |
|---|---|
| Vsebina: | Content (Syllabus outline): |

| Predstavljene bodo naslednje vsebine: | The following contents will be presented and siscussed: |
|---|---|
| 1. Zdravilne učinkovine rastlinskega izvora in rastlinski izvlečki s poudarkom pa klinično potrjenih primerih uporabe zdravilnih rastlin, njihova izolacija, molekularni način delovanja in uporaba v terapevtske namene;<br>2. Pomen gob v kitajski tradicionalni medicini in po svetu, vrste medicinskih gob, biotehnološki postopki gojenja, ekstrakcija aktivnih komponent iz gliv (encimi, polisaharidi, lektini, antioksidanti, terpenoidi, proteoglikani in proteinski derivati), uporaba prehranskih dopolonil za preventivne in kurativne namene ter lajšanje simptomov antitumorske terapije, ter priprava preparatov v obliki tinktur, praškov ali kapsul;<br>3. Sinteza, pomen, pridobivanje in biološka aktivnost naravnih produktov živalskega izvora, s posebnim povdarkom na spojinah iz morskih živali. Uporaba naravnih produktov morskega izvora in živalskih toksinov v biomedicini, biotehnologiji, farmakologiji in industriji. | 1. Medicinal substances from plants as well as plant crude extracts will be presented in terms of their strucure/activity realtionship, therapeutic use and clinical importance;<br>2. The importance of mushrooms in Chinese traditional medicine and worldwide, species of medicinal mushrooms, biotechnological methods of their cultivation, extraction of active components from fungi (enzymes, polysaccharides, lectins, antioxidants, terpenoids, proteoglycans and protein derivatives), the use of nutrition supplements for preventive and curative purposes and relieve the symptoms of antitumour therapies, and preparation of fungal products in the form of tinctures, powders or capsules;<br>3. The synthesis, biological significance, purification and biological activity of natural products from animal sources. Particular emphasis will be given to natural products deriving from marine animals. The use of marine natural products and animal toxins in biomedicine, biotechnology, pharmacology and industry. |

| Temeljna literatura in viri/Readings: |
|---|
| Učbenik: Sodobna fitoterapija, urednika: Samo Kreft, Nina Glavač Hočevar, SFD, 2013, *ISBN*: 978-961-92900-5-7/ Monograph: Modern Phytotherapy, SFD 2013, Samo Kreft, Nina Glavač Hočevar, eds; *ISBN*: 978-961-92900-5-7<br><br>Pregledni članki in novejši znanstveni članki s področja/Review papers and recent scientific papers |

| Cilji in kompetence: | Objectives and competences: |
|---|---|
| Študent se bo poglobil v ožjo raziskovalno problematiko, ki jo bo nadgrajeval v svoji doktorski disertaciji. Predmet ni namenjen ekstenzivnemu širjenju teoretičnega znanja, pač pa je cilj predstavitev določenih problemov in obvladovanje specifičnih metod in tehnik, ki lahko pripomorejo k rešitvi problemom. Namenjen je tudi poznavanju pregleda predhodnih raziskav s področja bodoče doktorske disertacije študenta. | Students will get deeper insight into research problems which he or she will upgrade in her/his doctoral thesis. The contents are not intended to extensively broaden the theoretical knowledge but should introduce specific problems, indicate methods and techniques with which the problem can be addressed. Students should get familiar with previous research in the field of their doctoral thesis. |

| Predvideni študijski rezultati: | Intended learning outcomes: |
|---|---|
| Znanje in razumevanje:<br>Zgoraj opisan pristop se mora odraziti v pravilnem načrtovanju raziskav in poskusov, ki | Knowledge and understanding:<br>Such an approach should result in the proper planning of research experiments which can |

| | |
|---|---|
| vodijo k preizkusu hipotez zastavljenih v temi doktorske disertacije. | test the hypotheses raised in the doctoral thesis. |

| Metode poučevanja in učenja: | Learning and teaching methods: |
|---|---|
| Neposredna predavanja naštetih nosilcev (vsak 2.5 uri), priprava in vodenje Journal clubov; priprava problemskih nalog, diskusije in konzultacije glede njihovega reševanja. Pregled in poprava rešitev problemskih nalog. | Frontal ex-cathedra teaching (2.5 hr per lecturer); preparation and supervision of Journal clubs; preparation of problem tasks, discussion and consultation. Asesement and correction of problem solutions. |

| Načini ocenjevanja: | Delež/Weight | Assessment: |
|---|---|---|
| Oddaja rešene problemske naloge, | 50,00 % | Presentation of problem solution, |
| sodelovanje na journal club-ih. | 50,00 % | participation at journal clubs. |

Reference nosilca/Lecturer's references:

**Kristina Sepčić:**

1. SAFA, Neda, TROBEC, Tomaž, HOLLAND, Darren C., SLAZAK, Blazej, JACOBSSON, Erik, HAWKES, Jeffrey A., FRANGEŽ, Robert, SEPČIĆ, Kristina, GÖRANSSON, Ulf, MOODIE, Lindon W. K., ROBERTSON, Luke P. Spatial distribution and stability of cholinesterase inhibitory protoberberine alkaloids from Papaver setiferum. *Journal of natural products*, ISSN 1520-6025. [Online ed.], 2021, str. [1-10], ilustr. doi: 10.1021/acs.jnatprod.1c00980. [COBISS.SI-ID 89689603].
2. MOODIE, Lindon W. K., SEPČIĆ, Kristina, TURK, Tom, FRANGEŽ, Robert, SVENSON, Johan. Natural cholinesterase inhibitors from marine organisms. *Natural product reports*, ISSN 0265-0568., 2019, vol. , iss. , 40 str., doi: 10.1039/c9np00010k. [COBISS.SI-ID 5024335].
3. BOTIĆ, Tanja, DEFANT, Andrea, ZANINI, Pietro, ŽUŽEK, Monika C., FRANGEŽ, Robert, JANUSSEN, Dorte, KERSKEN, Daniel, KNEZ, Željko, MANCINI, Ines, SEPČIĆ, Kristina. Discorhabdin alkaloids from Antarctic Latrunculia spp. sponges as a new class of cholinesterase inhibitors. *European journal of medicinal chemistry*, ISSN 0223-5234. [Print ed.], 2017, vol. 136, str. 294-304. doi: 10.1016/j.ejmech.2017.05.019. [COBISS.SI-ID 4313679].
4. OLSEN, Elisabeth K., HANSEN, Espen, MOODIE, Lindon W. K., ISAKSSON, Johan, SEPČIĆ, Kristina, CERGOLJ, Marija, SVENSON, Johan, ANDERSEN, Jeanette H. Marine AChE inhibitors isolated from Geodia barretti : natural compounds and their synthetic analogs. *Organic and Biomolecular Chemistry*, ISSN 1477-0520. [Print ed.], 2016, vol. 14, str. 1629-1640, ilustr., doi: 10.1039/c5ob02416a. [COBISS.SI-ID 3703887]
5. MOODIE, Lindon W. K., ŽUŽEK, Monika C., FRANGEŽ, Robert, ANDERSEN, Jeanette H., HANSEN, Espen, OLSEN, Elisabeth K., CERGOLJ, Marija, SEPČIĆ, Kristina, HANSEN, Kine Ø., SVENSON, Johan. Synthetic analogs of stryphnusin isolated from the marine sponge Stryphnus fortis inhibit acetylcholinesterase with no effect on muscle function or neuromuscular transmission. *Organic and Biomolecular Chemistry*, ISSN 1477-0520. [Print ed.], 2016, vol. 14, iss. 47, str. 11220-11229, ilustr., doi: 10.1039/C6OB02120D. [COBISS.SI-ID 4100431].
6. BERNE, Sabina, KALAUZ, Martina, LAPAT, Marko, SAVIN, Lora, JANUSSEN, Dorte, KERSKEN, Daniel, AMBROŽIČ, Jerneja, ZEMLJIČ JOKHADAR, Špela, JAKLIČ, Domen, GUNDE-CIMERMAN, Nina, LUNDER, Mojca, ROŠKAR, Irena, ELERŠEK, Tina, TURK, Tom, SEPČIĆ, Kristina. Screening of the Antarctic marine sponges (Porifera) as a source of bioactive compounds. *Polar biology*, ISSN 0722-4060, 2016, vol. 39, str. 947-959, doi: 10.1007/s00300-015-1835-4. [COBISS.SI-ID 3662671].

**Andrej Gregori:**

1. BRANDALISE, Federico, CESARONI, Valentina, GREGORI, Andrej, REPETTI, Margherita, ROMANO, Chiara, ORRÙ, Germano, BOTTA, Laura, GIROMETTA, Carolina, GUGLIELMINETTI, Maria Lidia,

SAVINO, Elena, et al. Dietary Supplementation of Hericium erinaceus increases mossy fiber-CA3 hippocampal neurotransmission and recognition memory in wild-type mice. *Evidence-based complementary and alternative medicine*. [Online ed.]. 2017, vol. 2017, str. 1-13. ISSN 1741-4288.
2. CÖR, Darija, BOTIĆ, Tanja, KNEZ, Željko, GREGORI, Andrej, POHLEVEN, Franc. The effects of different solvents on bioactive metabolites and "in vitro" antioxidant and anti-acetylcholinesterase activity of ganoderma lucidum fruiting body and primordia extracts. *Macedonian journal of chemistry and chemical engineering*. 2017, vol. 36, no. 1, str. 1-13. ISSN 1857-5552.
3. MARIČ, Ajda, SKOČAJ, Matej, LIKAR, Matevž, SEPČIĆ, Kristina, KRALJ CIGIĆ, Irena, GRUNDNER, Maja, GREGORI, Andrej. Comparison of lovastatin, citrinin and pigment production of different Monascus purpureus strains grown on rice and millet. *Journal of Food Science and Technology*. 2019, vol. , no., 10 str., [in press], ilustr. ISSN 0022-1155.
4. RODA, Elisa, GREGORI, Andrej, COBELLI, Filippo, BORSCI, Giuseppina, PRIORI, Erica Cecilia, CHINOSI, Silvia, RONCHI, Andrea, FRANCO, Renato, BERRETTA, Massimiliano, SICILIANI, Stella, et al. Novel medicinal mushroom blend as a promising supplement in integrative oncology : a multi-tiered study using 4T1 triple-negative mouse breast cancer model. *International journal of molecular sciences*. May 2020, vol. 21, no. 10, str. 1-28, ilustr. ISSN 1422-0067.
5. WELLHAM, Peter A. D., HAFEEZ, Abdul, GREGORI, Andrej, BROCK, Matthias, KIM, Dong-Hyun, DE MOOR, Cornelia, et al. Culture degeneration reduces sex-related gene expression, alters metabolite production and reduces insect pathogenic response in cordyceps militaris. *Microorganisms*. 2021, vol. 9, iss. 8, str. 1-22. ISSN 2076-2607.
6. BEROVIČ, Marin, ŠVAGELJ, Mirjan, HABIJANIČ, Jožica, GREGORI, Andrej, BOH PODGORNIK, Bojana, PANKL, Mojca, WRABER-HERZOG, Branka. Cultivation of medicinal mushrooms Ganoderma lucidum and Grifola frondosa mycelia and polysaccharides in bioreactors. *International journal of chemical engineering*, 2015, vol. 2, iss. 1, str. 53-57. http://seekdl.org/nm.php?id=6861. [COBISS.SI-ID 1536628419]

**Borut Štrukelj:**

1. PLAVEC, Tina Vida, MITROVIĆ, Ana, PERIŠIĆ, Milica, ŠTRUKELJ, Borut, KOS, Janko, BERLEC, Aleš. Targeting of fluorescent Lactococcus lactis to colorectal cancer cells through surface display of tumour-antigen binding proteins. Microbial biotechnology, ISSN 1751-7915. [Online ed.], [in press] 2021, str.14, doi: 10.1111/1751-7915.13907. [COBISS.SI-ID 73046275]
2. SIRŠE, Mateja, FOKTER, Samo K., ŠTRUKELJ, Borut, ZUPAN, Janja. Silver fir (Abies alba L.) polyphenolic extract shows beneficial influence on chondrogenesis in vitro under normal and inflammatory conditions. Molecules, ISSN 1420-3049, 2020, vol. 25, issue 20, str. 1-14, ilustr. https://doi.org/10.3390/molecules25204616, https://www.mdpi.com/1420-3049/25/20/4616, doi: 10.3390/molecules25204616. [COBISS.SI-ID 32142339]
3. PLAVEC, Tina Vida, ŠTRUKELJ, Borut, BERLEC, Aleš. Screening for new surface anchoring domains for Lactococcus lactis. Frontiers in microbiology, ISSN 1664-302X, 2019, vol. 10, str. 1879-1-1879-13, doi: 10.3389/fmicb.2019.01879. [COBISS.SI-ID 32563239]
4. LUNDER, Mojca, ROŠKAR, Irena, HOŠEK, Jan, ŠTRUKELJ, Borut. Silver fir (Abies alba) extracts inhibit enzymes involved in blood glucose management and protect against oxidative stress in high glucose environment. Plant foods for human nutrition, ISSN 0921-9668, 2019, vol. 74, iss. 1, str. 47-53, ilustr. https://link.springer.com/article/10.1007/s11130-018-0698-6, doi: 10.1007/s11130-018-0698-6. [COBISS.SI-ID 4626801]
5. ŠKRLEC, Katja, RUČMAN, Rudolf, JARC JOVIČIĆ, Eva, SIKIRIĆ, Predrag, ŠVAJGER, Urban, PETAN, Toni, PERIŠIĆ, Milica, ŠTRUKELJ, Borut, BERLEC, Aleš. Engineering recombinant Lactococcus lactis as a delivery vehicle for BPC-157 peptide with antioxidant activities. Applied microbiology and biotechnology, ISSN 0175-7598, 2018, vol. 102, no. 23, str. 10103-10117, doi: 10.1007/s00253-018-9333-6. [COBISS.SI-ID 31660583]
6. BERLEC, Aleš, ŠKRLEC, Katja, SLUGA, Janja, OLENIC, Maria, ŠTRUKELJ, Borut. Single plasmid systems for inducible dual protein expression and for CRISPR-Cas9/CRISPRi gene regulation in

lactic acid bacterium Lactococcus lactis. Scientific reports, ISSN 2045-2322, 2018, vol. 8, str. 1-11, ilustr., doi: 10.1038/s41598-018-19402-1. [COBISS.SI-ID 31103271]

**Samo Kreft:**

1. FATUR, Karsten, KREFT, Samo. Nixing the nightshades = traditional knowledge of intoxicating members of the Solanaceae among hallucinogenic plant and mushroom users in Slovenia. *PloS one*. 2021, vol. 16, no. 2, str. 1-15, ilustr. ISSN 1932-6203
2. TRŠINAR, Bojan, KREFT, Samo. Effect of saw palmetto extract on erectile dysfunction and libido in patients with lower urinary tract symptoms because of benign prostatic obstruction. *Journal of applied research on medicinal and aromatic plants*. 2019, vol. 2, iss. 1, str. 1-6, ilustr. ISSN 2214-7861.
3. STOJILKOVSKI, Katja, URANIČ AHAČIČ, Nataša, KOLAR, Darja, KREFT, Samo. Simple method for the determination of polysaccharides in herbal syrup. *Journal of carbohydrate chemistry*. 2019, vol. 37, iss. 7-8, str.431-441, ilustr. ISSN 1532-2327.
4. LUMPERT, Mateja, KREFT, Samo. Folk use of medicinal plants in Karst and Gorjanci, Slovenia. *Journal of ethnobiology and ethnomedicine*. [Online ed.]. 2017, no. 1:16, vol. 13, str. 1-34, tabele. ISSN 1746-4269
5. POVŠNAR, Marija, KOŽELJ, Gordana, KREFT, Samo, LUMPERT, Mateja. Rare tradition of the folk medicinal use of Aconitum spp. is kept alive in Solčavsko, Slovenia. *Journal of ethnobiology and ethnomedicine*. [Online ed.]. 2017, vol. 13, no. 45, 14 str., tabele. ISSN 1746-4269.
6. DREVENŠEK, Gorazd, LUNDER, Mojca, TAVČAR BENKOVIĆ, Eva, ŠTRUKELJ, Borut, KREFT, Samo. Cardioprotective effects of silver fir (Abies alba) extract in ischemic-reperfused isolated rat hearts. *Food & nutrition research*. oct. 2016, vol. 60, str. 1-7, graf. prikazi. ISSN 1654-661X.

# UČNI NAČRT PREDMETA/COURSE SYLLABUS

| | |
|---|---|
| Predmet: | Naslednje generacije molekulskih markerjev |
| Course title: | Next generation of molecular markers |

| Študijski programi in stopnja | Študijska smer | Letnik | Semestri |
|---|---|---|---|
| Bioznanosti, tretja stopnja, doktorski | biotehnologija | | Celoletni |

| | |
|---|---|
| Univerzitetna koda predmeta/University course code: | 3793 |

| Predavanja | Seminar | Vaje | Klinične vaje | Druge oblike študija | Samostojno delo | ECTS |
|---|---|---|---|---|---|---|
| 12 | 16 | 0 | 0 | 12 | 85 | 5 |

| | |
|---|---|
| Nosilec predmeta/Lecturer: | Nataša Štajner |

| | |
|---|---|
| Izvajalci predavanj: | Jernej Jakše, Nataša Štajner |
| Izvajalci seminarjev: | |
| Izvajalci vaj: | |
| Izvajalci kliničnih vaj: | |
| Izvajalci drugih oblik: | |
| Izvajalci praktičnega usposabljanja: | |

| | |
|---|---|
| Vrsta predmeta/Course type: | teoretični/theoretical |

| | | |
|---|---|---|
| Jeziki/Languages: | Predavanja/Lectures: | Angleščina, Slovenščina |
| | Vaje/Tutorial: | Angleščina, Slovenščina |

| | |
|---|---|
| Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti: | Prerequisites: |
| Splošni pogoji za vpis na doktorski študij. | General conditions for enrollment in doctoral studies. |

| Vsebina: | Content (Syllabus outline): |
|---|---|
| Genetski molekularni markerji so dedni polimorfizmi, ki so povezani s spremembami v DNA zaporedju in jih lahko odkrijemo in določimo v eni ali več populacijah preiskovanih organizmov. So nedvoumno izborno orodje moderne genetike in omogočajo študije pomembnih vprašanj populacijske genetike, ekološke genetike in evolucije. Tehnologije naslednjih generacij določevanja nukleotidnih | Genetic molecular markers are heritable polymorphisms that are related to changes in DNA sequence and can be detected and measured in one or more populations of individuals. They are the tools of choice of modern genetics and enable the study of important questions in population genetics, ecological genetics, and evolution. Next generation sequencing (NGS) is about to |

| | |
|---|---|
| zaporedij (NGS) povzročajo revolucionarne spremembe v genetskih analizah. Trenutno se večina NGS pristopov uporablja za sekvenciranje individualnih genomov, vendar se zaradi znatne globine sekvenciranja podatki lahko aplicirajo tudi na področju molekulskih markerjev. Posebno so atraktivni za uporabo npr. v populacijskih analizah nemodelnih organizmov.<br>Pri predmetu bomo študentom predstavili naslednje vsebine:<br>a) Kratke osnove trenutno uporabnih NGS prisopov in vpliv NGS na tehnologije genetskih markerjev (primerjave s tradicionalnimi molekulskimi markerji).<br>b) Odkrivanje NGS molekularnih markerjev in trenutne genotipizacijske metode (sekvenciranje zmanjšanega vzorca kot sta metodi knjižnice zmanjšanih vzorcev – RRL in zmanjšaje kompleksnosti polimorfnih zaporedij – CroPS; RAD-seq oz. z restrikcijskimi mesti povezani DNA markerji; genotipiozacija z nizko pokritostjo, ki vključuje genotipizacijo s sekvenciranjem (GBS) in hkratno hitro genotipizacijo (MSG)).<br>c) Načrtovanje eksperimentov pridobivanja markerjev naslednjih generacij (cilji, dostopnost referenčnega genoma, pričakovan nivo polimorfizma, izbira restrikcijskih encimov, adapterji, PCR pomnoževanje, združevanje osebkov ali hkratna analiza, izzivi).<br>d) Izzivi analize podatkov (pristopi, programska oprema)<br>e) Nadaljni razvoj področja.<br>f) Izbrani literaturni primeri uporabe. | revolutionize genetic analysis. Currently NGS techniques are mainly used to sequence individual genomes, but due to the high sequence coverage these data can be applied in the field of molecular markers as well. They are especially attractive for use in e.g. population analysis of non-model organisms.<br>The following topics will be included:<br>a) short overview of currently used NGS methods and their impact on genetic marker technology (comparison with tradicional molecular markers)<br>b) NGS molecular marker discovery and current genotyping methods (reduced representation sequencing, including reduced-representation libraries (RRLs) and complexity reduction of polymorphic sequences (CRoPS); Restriction site associated DNA markers or RAD-seq; and low coverage genotyping, including multiplexed shotgun genotyping (MSG) and genotyping by sequencing (GBS)).<br>c) Design of next generation marker discovery experiments (goals, availability of reference genome, expected degree of polymorphisms, choice of restriction enzymes, adapters, PCR amplification, sequencing, polling of individuals or multiplexing, challenges).<br>d) Data analysis challenges (methods, availability of program packages)<br>e) Future directions of the field.<br>f) Selected literature examples of the use. |

| Temeljna literatura in viri/Readings: |
|---|
| Izbrana poglavja iz sledečih knjg:<br><br>1) Molecular Markers in Plants. Robert J. Henry (Editor). ISBN: 978-1-118-47299-6. 216 pages. September 2012, Wiley-Blackwell<br><br>2) Tag-based Next Generation Sequencing. Matthias Harbers (Editor), Guenter Kahl (Editor) ISBN: 978-3-527-32819-2. 608 pages. December 2011, Wiley-Blackwell<br><br>3) Relevantni članki (Relevant articles)<br><br>Revijalni članki s področja, tekoča periodika in druga učna gradiva. |

| Cilji in kompetence: | Objectives and competences: |
|---|---|
| Osnovni izobraževalni cilj predmeta je predstaviti študentom metode in pristope, ki se uporabljajo na področju naslednjih generacij molekulskih markerjev s poudarkom na nemodelnih organizmih. | The main educational aim of the course is to present methods and research activities, which are used in the field of next generation molecular markers with emphasis on non-model species. |

| Predvideni študijski rezultati: | Intended learning outcomes: |
|---|---|
| Znanje in razumevanje:<br>Študent osvoji trenutna znanja, ki se tičejo razvoja in uporabe molekulskih markerjev, ki temeljijo na NGS pristopih.<br><br>Osvojene vsebine so dobra osnova za reševanje raziskovalnih problemov iz različnih področij uporabe molekulskih markerjev. | Knowledge and understanding:<br>Acquisitions of knowledge related to design and use of molecular markers based on NGS use.<br><br>Students will get knowledge and competences which will allow them to solve research problems in the field of molecular markers. |

| Metode poučevanja in učenja: | Learning and teaching methods: |
|---|---|
| Učenje se izvaja v obliki predavanj, v obliki seminarja in s konzultacijami. | Lectures, seminar and consultations. |

| Načini ocenjevanja: | Delež/Weight | Assessment: |
|---|---|---|
| 1) Ustno preverjanje znanja. | 50,00 % | 1) Oral exam. |
| 2) Seminar in njegova predstavitev. | 50,00 % | 2) Seminar and its demonstration. |

Reference nosilca/Lecturer's references:

**Štajner Nataša**

1. ŠTAJNER, Nataša, TOMIĆ, Lidija, IVANIŠEVIĆ, Dragoslav, KORAĆ, Nada, JOVANOVIĆ CVETKOVIĆ, Tatjana, BELESKI, Klime, ANGELOVA, Elizabeta, MARAŠ, Vesna, JAVORNIK, Branka. Microsatellite inferred genetic diversity and structure of Western Balkan grapevines (Vitis vinifera L.). Tree genetics & genomes, ISSN 1614-2942, 2013, vol. 10, iss. 1, str. 127-140. http://dx.doi.org/10.1007/s11295-013-0670-4, doi: 10.1007/s11295-013-0670-4. [COBISS.SI-ID 7753593]

2. ŠTAJNER, Nataša, JAKŠE, Jernej, JAVORNIK, Branka, MASUELLI, R. W., MARTÍNEZ, L. E. Highly variable AFLP and S-SAP markers for the identification of 'Malbec' and 'Syrah' clones. Vitis, ISSN 0042-7500, 2009, letn. 48, no. 3, str. 145-150. [COBISS.SI-ID 6051961]

3. TOMIĆ, Lidija, ŠTAJNER, Nataša, JOVANOVIĆ CVETKOVIĆ, Tatjana, CVETKOVIĆ, Miljan, JAVORNIK, Branka. Collection and genetic characterization of Vitis vinifera 'Žilavka' by microsatellites and AFLP markers. Acta agriculturae Slovenica, ISSN 1581-9175. [Tiskana izd.], 2012, letn. 99, št. 2, str. 143-150. http://aas.bf.uni-lj.si/september2012/04tomic.pdf, doi: 10.2478/v10014-012-0014-3. [COBISS.SI-ID 7304569]

4. TOMIĆ, Lidija, ŠTAJNER, Nataša, JOVANOVIĆ-CVETKOVIĆ, Tatjana, CVETKOVIĆ, Miljan, JAVORNIK, Branka. Identity and genetic relatedness of Bosnia and Herzegovina grapevine

germplasm. Scientia horticulturae, ISSN 0304-4238. [Print ed.], 2012, vol. 143, str. 122-126. http://dx.doi.org/10.1016/j.scienta.2012.05.023. [COBISS.SI-ID 7172473]

5. ŠTAJNER, Nataša, RUSJAN, Denis, KOROŠEC-KORUZA, Zora, JAVORNIK, Branka. Genetic characterization of old Slovenian grapevine varieties of Vitis vinifera L. by microsatellite genotyping. American journal of enology and viticulture, ISSN 0002-9254. [Print ed.], 2011, vol. 62, issue 2, str. 250-255, doi: 10.5344/ajev.2011.10011. [COBISS.SI-ID 6646649]

6. ŠTAJNER, Nataša, ANGELOVA, Elizabeta, BOZINOVIĆ, Zvonimir, PETKOV, Mihail, JAVORNIK, Branka. Microsatelite marker analysis of Macedonian grapevines (Vitis vinifera L.) compared to Bulgarian and Greek cultivars. Journal international des sciences de la vigne et du vin, ISSN 1151-0285, 2009, vol. 43, no. 1, str. 29-34. [COBISS.SI-ID 5951609]

# UČNI NAČRT PREDMETA/COURSE SYLLABUS

| | |
|---|---|
| Predmet: | Rastlinska biotehnologija |
| Course title: | Plant biotechnology |

| Študijski programi in stopnja | Študijska smer | Letnik | Semestri |
|---|---|---|---|
| Bioznanosti, tretja stopnja, doktorski | biotehnologija | | Celoletni |

| | |
|---|---|
| Univerzitetna koda predmeta/University course code: | 3795 |

| Predavanja | Seminar | Vaje | Klinične vaje | Druge oblike študija | Samostojno delo | ECTS |
|---|---|---|---|---|---|---|
| 20 | 50 | 0 | 0 | 30 | 150 | 10 |

| | |
|---|---|
| Nosilec predmeta/Lecturer: | Nataša Štajner |

| | |
|---|---|
| Izvajalci predavanj: | Borut Bohanec, Nataša Štajner, Špela Baebler, David Dobnik |
| Izvajalci seminarjev: | |
| Izvajalci vaj: | |
| Izvajalci kliničnih vaj: | |
| Izvajalci drugih oblik: | |
| Izvajalci praktičnega usposabljanja: | |

| | |
|---|---|
| Vrsta predmeta/Course type: | teoretični/theoretical |

| | | |
|---|---|---|
| Jeziki/Languages: | Predavanja/Lectures: | Angleščina, Slovenščina |
| | Vaje/Tutorial: | Angleščina, Slovenščina |

| Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti: | Prerequisites: |
|---|---|
| Zaključen drugostopenjski študij iz smeri biotehniških ved (UL-Biotehniška fakulteta). Za študente, ki v predhodnih programih niso zaključili zgoraj navedenih ustreznih smeri, se lahko določi opravljanje dodatnih obveznosti iz manjkajočih predmetov v obsegu od 10 do 30 KT prvo oz. drugostopenjskih programov. | Completed second degree of academic studies (MSc) at the Biotechnical Faculty. Students completing other related second degree study programmes may be required to enroll in additional 10-30 ECTS level 1 or 2 courses to meet the requirements. |

| Vsebina: | Content (Syllabus outline): |
|---|---|
| 1. Biotehnološki pristopi k premoščanju ovir pri manipulacijah genov in genomov pri rastlinah.<br>2. Strategije genskega spreminjanja rastlin | 1. Biotechnological approaches to plant gene and genome manipulation<br>2. Strategies of plant genetic modification<br>3. Biosafety of genetically modified plants |

| | |
|---|---|
| 3. Presoja tveganja uporabe gensko spremenjenih rastlin<br>4. Žlahtnjenje rastlin s pomočjo markerjev<br>5. Diagnostika rastlinskih patogenov<br>6. Primerjalna genomika pri rastlinah<br>8. Rastlinska translacijska genomika<br>Pri premoščanju ovir pri manipulacijah genov in genomov pri rastlinah se bodo študentje seznanili z inovativnimi biotehnološkimi metodami žlahtnjenja rastlin predvsem z genskim inženiringom in s tehnologijami mestno specifičnih nukleaz, žlahtnjenje s pomočjo markerjev in podobno. Predstavljene bodo strategije genskega spreminjanja rastlin za izboljšanje agronomskih lastnosti, odpornosti na biotske in abiotske strese, ustreznejšo kakovost, produkcijo zdravil ali drugih komponent. Obravnavana bodo področja biološke varnosti gensko spremenjenih rastlin ter biotehnološki pristopi pri diagnostiki rastlinskih patogenov. Slušatelji se bodo nadalje seznanili z usmeritvami primerjalne genomike pri rastlinah ter z uporabo genomskih podatkov modelnih organizmov pridobljenih z visoko zmogljivimi tehnologijami in funkcijskimi analizami v žlahtnjenju rastlin. | 4. Marker assisted selection<br>5. Diagnostics of plant pathogenes<br>6. Plant comparative genomics<br>7. Plant translation genomics<br>Student will learn about innovative biotechnological breeding methods, particularly genetic engineering, site-specific nuclease technologies and marker assisted selection. The strategies of plant genetic manipulation will include agronomic traits, resistance to biotic and abiotic stress, improvement of quality, production of drugs and other materials. Students will gain knowledge of scientific and legal aspects of biosafety and of advanced methods used in plant pathogen diagnostics. Students will also learn about plant comparative genomics and genomic data of model organisms obtained by high throughput technologies (NGS, proteomics, transcriptomics, metabolomics) and functional analysis, and their application in plant biotehnology |

| Temeljna literatura in viri/Readings: |
|---|
| Pregledni znanstveni članki področja / Review articles from specific fields |

| Cilji in kompetence: | Objectives and competences: |
|---|---|
| Cilj je osvojitev konceptov rastlinske biotehnologije pri razvoju biotehnoloških orodij, žlahtnjenju novih kultivarjev in diganostiki rastlinskih patogenov. Poleg trdnih osnov iz rastlinkse biotehnologije je cilj predmeta predstaviti najsodobnejša znanj iz področij ekspertiz predavateljev, ki se z raziskovalnim delom uveljavljajo na mednarodni ravni.<br><br>Kompetence, ki jih bo študent pridobil, so zlasti sposobnost celovitega razumevanja biotehnoloških konceptov in razvijanje "biotehnološkega" načina razmišljanja pri obravnavanju problemov s področja rastlinske pridelave, uporabo biotehnologije za analizo in razumevanje delovanja večplastnih bioloških sistemov, sposobnost načrtovanja poskusov ter usposobljenost za vrhunsko in odgovorno | Students in this course should be able to acquire knowledge of a wide spectrum of biotechnological concepts in the development of biotechnological tools, breeding of new cultivars and in plant pathogen diagnostics. In addition to providing solid knowledge of plant biotechnology, the aim of the course is also to present advanced, state of the art topics in plant biotechnology drawing on the expertise of course lecturers in internationally recognized research.<br><br>Competences gained cover a comprehensive understanding of biotechnological concepts and development of a biotechnological approach to agricultural production. Competence in using advanced biotehnological tools will enable students to analyse and understand multiple layers of |

| | |
|---|---|
| delovanje na raziskovalnem področju ter v relevantnih strokovnih in svetovalnih državnih telesih (npr. etične komisije, odbori za gensko spremenjene organizme ipd.) | biological systems. Students should be competent in conducting research in plant biotechnology and participation in professional and advisory bodies (e.g., ethical committees, scientific advisory boards on genetically modified organisms etc.). |

| Predvideni študijski rezultati: | Intended learning outcomes: |
|---|---|
| Pridobljeno znanje bo zadoščalo za učinkovito raziskovalno delo na področju rastlinske biotehnologije. Študent bo pridobil tudi osnovna znanja strokovnih in pravnih vidikov uporave proizvodov rastlinske biotehnologije. | Knowledge gained in this course should provide a solid basis for efficient research work in plant biotechnology. Students will also gain basic knowledge of professional and legal issues on the use of plant biotechnology products. |

| Metode poučevanja in učenja: | Learning and teaching methods: |
|---|---|
| Predavanja: predstavitev glavnih konceptov ter uvajanja v problematiko<br>Seminarska naloga: obravnava specifičnega problema<br>Induvidualne konzultacije | Lectures: introduction to concepts and topics<br>Seminar project: work on specific topics<br>Individual consultations |

| Načini ocenjevanja: | Delež/Weight | Assessment: |
|---|---|---|
| Pisni izpit | 60,00 % | Written final exam |
| opravljena seminarska naloga | 40,00 % | seminar project |

Reference nosilca/Lecturer's references:

**Štajner Nataša**


**1.** PROGAR, Vasja, JAKŠE, Jernej, **ŠTAJNER**, Nataša, RADIŠEK, Sebastjan, JAVORNIK, Branka, BERNE, Sabina. Comparative transcriptional analysis of hop responses to infection with Verticillium nonalfalfae. *Plant cell reports*, ISSN 0721-7714. [Print ed.], 2017, vol. 36, iss 10, str. 1599-1613
**2.** POKORN, Tine, RADIŠEK, Sebastjan, JAVORNIK, Branka, **ŠTAJNER**, Nataša, JAKŠE, Jernej. Development of hop transcriptome to support research into host-viroid interactions. *PloS one*, ISSN 1932-6203, Sep. 2017, vol. 12, iss. 9, 0184528.]
**3.** FLAJŠMAN, Marko, MANDELC, Stanislav, RADIŠEK, Sebastjan, **ŠTAJNER**, Nataša, JAKŠE, Jernej, KOŠMELJ, Katarina, JAVORNIK, Branka. Identification of novel virulence - associated proteins secreted to xylem by Verticillium nonalfalfae during colonization of hop plants. *Molecular plant-microbe interactions*, ISSN 0894-0282, 2016, vol. 29, no. 5, str. 362-373
**4.** CREGEEN, Sara, RADIŠEK, Sebastjan, MANDELC, Stanislav, TURK, Boris, **ŠTAJNER**, Nataša, JAKŠE, Jernej, JAVORNIK, Branka. Different gene expressions of resistant and susceptible hop cultivars in response to Infection with a highly aggressive strain of Verticillium albo-atrum. *Plant molecular biology reporter*, ISSN 0735-9640, 2015, vol. 33, iss. 3, str. 689-704
**5. ŠTAJNER**, Nataša, TOMIĆ, Lidija, PROGAR, Vasja, POKORN, Tine, LACOMBE, Thierry, LAUCOU, Valérie, BOURSIQUOT, Jean-Michel, JAVORNIK, Branka, BACILIERI, Roberto. Genetic clustering and parentage analysis of Western Balkan grapevines (Vitis vinifera L.). *Vitis*, ISSN 0042-7500, 2015, vol. 54, spec. iss., str. 67-72.

**6.** REŠETIČ, Tjaša, **ŠTAJNER**, Nataša, BANDELJ, Dunja, JAVORNIK, Branka, JAKŠE, Jernej. Validation of candidate reference genes in RT-qPCR studies of developing olive fruit and expression analysis of four genes involved in fatty acids metabolism. *Molecular breeding*, ISSN 1380-3743. [Tiskana izd.], 2013, vol. 32, issue 1, str. 211-222.
**7. ŠTAJNER**, Nataša, CREGEEN, Sara, JAVORNIK, Branka. Evaluation of reference genes for RT-qPCR expression studies in hop (Humulus lupulus L.) during infection with vascular pathogen Verticillium albo-atrum. *PloS one*, ISSN 1932-6203, 2013, vol. 8, issue 7, str. 1-13 (
**8. ŠTAJNER**, Nataša, TOMIĆ, Lidija, IVANIŠEVIĆ, Dragoslav, KORAĆ, Nada, JOVANOVIĆ CVETKOVIĆ, Tatjana, BELESKI, Klime, ANGELOVA, Elizabeta, MARAŠ, Vesna, JAVORNIK, Branka. Microsatellite inferred genetic diversity and structure of Western Balkan grapevines (Vitis vinifera L.). *Tree genetics & genomes*, ISSN 1614-2942, 2013, vol. 10, iss. 1, str. 127-140.
**9. ŠTAJNER**, Nataša, RUSJAN, Denis, KOROŠEC-KORUZA, Zora, JAVORNIK, Branka. Genetic characterization of old Slovenian grapevine varieties of Vitis vinifera L. by microsatellite genotyping. *American journal of enology and viticulture*, ISSN 0002-9254. [Print ed.], 2011, vol. 62, issue 2, str. 250-255
**10.** JAKŠE, Jernej, **ŠTAJNER**, Nataša, LUTHAR, Zlata, JELTSCH, Jean-Marc, JAVORNIK, Branka. Development of transcript-associated microsatellite markers for diversity and linkage mapping studies in hop (Humulus lupulus L.). *Molecular breeding*, ISSN 1380-3743. [Tiskana izd.], 2011, vol. 28, no. 2, str. 227-239.

**Borut Bohanec**

DUANGJIT, Janejira, WELSH, Kent, WISE, Mitchel L., BOHANEC, Borut, HAVEY, Michael J. Genetic analyses of anthocyanin concentrations and intensity of red bulb color among segregating haploid progenies of onion. *Molecular breeding*, ISSN 1380-3743. [Tiskana izd.], 2014, v tisku.
SUSIČ, Nik, BOHANEC, Borut, MUROVEC, Jana. Agrobacterium tumefaciens-mediated transformation of bush monkey-flower (Mimulus aurantiacus Curtis) with a new reporter gene ZsGreen. *Plant cell, tissue and organ culture*, ISSN 0167-6857. [Print ed.], 2014, vol. 116, iss. 2, str. 243-251.
KOŠMRLJ, Kristina, MUROVEC, Jana, BOHANEC, Borut. Haploid induction in hull-less seed pumpkin through parthenogenesis induced by X-ray-irradiated pollen. *Journal of the American Society for Horticultural Science*, ISSN 0003-1062. [Print ed.], 2013, vol. 138, no. 4, str. 310-316.
MUROVEC, Jana, BOHANEC, Borut. Haploid induction in Mimulus aurantiacus Curtis obtained by pollination with gamma irradiated pollen. *Scientia horticulturae*, ISSN 0304-4238. [Print ed.], 2013, vol. 162, str. 218-225.
ORAŽEM, Petra, ŠTAJNER, Nataša, BOHANEC, Borut. Effect of X-ray irradiation on olive shoot culture evaluated by morphological measurements, nuclear DNA content and SSR and AFLP markers. *Trees*, ISSN 0931-1890, 2013, vol. 27, issue 6, str. 1587-1595.
MUROVEC, Jana, DRAŠLAR, Kazimir, BOHANEC, Borut. Detailed analysis of Cucurbita pepo seed coat types and structures with scanning electron microscopy. *Botany*, ISSN 1916-2790. [Tiskana izd.], 2012, vol. 90, no. 12, str. 1161-1169.

**Špela Baebler**

LUKAN, Tjaša, POMPE NOVAK, Maruša, BAEBLER, Špela, TUŠEK-ŽNIDARIČ, Magda, KLADNIK, Aleš, KRIŽNIK, Maja, BLEJEC, Andrej, ZAGORŠČAK, Maja, STARE, Katja, DUŠAK, Barbara, COLL RIUS, Anna, POLLMANN, Stephan, MORGIEWICZ, Karolina, HENNIG, Jacek, GRUDEN, Kristina. Precision transcriptomics of viral foci reveals the spatial regulation of immune-signaling genes and identifies RBOHD as an important player in the incompatible interaction between potato virus Y and potato. The Plant journal, ISSN 0960-7412, 2020, vol. , iss. , str. 1-17, ilustr., doi: 10.1111/tpj.14953. [COBISS.SI-ID 27546883]

KRIŽNIK, Maja, BAEBLER, Špela, GRUDEN, Kristina. Roles of small RNAs in the establishment of tolerant interaction between plants and viruses. Current opinion in virology. Jun. 2020, vol. 42, str. 25-31, ilustr. ISSN 1879-6257. DOI: 10.1016/j.coviro.2020.04.006. [COBISS.SI-ID 17660163], [JCR, SNIP, WoS, Scopus]

BAEBLER, Špela, COLL RIUS, Anna, GRUDEN, Kristina. Plant molecular responses to potato virus Y : a continuum of outcomes from sensitivity and tolerance to resistance. Viruses, ISSN 1999-4915, 2020, vol. 12, iss. 2, str. 1-17, ilustr. https://www.mdpi.com/1999-4915/12/2/217, doi: 10.3390/v12020217. [COBISS.SI-ID 40664837]

LUKAN, Tjaša, BAEBLER, Špela, POMPE NOVAK, Maruša, GUČEK, Katja, ZAGORŠČAK, Maja, COLL RIUS, Anna, GRUDEN, Kristina. Cell death is not sufficient for the restriction of potato virus Y spread in hypersensitive response-conferred resistance in potato. Frontiers in plant science. 2018, str. 1-12, vol. 9. ISSN 1664-462X.
https://www.frontiersin.org/articles/10.3389/fpls.2018.00168/abstract, DOI: 10.3389/fpls.2018.00168. [COBISS.SI-ID 4609615]

SEDLAR, Aleš, GERIČ STARE, Barbara, MAVRIČ PLEŠKO, Irena, DOLNIČAR, Peter, MARAS, Marko, ŠUŠTAR VOZLIČ, Jelka, BAEBLER, Špela, GRUDEN, Kristina, MEGLIČ, Vladimir. Expression and regulation of programmed cell death associated genes in systemic necrosis of PVYNTN susceptible potato tubers. Plant Pathology. June 2018, vol.67, iss. 5, str. 1238-1252. ISSN 0032-0862. DOI: 10.1111/ppa.12818. [COBISS.SI-ID 5408872]

RAMŠAK, Živa, COLL RIUS, Anna, STARE, Tjaša, TZFADIA, Oren, BAEBLER, Špela, VAN DE PEER, Yves, GRUDEN, Kristina. Network modelling unravels mechanisms of crosstalk between ethylene and salicylate signalling in potato. Plant physiology, ISSN 0032-0889, 2018, vol. 178, str. 488-499. http://dx.doi.org/10.1104/pp.18.00450, doi: 10.1104/pp.18.00450. [COBISS.SI-ID 4778575]

LUKAN, Tjaša, MACHENS, Fabian, COLL RIUS, Anna, BAEBLER, Špela, MESSERSCHMIDT, Katrin, GRUDEN, Kristina. Plant X-tender : an extension of the AssemblX system for the assembly and expression of multigene constructs in plants. PloS one. 2018, vol. 13, iss. 1, str. 1-19, ilustr. ISSN 1932-6203. http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0190526, DOI: 10.1371/journal.pone.0190526. [COBISS.SI-ID 4609359]

KRIŽNIK, Maja, PETEK, Marko, DOBNIK, David, RAMŠAK, Živa, BAEBLER, Špela, POLLMANN, Stephan, KREUZE, Jan F., ŽEL, Jana, GRUDEN, Kristina. Salicylic acid perturbs sRNA-gibberellin regulatory network in immune response of potato to Potato virus Y infection. Frontiers in plant science, ISSN 1664-462X, 2017, vol. 8, str. 1-14.
https://www.frontiersin.org/articles/10.3389/fpls.2017.02192/full, doi: 10.3389/fpls.2017.02192. [COBISS.SI-ID 4545103]

**David Dobnik**

MEHLE, Nataša, GREGUR, Larisa, BOGOŽALEC KOŠIR, Alexandra, DOBNIK, David. One-step reverse-transcription digital PCR for reliable quantification of different pepino mosaic virus genotypes. Plants. 2020, vol. 9, no. 3, str. 1-13. ISSN 2223-7747. DOI: 10.3390/plants9030326. [COBISS.SI-ID 5319247],

MEHLE, Nataša, DOBNIK, David, RAVNIKAR, Maja, POMPE NOVAK, Maruša. Validated reverse transcription droplet digital PCR serves as a higher order method for absolute quantification of

Potato virus Y strains. Analytical and bioanalytical chemistry. 2018, vol. 410, iss. 16, str. 3815-3825. ISSN 1618-2642. DOI: 10.1007/s00216-018-1053-3. [COBISS.SI-ID 4684879],

RUPAR, Matevž, FAUREZ, Florence, TRIBODET, Michel, GUTIÉRREZ-AGUIRRE, Ion, DELAUNAY, Agnes, GLAIS, Laurent, KRIŽNIK, Maja, DOBNIK, David, GRUDEN, Kristina, JACQUOT, Emmanuel, RAVNIKAR, Maja. Fluorescently tagged Potato virus Y : a versatile tool for functional analysis of plant-virus interactions. Molecular plant-microbe interactions. 2015, vol. 28, no. 7, str. 739-750. ISSN 0894-0282. DOI: 10.1094/MPMI-07-14-0218-TA. [COBISS.SI-ID 3518031]

DOBNIK, David, SPILSBERG, Bjørn, BOGOŽALEC KOŠIR, Alexandra, HOLST-JENSEN, Arne, ŽEL, Jana. Multiplex quantification of 12 European Union authorized genetically modified maize lines with droplet digital polymerase chain reaction. Analytical chemistry. [Print ed.]. 2015, vol. 87, iss. 16, str. 8218-8226. ISSN 0003-2700. DOI: 10.1021/acs.analchem.5b01208. [COBISS.SI-ID 3540559]

DOBNIK, David, LAZAR, Ana, STARE, Tjaša, GRUDEN, Kristina, VLEESHOUWERS, Vivianne G. A. A., ŽEL, Jana. Solanum venturii, a suitable model system for virus-induced gene silencing studies in potato reveals StMKK6 as an important player in plant immunity. Plant methods. 2016, vol. 12, no. 29, str. 1-12. ISSN 1746-4811. DOI: 10.1186/s13007-016-0129-3. [COBISS.SI-ID 3877967]

KRIŽNIK, Maja, PETEK, Marko, DOBNIK, David, RAMŠAK, Živa, BAEBLER, Špela, POLLMANN, Stephan, KREUZE, Jan F., ŽEL, Jana, GRUDEN, Kristina. Salicylic acid perturbs sRNA-gibberellin regulatory network in immune response of potato to Potato virus Y infection. Frontiers in plant science. 2017, vol. 8, str. 1-14. ISSN 1664-462X. https://www.frontiersin.org/articles/10.3389/fpls.2017.02192/full, DOI: 10.3389/fpls.2017.02192. [COBISS.SI-ID 4545103]

DOBNIK, David, DEMŠAR, Tina, HUBER, Ingrid, GERDES, Lars, BROEDERS, Sylvia, ROOSENS, Nancy, DEBODE, Frédéric, BERBEN, Gilbert, ŽEL, Jana. Inter-laboratory analysis of selected genetically modified plant reference materials with digital PCR. Analytical and bioanalytical chemistry. 2018, vol. 410, iss. 1, str. 211-221. ISSN 1618-2642. http://dx.doi.org/10.1007/s00216-017-0711-1, DOI: 10.1007/s00216-017-0711-1. [COBISS.SI-ID 4500303]

# UČNI NAČRT PREDMETA/COURSE SYLLABUS

| | |
|---|---|
| Predmet: | Sodobna biološka zdravila |
| Course title: | Modern biological medicines |

| Študijski programi in stopnja | Študijska smer | Letnik | Semestri |
|---|---|---|---|
| Bioznanosti, tretja stopnja, doktorski | biotehnologija | | Celoletni |

| | |
|---|---|
| Univerzitetna koda predmeta/University course code: | 3796 |

| Predavanja | Seminar | Vaje | Klinične vaje | Druge oblike študija | Samostojno delo | ECTS |
|---|---|---|---|---|---|---|
| 10 | 20 | 5 | 0 | 5 | 85 | 5 |

| | |
|---|---|
| Nosilec predmeta/Lecturer: | Borut Štrukelj |

| | |
|---|---|
| Izvajalci predavanj: | Borut Štrukelj |
| Izvajalci seminarjev: | |
| Izvajalci vaj: | |
| Izvajalci kliničnih vaj: | |
| Izvajalci drugih oblik: | |
| Izvajalci praktičnega usposabljanja: | |

| | |
|---|---|
| Vrsta predmeta/Course type: | teoretični/theoretical |

| | | |
|---|---|---|
| Jeziki/Languages: | Predavanja/Lectures: | Angleščina, Slovenščina |
| | Vaje/Tutorial: | Angleščina, Slovenščina |

| | |
|---|---|
| Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti: | Prerequisites: |
| Splošni pogoji za vpis na doktorski študij | General prerequisits for application on doctoral study |

| Vsebina: | Content (Syllabus outline): |
|---|---|
| V okviru predmeta »Sodobna biološka zdravila« bo slušatelj spoznal razvrstitev, pripravo in molekularno delovanje sledečih sodobnih bioloških zdravilnih učinkovin:<br>1. Eritropoetini<br>2. Inzulini<br>3. Monoklonska protitelesa<br>4. Rekombinantna cepiva<br>5. Citokini | Within the frame of subject »Modern biological medicines« attendants will be subjected to structre, activity and distribution of the following modern biological medicinal substances:<br>1. Erythropoietins<br>2. Insulins<br>3. Monoclonal antibodies<br>4. Recombinant vaccines |

| | |
|---|---|
| 6. Podobna biološka zdravila<br>7. Genske učinkovine | 5. Cytokines<br>6. Biosimilars<br>7. Gene products |

| Temeljna literatura in viri/Readings: |
|---|
| 1. *Biološka zdravila* : od gena do učinkovine. 1. izd. Ljubljana: Slovensko farmacevtsko društvo, 2007, Urednika: Borut Štrukelj, Janko Kos; *ISBN* 978-961-90099-8-7.<br>2. *Gary Walsh***:** Pharmaceutical Biotechnology. Concepts and Applications. John Wiley & Sons, Ltd, 2007. ISBN 978-0-470-01244-4.<br>3. Pregledni članki in novejši znanstveni članki s področja/Review papers and recent scientific papers |

| Cilji in kompetence: | Objectives and competences: |
|---|---|
| Cilj predmeta je razjasniti in poglobiti znanja na področju sodobne farmacevtske biotehnologije. Poleg teoretskih znanj bo študent pridobil kompetenco priprave, izvedbe in reševanja težjih biotehnoloških nalog in problemov, ki jih bo s pridom implementiral v času doktorskega dela in kasneje v praksi. | The main goal of the subject is to clarify and upgrade broad theoretical and practical knowledge and competencies in the field of pharmaceutical biotechnology. Student will be qualified to plan, perform and solve complex biotechnological problems and will achieve competences for their implementation during doctoral work and later in real professional environment. |

| Predvideni študijski rezultati: | Intended learning outcomes: |
|---|---|
| Znanje in razumevanje:<br><br>Z osvojitvijo in razumevanjem tematik programa ter z uspešno izdelavo in rešitvijo farmacevtsko-biotehnološkega problema bo študent pridobil sposobnost hitrejšega, boljšega in popolnejšega načrtovanja in izvajanja doktroskega dela kot tudi zmožnost širitve znanja na sodelavce v nadaljnjem profesionalnem okolju. | Knowledge and understanding:<br><br>By absolving the content of the sylabus with the outcome of biotech problem learning students will be able to achieve the knowledge that lead to individual, fully-responsible planning of research experiments as well as to transfer the topics to other co-workers in real conditions. |

| Metode poučevanja in učenja: | Learning and teaching methods: |
|---|---|
| Neposredna predavanja z aktivno udeležbo slušateljev;e-študij preko telekonference; pomoč in nadzor pri projektnem delu, pomoč in diskusija pri pripravi preglednega ali poljudno-strokovnega članka | Frontal ex-cathedra teaching with active discussion; e-leranking by means of teleconferences; supervision of project-based learning; monitoring and supervising in the manuscript preparation, discussion and consultation. |

| Načini ocenjevanja: | Delež/Weight | Assessment: |
|---|---|---|
| Priprava in oddaja farmacevtsko-biotehnološkega projekta; | 70,00 % | Elaboration of pharma-biotech project, |
| sodelovanje v pripravi preglednega strokovnega ali poljudno-strokovnega članka | 30,00 % | colaboration in the preparation of review or popular-scientific article |

Reference nosilca/Lecturer's references:

**1.** ZADRAVEC, Petra, MAVRIČ, Anja, BOGOVIČ MATIJAŠIĆ, Bojana, ŠTRUKELJ, Borut, BERLEC, Aleš. Engineering BmpA as a carrier for surface display of IgG-binding domain on Lactococcus lactis. *Protein engineering, design & selection*, ISSN 1741-0126, 2014, vol. 27, no. 1, str. 21-27.
**2.** BERLEC, Aleš, MALOVRH, Tadej, ZADRAVEC, Petra, STEYER, Andrej, RAVNIKAR, Matjaž, SABOTIČ, Jerica, POLJŠAK-PRIJATELJ, Mateja, ŠTRUKELJ, Borut. Expression of a hepatitis A virus antigen in Lactococcus lactis and Escherichia coli and evaluation of its immunogenicity. *Applied microbiology and biotechnology*, ISSN 0175-7598, 2013, vol. 97, iss. 10, str. 4333-4342.
**3.** VODNIK, Miha, MOLEK, Peter, ŠTRUKELJ, Borut, LUNDER, Mojca. Peptides binding to the hunger hormone ghrelin. *Hormone and Metabolic Research*, ISSN 0018-5043, 2013, vol. 45, no. 5, str. 372-377.
**4.** VODNIK, Miha, ŠTRUKELJ, Borut, LUNDER, Mojca. HWGMWSY, an unanticipated polystyrene binding peptide from random phage display libraries. *Analytical biochemistry*, ISSN 0003-2697, 2012, vol. 424, iss. 2, str. 83-86.
**5.** BERLEC, Aleš, ŠTRUKELJ, Borut. Generating a custom TA-cloning expresion plasmid for Lactococcus lactis. *Biotechniques*, ISSN 0736-6205, 2012, vol. 52, no. 1, str. 51-53.
**6.** BERLEC, Aleš, RAVNIKAR, Matjaž, ŠTRUKELJ, Borut. Lactic acid bacteria as oral delivery systems for biomolecules. *Pharmazie*, ISSN 0031-7144, 2012, vol. 67, no. 11, str. 891-898.
7. MOLEK, Peter, ŠTRUKELJ, Borut, BRATKOVIČ, Tomaž. Peptide phage display as a tool for drug discovery: targeting membrane receptors. *Molecules*, ISSN 1420-3049, 2011, vol. 16, no. 1, str. 857-887.

# UČNI NAČRT PREDMETA/COURSE SYLLABUS

| | |
|---|---|
| Predmet: | Sodobne biotehnološke metode |
| Course title: | Modern biotechnological methods |

| Študijski programi in stopnja | Študijska smer | Letnik | Semestri |
|---|---|---|---|
| Bioznanosti, tretja stopnja, doktorski | biotehnologija | | Celoletni |

| | |
|---|---|
| Univerzitetna koda predmeta/University course code: | 3797 |

| Predavanja | Seminar | Vaje | Klinične vaje | Druge oblike študija | Samostojno delo | ECTS |
|---|---|---|---|---|---|---|
| 10 | 0 | 5 | 0 | 25 | 85 | 5 |

| | |
|---|---|
| Nosilec predmeta/Lecturer: | Igor Križaj |

| | |
|---|---|
| Izvajalci predavanj: | Igor Križaj, Radovan Komel |
| Izvajalci seminarjev: | |
| Izvajalci vaj: | |
| Izvajalci kliničnih vaj: | |
| Izvajalci drugih oblik: | |
| Izvajalci praktičnega usposabljanja: | |

| | |
|---|---|
| Vrsta predmeta/Course type: | teoretični/theoretical |

| | | |
|---|---|---|
| Jeziki/Languages: | Predavanja/Lectures: | Slovenščina, Angleščina, |
| | Vaje/Tutorial: | Slovenščina, Angleščina, |

| | |
|---|---|
| Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti: | Prerequisites: |
| Splošni pogoji za vpis na doktorski študij. | General prerequisites to enter doctoral study. |

| Vsebina: | Content (Syllabus outline): |
|---|---|
| **Proteini:** Čiščenje: viri proteinov; homogenizacija; centrifugiranje; ultrafiltracija; dializa; principi različnih vrst tekočinske kromatografije (gelska, hidrofobna, ionska, afinitetna …) in načini njihove izvedbe (klasična, FPLC, HPLC …); elektroforetske metode (nativna in NaDS PAGE, izoelektrično fokusiranje, prenos Western); izolacija membranskih proteinov (detergenti …). Metode za detekcijo, kvantifikacijo in karakterizacijo proteinov: v | **Proteins:** Purification: protein sources; homogenization; centrifugation; ultrafiltration; dialysis; principles of liquid chromatography (gel filtration, hydrophobic, ion-exchange, affinity …) and modes of their implementation (classical, FPLC, HPLC …); electrophoretic methods (native and SDS PAGE, isoelectric focussing, Western blotting …); isolation of membrane proteins (detergents). Methods for detection, quantification and characterization |

| | |
|---|---|
| raztopinah, gelih, bioloških membranah in na sintetičnih membranah (imunološke,~~imunokemijske~~ radioizotopske in spektroskopske metode, barvila). Strukturna karakterizacija proteinov: določanje aminokislinske sestave in zaporedja; post-translacijskih modifikacij. Proteomika: 2D PAGE; masna spektrometrija, tehnologija MudPIT. **Nukleinske kisline (NK):** *Izolacija in čiščenje* (biološki viri/tkiva – shranjevanje in homogeniziranje; varnostni ukrepi; obarjanje in centrifugiranje NK; elektroforezne metode in izolacija NK; kromatografske metode; subtrakcija). *Izdelava genske knjižnice/banke* (restrikcijski encimi, fragmentiranje DNA, delna restrikcija, metoda PCR in njene izvedenke; vektorji za prenos DNA, vnos in kloniranje DNA v različnih gostiteljskih celicah, selekcija rekombinantnih klonov; genomske in cDNA knjižnice). *Preiskava genskih knjižnic* (gensko-specifične sonde, hibridizacija kolonij/plakov, ekspresijske knjižnice; RFLP, pozicijsko kloniranje, sprehod/skok po kromosomu). *Določanje nukleotidnega zaporedja* (metoda po Sangerju, po-genomski pristopi – avtomatizacija). *Karakterizacija NK* (restrikcijska analiza, prenosa Southern in Northern; iskanje podobnosti nukleotidnih zaporedij; analiza genskih mutacij in polimorfizmov). *Mutageneza* (naključna in usmerjena/mestno-specifična mutageneza; proteinsko inženirstvo). *Izražanje tujih genov* (fuzijski proteini, sekrecija; analiza mRNA, RT-PCR; hibridizacija *in situ*, FISH; »DNA-prstni odtis«; kvasni dvohibridni sistem; diferenčne metode, fagni prikaz, qPCR, DNA mikromreže (bio-čipi)). *Transgeneza pri evkariontih* (opis metod; utišanje genov). Preurejanje genomov (CRISPR/Cas, gensko zdravljenje, imunonoterapija/CAP-T). *Analiza genomov* (kartiranje, določanje nukleotidnih zaporedij, primerjalna genomika; transkriptomika). *Bioinformatika, podatkovne baze in Internet.* | of proteins: in solution, gels, biological membranes and on synthetic membranes (immunological, radioisotopic and spectroscopic methods, dyes). Structural characterization of proteins: determination of amino acid composition and sequence; post-translational modifications. Proteomics: 2D PAGE; mass spectrometry, MudPIT technology. **Nucleic acids (NA):** *Isolation and purification* (biological sources/tissues – storage and homogenization; protection provisions; NA precipitation and centrifugation; electrophoresis and isolation of NA; chromatography; subtraction). *Construction of gene library/bank* (restriction enzymes, cutting and joining DNA molecules, partial digestion, PCR methods; vectors and DNA transfer, DNA cloning in various host cells, selection of recombinant clones; genomic and cDNA libraries). *Gene library screening* (gene specific probes, colony hybridization, expression libraries; RFLP, positional cloning, chromosome walking/jumping). *DNA sequencing* (Sanger method, post-genomic approaches – automatization). *Characterization of NA* (restriction analysis, Southern and Northern blotting; comparative sequence analysis; genetic polymorphisms and mutation analysis). *Mutagenesis* (random and site-specific mutagenesis; protein engineering). *Heterologous gene expression* (fusion proteins, secretion; mRNA analysis, RT-PCR, *in situ* hybridization, FISH; DNA fingerprinting; yeast two-hybrid system; differential screening, phage display, qPCR, DNA microarrays (biochips)). *Transgenesis* (methods; gene silencing). *Genome editing* (CRISPR/Cas, gene therapy, immunotherapy/CAR-T). *Genome analysis* (genome maping and sequencing, comparative genomics; transcriptomics). *Bioinformatics, databases and Internet.* |

Temeljna literatura in viri/Readings:

WILLSON, K., WALKER, J. (Eds.), 2005. Principles and Techniques of Biochemistry and Molecular Biology; 6th Edition. Cambridge University Press, Cambridge (U.K.), 783 str., ISBN 0-521-82889-9.

S. B. Primrose and R. M. Twyman (2006): Principles of Gene Manipulation and Genomics; 7th Edition. Blackwell Publishing, Malden (U.S.A.), Oxford (U.K.), Carlton (Austr.), 390 str., ISBN: 1-4051-3544-1.

Zapiski predavanj, revijalni članki s področja, tekoča periodika, druga učna gradiva.

| Cilji in kompetence: | Objectives and competences: |
|---|---|
| Temeljni izobraževalni cilj je seznanitev študentov z metodami in tehnikami sodobne biokemije in molekularne biologije s posebnim poudarkom na tistih, ki se uporabljajo v tako imenovani 'sodobni biotehnologiji'. Predmet usmerja študenta k samostojnemu teoretičnemu (analiza literature, reševanje problemov, sinteza zaključkov) in eksperimentalnemu delu (organiziranje in načrtovanje dela). | The main educational goal is to familiarize students with the contemporary methods and techniques of biochemistry and molecular biology especially emphasising those used in the so-called “modernbiotechnology”. The course directs students to autonomous theoretical (analysis of literature, problem solving, formulation of conclusions) and experimental work (organization and planning of the work). |

| Predvideni študijski rezultati: | Intended learning outcomes: |
|---|---|
| Študent spozna ali poglobi znanje o metodah in tehnikah analize proteinov in nukleinskih kislin. Predmet usmerja študenta k uporabi pridobljenega znanja v temeljnih ali aplikativnih raziskavah na področju njegovega raziskovalnega ali razvojnega dela. Usmerja ga k samostojnemu načrtovanju analitskih postopkov, reševanju problemov z organiziranjem in načrtovanjem eksperimentalnega dela. | Student learns or deepens the knowledge about methods and techniques for analysis of proteins and nucleic acids.-The course leads student towards application of the acquired knowledge in his research or developmental work. It teaches students to devise their analytical procedures and to resolve their research problems by organizing and designing their experimental work autonomously. |

| Metode poučevanja in učenja: | Learning and teaching methods: |
|---|---|
| Predavanja, vodene diskusije, problemsko-zasnovano učenje, demonstracije v laboratoriju, konzultacije. | Lectures, moderated discussions, problem-based learning, laboratory demonstrations, consultations. |

| Načini ocenjevanja: | Delež/Weight | Assessment: |
|---|---|---|
| Ustni izpit. | 100,00 % | Oral examination. |

Reference nosilca/Lecturer's references:

**Igor Križaj**

Latinović, Z., Leonardi, A., Koh, C.Y., Kini, R.M., Trampuš Bakija, A., Pungerčar, J. and **Križaj, I.** (2020): The procoagulant snake venom serine protease potentially having a dual, blood coagulation factor V and X-activating activity. *Toxins* 12(6), 358.

Lang Balija M., Leonardi, A., Brgles, M., Sviben, D., Kurtović, T., Halassy, B. and **Križaj, I.** (2020): Biological activities and proteomic profile of the venom of *Vipera ursinii* ssp., a very rare karst viper from Croatia. *Toxins* 12(3), 187.

Leonardi, A., Sajevic, T., Pungerčar, J. and **Križaj, I.** (2019): A comprehensive study of the proteome and transcriptome of the venom of the most venomous European viper: Discovery of a new subclass of ancestral snake venom metalloproteinase precursor-derived proteins. *J. Proteome Res.* 18, 2287–2309.

Šribar, J., Kovačič, L., Oberčkal, J., Ivanušec, A., Petan, T., Fox, J.W. and **Križaj**, **I.** (2019): The neurotoxic secreted phospholipase $A_2$ from the *Vipera a. ammodytes* venom targets cytochrome c oxidase in neuronal mitochondria *Sci. Rep.* 9, 293.

Latinović, Z., Leonardi, A., Kovačič, L., Koh, C.Y., Šribar, J., Trampuš Bakija, A., Venkateswarlu D., Kini, R.M. and **Križaj, I.** (2018): The first intrinsic tenase complex inhibitor with serine protease structure offers a new perspective in anticoagulant therapy. *Thromb. Haemost.* 118(10), 1713–1728.

Latinović, Z., Leonardi, A, Šribar, J., Sajevic, T., Žužek, C.M., Frangež, R., Halassy, B., Trampuš-Bakija, A., Pungerčar, J. and **Križaj, I.** (2016): Venomics of *Vipera berus berus*; an explanation of differences in pathology elicited by *Vipera ammodytes ammodytes* envenomation: Therapeutic implications. *J. Proteomics* 146, 34–47.

**Radovan Komel:**

Kastelic, D., Soler, N., Komel, R. and Pompon, D. (2013): The Global Sequence Signature algorithm unveils a structural network surrounding heavy chain CDR3 Loop in Camelidae variable domains. *Biochim. Biophys. Acta, Gen. Subj.* 1830, 3373–3381.
[doi: 10.1016/j.bbagen.2013.02. 014]

Berne, S., Podobnik, B., Zupanec, N., Novak M., Kraševec, N., Turk, S., Korošec, B., Lah, L., Šuligoj, E., Stojan, J., Gobec, S. and Komel, R. (2012): Virtual screening yields inhibitors of novel antifungal drug target, benzoate 4-monooxygenase. *J. Chem. Inf. Model.* 52, 3053–3063.
[doi: 10.1021/ci3004418]

Liović, M., Ožir, M., Bedina Zavec, A., Peternel, Š., Komel, R. and Zupančič, T. (2012): Inclusion bodies as potential vehicles for recombinant protein delivery into epithelial cells. *Microb. Cell Factories* 11, 67 [1–5].
[doi: 10.1186/1475-2859-11-67]

Lah, L., Podobnik, B., Novak, M., Korošec, B., Berne, S., Vogelsang, M., Kraševec, N., Zupanec, N., Stojan, J., Bohlman, J. and Komel, R. (2011): The versatility of the fungal cytochrome P450 monooxygenase system is instrumental in xenobiotic detoxification. *Mol. Microbiol.* 85, 1374–1389.
[doi: 10.1111/j.1365-2958.2011.07772.x]

Peternel, Š. and Komel, R. (2010): Isolation of biologically active nanomaterial (inclusion bodies) from bacterial cells. *Microb. Cell Factories* 9, 66 [1–16].
[doi: 10.1186/ 1475-2859-9-66]

Vogelsang, M., Comino, A., Zupanec, N., Hudler, P. and Komel, R. (2009): Assessing pathogenicity of MLH1 variants by co-expression of human MLH1 and PMS2 genes in yeast. *BMC Cancer* 9, 1–9.