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| <b>Study programme:</b> Astronomy and Astrophysics – PhD Studies   |
| <b>Course:</b> Astrobiology  |
| <b>Teacher or teachers:</b> Andjelka Kovačević   |
| <b>Status:</b> optional  |
| <b>ECTS credits:</b> 9   |
| <b>Requirements:</b> none  |
| <p><b>Course objective:</b> The course aims to present the detailed status of current research in astrobiology, which consists of topics in three overlapping areas: astrophysics and planetary sciences, geochemistry and geology, and molecular biology and biochemistry. This course aims to acquaint students with the main issues and results of astrobiological research. The course is also open to other interested postgraduates at the university.</p>   |
| <p><b>Course outcome:</b> Outcome 1: Mastering the main subfields of astrobiology and understanding their interdisciplinarity</p> <ul style="list-style-type: none"> <li>· Outcome 2: Ability to use and design advanced scientific, experimental, observational, computational, and theoretical methods appropriate to the subdisciplines of astrobiology to conduct independent scientific research.</li> <li>· Outcome 3: Mastering the techniques of presenting the results of scientific analysis in written and oral form at a professional level.</li> <li>· Outcome 4: Understanding of current areas of research, and key open questions and the most important scientific papers within astrobiology.</li> </ul> |

**Course description:**

## Theoretical classes

Astrophysics and planetaristic: Characterization of super-Earths and terrestrial exoplanets, planetary habitability and habitable zones, the formation of terrestrial planets, the search for life in the solar system, the origin of water and biomolecules on the planets, the early evolution of Earth and Mars, biology of life as we know it: analogous sites for extremophiles, subterranean living environments, mineral and isotopic records of the evolution of life, biomolecules and the first cells, extreme ecosystems, the origin of life, the RNA world, the evolution of life on Earth. Habitability of galaxies: Types of galaxies and their structure, Evolution of galaxies by components: (stellar, gaseous and interstellar) - Metallicity and planet formation, Continuous habitability: terminal explosions of stellar objects and dynamic stellar components, Galactic habitable zone, N-body simulation and galaxy habitability Application of cellular automata in galaxy habitability simulations, Cosmological aspects of habitability (Continuity thesis, Cosmological simulations and trees,), Astrobiological landscapes, phase transitions, Characteristic time scales and astrobiological complexity, Astrobiology and SETI, Macroengineering and Kardashian scale, SETI via messages Hypothesis on panspermia and SETI.

## Practical teaching

Programming in the domain of cellular automata for galaxy habitability simulations, statistical data processing of large databases of extrasolar planets in the Python language.

**Recommended literature:**

- Schiff, J.L., Introduction to Cellular Automata, [http://psoup.math.wisc.edu/pub/Schiff\\_CAbook.pdf](http://psoup.math.wisc.edu/pub/Schiff_CAbook.pdf)
- Kardashev, N.S., On the inevitability and the possible structures of supercivilizations, IN: The search for extraterrestrial life: Recent developments; Proceedings of the Symposium, Boston, MA, June 18-21, 1984 (A86-38126 17-88). Dordrecht, D. Reidel Publishing Co., 1985, p. 497-504. <http://articles.adsabs.harvard.edu/pdf/1985IAUS..112..497K>
- Wright, J.T., Dyson Spheres, 2020, Serbian Astronomical Journal, vol. 200, pp. 1-18 [https://ui.adsabs.harvard.edu/link\\_gateway/2020SerAJ.200....1W/ADS\\_PDF](https://ui.adsabs.harvard.edu/link_gateway/2020SerAJ.200....1W/ADS_PDF)
- Forgan, D. et al., Evaluating galactic habitability using high-resolution cosmological simulations of galaxy formation, 2017, International Journal of Astrobiology, Volume 16, Issue 1, pp. 60-73 [https://ui.adsabs.harvard.edu/link\\_gateway/2017IJAsB..16...60F/EPRINT\\_PDF](https://ui.adsabs.harvard.edu/link_gateway/2017IJAsB..16...60F/EPRINT_PDF)
- Ginsburg, I. et al., Galactic Panspermia, 2018, The Astrophysical Journal Letters, Volume 868, Issue 1, article id. L12, 6 pp. [https://ui.adsabs.harvard.edu/link\\_gateway/2018ApJ...868L..12G/PUB\\_PDF](https://ui.adsabs.harvard.edu/link_gateway/2018ApJ...868L..12G/PUB_PDF)
- Lineweaver, C. et al., The Galactic Habitable Zone and the Age Distribution of Complex Life in the Milky Way, 2004, Science, Volume 303, Issue 5654, pp. 59-62 [https://ui.adsabs.harvard.edu/link\\_gateway/2004Sci...303...59L/EPRINT\\_PDF](https://ui.adsabs.harvard.edu/link_gateway/2004Sci...303...59L/EPRINT_PDF)
- Andjelka Kovačević, 2016, Astrobiologija, izdavač: Matematički fakultet Univerziteta u Beogradu

**Total number of classes:**  
10

**Theoretical classes:** 4

**Practical classes:** 6

**Teaching methods:**

Part of the lecture will be standard frontal lectures, and the other part of the lecture will be "practical" sessions. Students will have to solve problems and exercises under the supervision of a teacher.

**Grading system (maximum number of points: 100)**

| <b>Pre-exam requirements</b> | points | <b>Final exam</b> | points |
|------------------------------|--------|-------------------|--------|
| Activity in class            |        | Written exam      |        |
| Practical work               | 30     | Oral exam         | 40     |
| Colloquia                    |        |                   |        |
| Seminars                     | 30     |                   |        |