



Univerza v Mariboru

Fakulteta za naravoslovje
in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Modeliranje v fiziki mehke snovi
Course title:	Modelling in soft matter physics

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
FIZIKA		1. ali 2.	1., 2. ali 4.
PHYSICS		1. or 2.	1., 2. or 4.

Vrsta predmeta / Course type

Izbirni za vse module

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Lab. vaje Laboratory work	Mentorstvo Mentorship	Samost. delo Individ. work	ECTS
15					165	6

Nosilec predmeta / Lecturer:

Samo Kralj

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenski/Slovenian in/and angleški s slovenskim
prevodom/English with translation in Slovenian
Vaje / Tutorial:

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

Predznanje iz klasične in moderne fizike, trdne snovi in iz matematične fizike

Prerequisites:

Preknowledge of classical and modern physics, solid state physics and mathematical methods in physics.

Vsebina:

- 1) Modeliranje: makroskopski, mezoskopski in semi-mikroskopski modeli
- 2) Tipične eksperimentalne meritve
- 3) Numerično modeliranje
- 4) Fizikalni pojavi: fazno obnašanje in kritični pojavi v sistemih z orientacijsko in

Content (Syllabus outline):

- 1) Modelling: macroscopic, mesoscopic, semi-microscopic models
- 2) Typical experimental measurements
- 3) Numerical modelling
- 4) Physical phenomena: phase behaviour and critical phenomena in systems exhibiting

translacijsko urejenostjo, neravnovesni pojavi, topološki defekti v mehki snovi, vpliv nereda na fazno in strukturno obnašanje

5) Aplikacije

orientational and translational ordering, non-equilibrium behaviour, topological defects in soft materials, impact of disorder on phase and structural ordering

5) Applications

Temeljni literatura in viri / Readings:

- 1) M. Kleman, O.D. Lavrentovich, *Soft Matter Physics*, Springer-Verlag, New York, 2003.
- 2) P. M. Chaikin, T. C. Lubensky, *Principles of Condensed Matter Physics*, Cambridge University Press, Cambridge, England, 1995.
- 3) G. Baumann, *Mathematica for Theoretical Physicists*, Springer-Verlag, Heidelberg, 1993.
- 4) R.L. Zimmerman, F.I. Olness, *Mathematica for Physicists*, Addison Wesley, New York, 2002.
- 5) K.F. Riley, M.P. Hobson, S.J. Bence, *Mathematical Methods for Physics and Engineering*, 3rd edition, Cambridge University Press, Cambridge, 2006

Cilji in kompetence:

Študenti poglobijo znanje s področja modeliranja v fiziki mehkih sistemov in povezavo z drugimi področji v fiziki.

Objectives and competences:

Students acquire advanced knowledge on modeling in physics of soft systems and universalities.

Predvideni študijski rezultati:

Znanje in razumevanje:
Razumevanje procesov v mehkih snovi.

Prenosljive/ključne spretnosti in drugi atributi:
Rešitev problemov z matematičnimi orodji, numeričnimi metodami, univerzalnosti v fiziki in celosten pristop k reševanju problemov.

Intended learning outcomes:

Knowledge and understanding:
Understanding of processes in soft systems.

Transferable/Key Skills and other attributes:
Solving of problems with mathematical tools, numerical methods, universalities in physics and gained global approach on solving a problem.

Metode poučevanja in učenja:

Predavanja, seminar, reševanje odprtih problemov.

Learning and teaching methods:

Lectures, seminar, solving open problems.

Načini ocenjevanja:

Delež (v %) /

Weight (in %) **Assessment:**

Način (pisni izpit, ustno izpraševanje, naloge, projekt)		Type (examination, oral, coursework, project):
3 seminarji Ustni izpit	50% 50%	3 Seminars Oral exam

Reference nosilca / Lecturer's references:

1. MESAREC, Luka, KURIOZ, Pavlo, IGLIČ, Aleš, GÓZDŽ, Wojciech, KRALJ, Samo. Curvature-controlled topological defects. *Crystals*, ISSN 2073-4352, 2017, vol. 7, no. 6, str. 1-11, ilustr. <http://www.mdpi.com/2073-4352/7/6/153>, doi: [10.3390/cryst7060153](https://doi.org/10.3390/cryst7060153). [COBISS.SI-ID [11753556](https://www.cobiss.si/id/11753556)]
2. HARKAI, Saša, AMBROŽIČ, Milan, KRALJ, Samo. Impact of diffusion limited aggregates of impurities on nematic ordering. *Physica. A, Statistical mechanics and its applications*, ISSN 0378-4371. [Print ed.], 2017, vol. 467, str. 249-256, doi: [10.1016/j.physa.2016.10.001](https://doi.org/10.1016/j.physa.2016.10.001). [COBISS.SI-ID [22772744](https://www.cobiss.si/id/22772744)]
3. KRALJ, Samo, MURRAY, Bryce S., ROSENBLATT, Charles. Decomposition of strongly charged topological defects. *Physical review. E*, ISSN 2470-0045, 2017, vol. 95, iss. 4, str. 042702-1-042702-9, doi: [10.1103/PhysRevE.95.042702](https://doi.org/10.1103/PhysRevE.95.042702). [COBISS.SI-ID [23098888](https://www.cobiss.si/id/23098888)]
4. MAKSIMOCHKIN, Gennady I., SHMELIOVA, Dina V., PASECHNIK, Sergey V., DUBTSOV, Alexander, SEMINA, O. A., KRALJ, Samo. Orientational fluctuations and phase transitions in 8CB confined by cylindrical pores of the PET film. *Phase transitions*, ISSN 0141-1594, 2016, vol. 89, no. 7/8, str. 846-855, doi: [10.1080/01411594.2016.1199802](https://doi.org/10.1080/01411594.2016.1199802). [COBISS.SI-ID [22500872](https://www.cobiss.si/id/22500872)]
5. MESAREC, Luka, GÓZDŽ, Wojciech, IGLIČ, Aleš, KRALJ, Samo. Effective topological charge cancelation mechanism. *Scientific reports*, ISSN 2045-2322, 2016, vol. 6, art. no. 27117, str. 1-9, ilustr. <http://www.nature.com/articles/srep27117>, doi: [10.1038/srep27117](https://doi.org/10.1038/srep27117). [COBISS.SI-ID [22256136](https://www.cobiss.si/id/22256136)]
6. BUČEK, Slavko, KRALJ, Samo, SLUCKIN, T. J. Hysteresis in Two-Dimensional Liquid Crystal Models. *Advances in Condensed Matter Physics*, ISSN 1687-8124. [Spletna izd.], 2015, vol. 2015, str. 1-10. <http://www.hindawi.com/journals/acmp/2015/834867/>. [COBISS.SI-ID [11869235](https://www.cobiss.si/id/11869235)]