UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet	Napredna fizika trdne snovi
Course name	Advanced solid state physics

Študijski program in stopnja Study program and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Fizika in Astrofizika II. stopnja	Fizika trdne snovi	1	/
Physics and Astrophysics II. level	Solid state physics	1	/

Vrsta predmeta / Course type	obvezni / mandatory
Univerzitetna koda predmeta / University course code	2FTS06

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Lab. work	Teren. vaje Field work	Samost. delo Indiv. work	ECTS
45	/	45	/	/	180	9

Nosilec predmeta / Lecturer	doc. dr. Layla Martin-Samos Colomer	
Jeziki / Languages	**Predavanja / Lectures**	slovenščina / English
	Vaje / Tutorial	slovenščina / English

Pogoji za opravljanje študijskih obveznosti	Prerequisites
Fizika trdne snovi Kvantna mehanika	Solid state physics Quantum mechanics

Vsebina	Syllabus outline
1. Klasifikacija Bravaisovih struktur in kristalne strukture 2. Elektronska stanja v periodičnem potencialu 3. Elektroni v šibkem periodičnem potencialu 4. Metoda močnih vezi 5. Druge metode računanja energijskih pasov 6. Semiklasični model elektronske dinamike 7. Semiklasična teorija prevodnosti v kovinah 8. Opustitev aproksimacije relaksacijskega časa 9. Opustitev aproksimacije neodvisnih elektronov: Hartree; Hartree-Fock; Dielektrična funkcija; Thomas-Fermijevo in Linhardtov model senčenja; Senčenje in HF aproksimacija; Teorija fermijevih tekočin 10. Izbrana poglavja modernih opisov elektronskih korelacij: teorija perturbacije med	1. Classification of Brvais Lattices and Crystal Structures 2. Electron levels in a periodic potential 3. Electrons in a weak potential 4. The tight binding Method 5. Other methods for calculating Band structures 6. The semi-classical model of electrons dynamics 7. The semi-classical theory of conduction in metals 8. Beyond the relaxation-time approximation 9. Beyond the independent electron approximation: Hartree; Hartree-Fock; The dielectric function; Thomas-Fermi and Lindhard Screening; Frequency dependent Lindhard Screening; Screening the HF approximation;

več telesi; teorija zlepkov (DFT); DMFT	Fermi Liquid Theory 10. Select topics of modern approaches to electronic correlations: Many-Body Perturbation Theory; Density Functional Theory; DMFT

Temeljni literatura in viri / Basic readings
N. W. Ashcroft, N. D. Mermin, Solid state Physics, Saunders Co. (1976)

Cilji in kompetence	**Objectives and competences**
Študenti bodo poglobili znanje in spoznali aplikativne primere klasičnega in kvantnega opisa elektronskih lastnosti trdnin. Študenti se bodo seznanili z fundamentalnimi znanji fizike trdne snovi in modernimi pristopi, ki se uporabljajo za opis elektronskih korelacij v fiziki trdne in mehke snovi.	Students will get a deeper insight on applications of classical and quantum descriptions to explain electronic properties of solids. The Students will be introduced to the foundations of solid state physics and to the modern approaches that are in use for describing electronic correlations in solids and soft-matter.

Predvideni študijski rezultati	**Intended learning outcomes**
Študenti bodo spoznali osnovne koncepte elektronskih lastnosti kovin. Znali bodo matematično in fizikalno opisati fundamentalne lastnosti transporta. Razumeli bodo razliko med kovinami, polprevodniki in izolatorji, poznali bodo fenomen senčenja Razumeli bodo fenomene, ki se pojavijo v trdninah in/ali v mehki snovi	Students will obtain fundamental concepts of electronic properties of metals. They will be able to describe mathematically and physically fundamental transport properties. They will be able to understand the difference beween metals, semi-conductors and insulators (screening effects) They will be able to understand the basic phenomena that take place in a solid and/or soft-matter material

Metode poučevanja in učenja	**Learning and teaching methods**
- predavanja, vaje, domače naloge	- lectures, tutorial, homework

Načini ocenjevanja	**Utež / Weight (%)**	**Assessment**
- domače naloge - pisni izpit - ustni izpit	33 33 34	- homework - written exam - oral exam

Reference nosilca / references of the course principal
Doc. dr. Layla Samos Colomer je docentka za področje fizike na Univerzi v Novi Gorici. Layla Colomer Samos is assistant professor of physics at the University of Nova Gorica.

Izbrane objave / selected publications:

1. MA, Changru, MARTIN-SAMOS, Layla, FABRIS, Stefano, LAIO, Alessandro, PICCININ, Simone. QMMMW : a wrapper for QM/MM simulations with Quantum ESPRESSO and LAMMPS. *Computer physics communications*, ISSN 0010-4655. [Print ed.], 2015, vol. 195, str. 191-198, ilustr., doi: 10.1016/j.cpc.2015.04.024. [COBISS.SI-ID 4028667]

2. GIACOMAZZI, Luigi, MARTIN-SAMOS, Layla, BOUKENTER, A., OUERDANE, Y., GIRARD, S., RICHARD, Nicolas. Ge(2), Ge(1) and Ge-E´ centers in irradiated Ge-doped silica : a first-principles EPR study. *Optical materials express*, ISSN 2159-3930. [Online ed.], 2015, vol. 5, iss. 5, str. 1054-1064, ilustr., doi: 10.1364/OME.5.001054. [COBISS.SI-ID 4028923]

3. MARTIN-SAMOS, Layla, BUSSI, Giovanni, RUINI, Alice, MOLINARI, Elisa, CALDAS, Marília J. SiO [sub] 2 in density functional theory and beyond. *Physica status solidi. B, Basic research*, ISSN 0370-1972, 2011, vol. 248, no. 5, str. 1061-1066. [COBISS.SI-ID 2238203]

4. MARTIN-SAMOS, Layla, ROMA, G., RINKE, P., LIMOGE, Y. Charged oxygen defects in SiO [sub] 2 : going beyond local and semilocal approximations to density functional theory. *Physical review letters*, ISSN 0031-9007. [Print ed.], feb. 2010, vol. 104, no. 7, str. 075502-1-075502-4. [COBISS.SI-ID 2235899]

5. MARTIN-SAMOS, Layla, LIMOGE, Y., CROCOMBETTE, J. P., ROMA, G. Neutral self-defects in a silica model : a first-principles study. *Physical review. B, Condensed matter and materials physics*, ISSN 1098-0121, 2005, vol. 71, no. 1, str. 014116-1-014116-12. [COBISS.SI-ID 2238715]