Univerza v Mariboru
University of Maribor

Fakulteta za naravoslovje in matematiko
Faculty of Natural Sciencies and Mathematics

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION	
Predmet:	Kompleksne tekočine pod ekstremnimi pogoji
Subject Title:	Complex fluids under extreme conditions

Študijski program **Study programme**	**Študijska smer** **Study field**	**Letnik** **Year**	**Semester** **Semester**
FIZIKA PHYSICS	-	1 ali 2	**1 ali 2**

Univerzitetna koda predmeta / University subject code:

Predavanja **Lectures**	**Seminar** **Seminar**	**Sem. vaje** **Tutorial**	**Lab. vaje** **Labor work**	**Teren. vaje** **Field work**	**Samost. delo** **Individ. work**	**ECTS**
15	**10**				**125**	**5**

Nosilec predmeta / Lecturer: Sylwester J. Rzoska

Jeziki / Languages:	
Predavanja / Lecture:	slovenski/Slovenian in/and angleški s slovenskim prevodom/English with translation in Slovenian
Vaje / Tutorial:	slovenski/Slovenian in/and angleški s slovenskim prevodom/English with translation in Slovenian

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

Predznanje iz klasične in moderne fizike ter trdne snovi.

Prerequisits:

Preknowledge of classical and modern physics, solid state physics.

Vsebina:

1) Linearna in nelinearna dielektrična spektroskopija v tlačenih tekočih kristalih:
Predavanja bodo fokusirana na podatke, ki jih da kombinirana temperaturna in tlačna analiza z uporabo linearne in nelinearne dielektrične spektroskopije. Posebna pozornost bo posvečene nedavnem odkritju, da lahko obravnavamo izotropno fazo kot kompleksno tekočino, ki izkazuje steklasto in set kritičnih obnašanj. Tlačne analize bodo posegale iz področja negativnih tlakov, do ekstremno visokih tlakov v MPa domeni.
2) Termodinamika in pretranzicijsko obnašanje kritičnih binarnih mešanic v temperaturno-tlačnih analizah:
Predavanja bodo najprej predstavila probleme z mešanjem in spremljajočimi pretranzicijskimi pojavi. Nadalje se bomo osredotočili na pojave, ki jih sproži prisotnost tlaka, izhajajoč iz razpetih tekočin (negativni tlak) do izjemno visokih pozitivnih tlakov. Poleg faznega diagrama mešanic bomo preučili tudi predtranzicijske pojave, ki jih zaznamo z linearno in nelinearno dielektrično metodo. Preučevali bomo nizko molekularne kritične mešanice in kritične spojine.
3) Podhlajene steklaste tekočine pod visokimi tlaki:
Podhlajene steklaste tekočine predstavljajo ene izmed aktualnih področij kondenzirane materije. Najprej bomo preučili splošne značilnosti takšnih sistemov. Nato bomo

Content (Syllabus outline):

1) Linear and nonlinear dielectric spectroscopy in pressurized liquid crystalline materials:
These lectures will focus on the evidence gain from comprehensive pressure and temperature studies based on linear and nonlinear dielectric spectroscopy. Particular attention will be paid to the up-to-date clear evidence that the isotropic phase as well lying below mesophase can be considered as the model complex liquids, exhibiting glassy dynamics and a set of critical – like behavior. The application of pressure will cover the unusual range from negative pressures to the extreme GPa domain.
2) Thermodynamics and pretranitional behavior of critical, binary mixtures in comprehensive pressure – temperature studies:
These lecture will present firstly general problems associated with miscibility and related pretransitional phenomena. Next they will focus on properties induced via the application of pressure , starting from the stretched – liquid (negative pressures) to very high (positive) pressures). Apart from the miscibility and phase diagrams, particular attention will be paid to pretransitional phenomena, with the focus on the ones associated with linear and nonlinear dielectric method. The discussion will cover both low-molecular critical mixtures and critical blends.

predstavili moderne rezultate, z novim pogledom na stanje snovi, s poudakom na dinamičnih testih pod velikimi tlaki in nelinearno dielektrično spektroskopijo. Na GPa območju dielektričnih meritev nizkomolekularnih in polimernih steklastih materialov je naša skupina vodilna v svetu.	3) Supercooled glassforming liquids under high compression: Supercooled, glassforming liquids are one of the most challenging filed of the modern condensed matter. Firstly general properties of such systems will be discussed. Next lectures the most modern results, giving novel insight into phenomenon will be presented, with the focus on dynamics tests under very high pressure and on nonlinear dielectric spectroscopy. This will be based on experience of our groups, the only group entering the GPa domain in dielectric tests on low-molecular and polymeric glassformers at present.

Temeljni literatura in viri / Textbook:

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) S. J. Rzoska, V. Zhelezny, Phase behavior of perturbed liquid crystals, ARW NATO Sci. Series: Nonlinear Dielectric Phenomena in Complex Liquids, Kluwer, Brussels, 2004.
4) Članki v Science, Nature, Scientific American.

Cilji:	**Objectives:**
Študenti poglobijo znanje s področja fizike mehkih sistemov pod ekstremnimi pogoji.	Students acquire advanced knowledge on physics of soft systems under extreme conditions.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Razumevanje procesov v mehkih sistemih pod ekstremnimi pogoji. Prenesljive/ključne spretnosti in drugi atributi: Različni eksperimentalni pristopi, univerzalnosti v fiziki in celosten pristop k reševanju problemov.	Knowledge and Understanding: Understanding of processes in soft systems under extreme conditions. Transferable/Key Skills and other attributes: Different experimental methods, universalities in physics and gained global approach on solving a problem.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminar.	Lectures, seminar.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Seminar	**100**	Seminar