Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Termodinamika
Course title:	Thermodynamics

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Enovit magistrski študijski program druge stopnje Predmetni učitelj	/	2	4
Five-year master's degree program Subject Teacher	/		

Vrsta predmeta / Course type Obvezni/Obligatory

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Lab. vaje Laboratory work	Terenske vaje Field work	Samost. delo Individ. work	ECTS
20		20			50	3

Nosilec predmeta / Lecturer: Milan Brumen

Jeziki / Languages:		
	Predavanja / Lectures:	slovenski, angleški
	Vaje / Tutorial:	slovenski, angleški

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

Predznanje iz mehanike.

Prerequisits:

Preknowledge of mechanics.

Vsebina:

Termodinamični sistemi, spremenljivke in

makroskopsko stanje sistema. Ničti zakon termodinamike, temperatura in toplotno

raztezanje snovi.

1. zakon termodinamike, notranja energija, delo in toplota.

2. zakon termodinamike in entropija, Carnotova krožna sprememba idealnega plina in izkoristek idealnega toplotnega stroja.

Content (Syllabus outline):

Thermodynamic systems, macroscopic state and state variables. The zeroth law of hermodynamics, temperature and thermal expansion.The first law of thermodynamics, internal energy, work and heat. The second law of thermodynamics and entropy. The Carnot cycle and the efficiency of an ideal heat

engine. The ideal gas as an example. The equation of state and state variables changes at different conditions. Microscopic model of the ideal gas, its microscopic state. Kinetic theory of ideal gases, the equipartition of energy. The Maxwell speed

Izbran termodinamični sistem: idealni plin, enačba stanja in spremembe makroskopskega stanja pri različnih pogojih. Mikroskopski model idealnega plina in njegovo mikroskopsko stanje. Kinetična teorija idealnega plina in ekviparticijski teorem. Maxwellova hitrostna porazdelitev.Specifična toplota pri konstantnem tlaku in konstantnem volumnu eno in večatomnega idealnega plina. Statistična definicija entropije in termodinamčni zakoni v statistični interpretaciji. Statistična interpretacija termodinamičnega ravnovesnega stanja. Termodinamični potenciali in principa minimalne proste energije ter maksimalne entropije. Kemijski potencial in ravnovesje faz. Fazni prehodi. Neravnovesna termodinamika, tokovi in gonilne sile, Onsagerjeve relacije. Spontani procesi. Difuzija snovi. Prevajanje toplote: prevajanje, konvekcija, sevanje.	distribution. Specific heat of ideal gases at constant volume and constant pressure. Statistical definition of entropy, statistical interpretation of thermodynamics laws. Statistical interpretation of hermodynamic equilibrium. Thermodynamic potentials, the principles of minimum free energy and maximum entropy. Chemical potential, phase equilibrium, phase transitions. Nonequilibrium thermodynamics, fluxes and driving forces, nsager relations. Spontaneous processes. Diffusion. The transfer of heat: conduction, convection and radiation.

Temeljni literatura in viri / Readings:

- D. Haliday, R. Resnick, J. Walker: Fundamentals of Physics, extended, with Modern Physics, John Wiley & Sons 1993.
- Reif: Statistical Physics, Berkeley Physics Course, Volume 5, McGraw-Hill, 1967; nemški prevod, dopolnjeno, Friedr. Vieweg & Sohn, 1990.
- J. Strnad: Fizika 1. del: Mehanika, Toplota, Društvo matematikov, fizikov in astronomov Slovenije 1995.

Cilji in kompetence:	**Objectives and competences:**
Študenti osvojijo osnovno znanje s področij toplotnih pojavov in njihovih interpretacij z osnovnimi metodami in koncepti statistične mehanike.	Students acquire basic knowledge from thermodynamic phenomena and their interpretation with basic concepts and methods of statistical mechanic.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Razumevanje osnovnih procesov v naravi na makroskopski in mikroskopski ravni. Pri tem znajo kvantitativno opisati nekatere osnovne pojave.	**Knowledge and understanding:** Understanding of the basic processes in nature on the macroscopic as well as microscopic scale. They are able to describe some basic phenomena on quantitative level.

Prenesljive/ključne spretnosti in drugi atributi:	**Transferable/Key Skills and other attributes:**
Rešitev problemov z matematičnimi orodji in celosten pristop k reševanju problemov. Sposobnost prepoznati problem in ga eoretično obravnavati v okviru osnovnih metod statistične termodinamike.	Solving problems with mathematical tools, an integral approach to solving problems. Ability to identify problems and describe them theoretically within the scope of elementary methods of statistical thermodynamics.

Metode poučevanja in učenja:	**Learning and teaching methods:**
- predavanja z demonstracijskimi poskusi - računske vaje, tudi ob uporabi računalniških uporabniških programov	- lectures with experiments - tutorial, with the use of relevant computer softwar

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt)		Type (examination, oral, coursework, project):
2 pisna kolokvija ali pisni izpit	**50**	Two written tests or written exam
ustni izpi	**50**	oral exa

Reference nosilca / Lecturer's references:

REPNIK, Robert, MATHELITSCH, Leopold, SVETEC, Milan, KRALJ, Samo. Physics of defects in nematic liquid crystals. *Eur. j. phys.*, 2003, 24, str. 481-491, ilustr. [COBISS.SI-ID 12755208]

BRADAČ, Zlatko, KRALJ, Samo, SVETEC, Milan, ŽUMER, Slobodan. Annihilation of nematic point defects : postcollision scenarios. *Phys. rev., E Stat. phys. plasmas fluids relat.*, 2003, 67, str. 050702-1-050702-4. [COBISS.SI-ID 1666404]

SVETEC, Milan, BRADAČ, Zlatko, KRALJ, Samo, ŽUMER, Slobodan. Hedgehog annihilation in a confined nematic liquid crystal : [presented at 19th International Liquid Crystal Conference ILCC2002,

Edinburgh]. *Mol. cryst. liq. cryst. (Phila. Pa. : 2003)*, 2004, 413, str. 43/[2179]-51[2187]. [COBISS.SI-ID 1743460]

SVETEC, Milan, KRALJ, Samo, BRADAČ, Zlatko, ŽUMER, Slobodan. Annihilation of nematic point defects : pre-collision and post-collision evolution. *The European physical journal. E, Soft matter*, 2006, vol. 19, issue 5. [COBISS.SI-ID 14632712]

SVETEC, Milan, SLAVINEC, Mitja. Structural transition of nematic liquid crystal in cylindrical capillary as a result of the annihilation of two point defects. *J. chem. phys.*, 2008, vol. 128, no. 8, str. 084704-1-084704-6, ilustr.http://link.aip.org/link/?JCPSA6/128/084704/1, http://dx.doi.org/10.1063/1.2839301. [COBISS.SI-ID 15899400]