Univerza v Mariboru
University of Maribor

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION	
Predmet:	**Termodinamika**
Subject Title:	Thermodynamics

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Fizika Physics		1	**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
30		30			90	**5**

Nosilec predmeta / Lecturer: Milan Brumen, Aleš Fajmut

Jeziki / Languages:	
Predavanja / Lecture:	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.
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

Content (Syllabus outline):

Thermodynamic systems, macroscopic state and state variables.
The zeroth law of thermodynamics, 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 distribution.
Specific heat of ideal gases at constant volume and constant pressure.
Statistical definition of entropy, statistical interpretation of thermodynamics laws.
Statistical interpretation of thermodynamic equilibrium.
Thermodynamic potentials, the principles of minimum free energy and maximum entropy.
Chemical potential, phase equilibrium, phase transitions.
Nonequilibrium thermodynamics, fluxes and driving forces, Onsager relations.

sile, Onsagerjeve relacije. Spontani procesi. Difuzija snovi. Prevajanje toplote: prevajanje, konvekcija, sevanje.	Spontaneous processes. Diffusion. The transfer of heat: conduction, convection and radiation.

Temeljni literatura in viri / Textbooks:

D. Haliday, R. Resnick, J. Walker: Fundamentals of Physics, extended, with Modern Physics, John Wiley & Sons 1993.
F. 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:	**Objectives:**
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 mechanics.

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. Prenesljive/ključne spretnosti in drugi atributi: Rešitev problemov z matematičnimi orodji in celosten pristop k reševanju problemov. Sposobnost prepoznati problem in ga teoretično obravnavati v okviru osnovnih metod statistične termodinamike.	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. Transferable/Key Skills and other attributes: 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 software

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
2 pisna kolokvija ali pisni izpit	**50%**	Two written tests or written exam
ustni izpit	**50%**	oral exam