Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	**Fizika za matematike**
Course title:	Physics for mathematicians

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Matematika		**3.**	**6.**
Mathematics		**3.**	**6.**

Vrsta predmeta / Course type

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
45		**30**	**15**		**90**	**6**

Nosilec predmeta / Lecturer: Mitja SLAVINEC

Jeziki / Languages:	
Predavanja / Lectures:	SLOVENSKO/SLOVENE
Vaje / Tutorial:	SLOVENSKO/SLOVENE

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

Jih ni.

Prerequisits:

There are none.

Vsebina:

Vsebina predavanj:

1. Newtonovi zakoni gibanja; ohranitveni zakoni gibalne količine, vrtilne količine in energije.
Gravitacija: Keplerjevi zakoni gibanja planetov, Newtonov zakon gravitacije.
Nihanje: harmonični oscilator. Valovanje: zvok.

2. Statistična termodinamika:
zakoni termodinamike; kinetična teorija plinov; Maxwellova hitrostna porazdelitev; statistična interpretacija zakonov termodinamike.

Content (Syllabus outline):

Lectures:

1. Newton's laws of motion; conservation laws of momentum, angular momentum and energy.
Gravitation: Kepler's laws of planetary motion, Newton's law of gravitation.
Oscillations: harmonic oscillator. Waves: sound.

2. Statistical thermodynamics: laws of thermodynamics, kinetic theory of gases, Maxwell's velocity distribution, statistical interpretation of the laws of thermodynamics.

3. Electricity and magnetism:

3. Elektrika in magnetizem: električna sila, Coulombov zakon in koncept električnega polja; električni potencial in Poissonova enačba; električni tok, magnetno polje, Biot-Savartov zakon in Amperov zakon; časovno spremenljivo električno in magnetno polje; Faradayev zakon in Maxwellove enačbe.	the electric force, the Coulomb's law and the concept of the electric field; the electric potential and the Poisson's equation; electric current, magnetic field, the Biot-Savart law and the Ampere's law; in time changing electric and magnetic fields, the Faraday's law and the complete set of Maxwell's equations.
4. Elektromagnetno valovanje: svetloba. Lastnosti valovanja: odboj, lom, uklon in interferenca. Eksperimenti, ki jih valovna teorija svetlobe ne opiše: fotoefekt, Comptonov pojav, črtasti sevalni in absorpcijski spektri plinov, sevanje črnega telesa.	4. Electromagnetic waves: light. Wave properties: reflection, refraction, diffraction and interference. Experiments unable to be described in terms of the wave theory of light: the photoelectric effect, the Compton effect, emission and absorption line spectra of gases, the blackbody radiation.
5. Prehod na koncepte moderne fizike: koncept svetlobnega delca: foton; dvojnost delčnega in valovnega opisa svetlobe in materialnih delcev, de Brogliejeva valovna dolžina; Bohrov model vodikovega atoma.	5. Towards the concepts of modern physics: the concept of electromagnetic quantum: photon; the wave-particle duality of light and material particles, de Broglie waves; the model of hydrogen atom according to Bohr.
6. Osnovni koncepti kvantne fizike v Schrödingerjevem valovnem opisu: valovna funkcija, valovni paket, kvantizirana energijska stanja in kvantna števila, načelo nedoločenosti.	6. Basic concepts of quantum physics in Schrödinger's wave mechanics: the wave function, the wave packet, quantisation of energy states and quantum numbers, uncertainty principle.
7. Specialna teorija relativnosti: osnovni koncepti, Lorentzova transformacija, skrčitev dolžin in podaljšanje časa; energija in masa ter procesi v jedrski fiziki	7. The special theory of relativity: basic principles, the Lorentz transformation; time dilation and length contraction; energy and mass and the processes in nuclear physics.
Vsebina seminarjev: Izbrani zgledi iz zgoraj navedenih vsebin, poglobljeno obravnavani. Vsebina laboratorijskih vaj: 1. Gravitacija; merjenje gravitacijskega pospeška. 2. Harmonični oscilator: mehanska in elektromagnetna nihanja. 3. Preverjanje zakonov termodinamike. 4. Merjenje hitrostne porazdelitve delcev 5. Električno in magnetno polje. 6. Radioaktivnost in ionizirajoče sevanje 7. Dvojnost valovnega in delčnega opisa:	Seminars: Selected examples from topics of lectures elaborated in details. Labour works: 1. Gravitation; measurements of acceleration of falling objects. 2. Harmonic oscillator: mechanic and electromagnetic oscillations. 3. Experiments illustrating thermodynamic laws. 4. Measurements of velocity distribution of

interferenca svetlobe in elektronov. 8. Emisijski in absorpcijski črtasti spektri plinov.	particles 5. Electric and magnetic fields. 6. Radioactivity and ionising radiation 7. Wave-particle duality: interference of light and electrons. 8. Emission and absorption line spectra of gases.

Temeljni literatura in viri / Readings:

- R. Kladnik, Visokošolska fizika (1.del: mehanski in toplotni pojavi, 2. del: elektrika, atomika, 3. del: valovni pojavi), DZS, Ljubljana, 1989
- N. Garcia, A. Damask, Physics for computer science students, Springer Verlag, New York, 1991
- D. Halliday, R. Resnick, J. Walker, Fundamentals of physics, 5. Ed., John Wiley & Sons, New York, 1997
- M.S. Longair, Theoretical concepts in physics, Cambridge University Press, Cambridge, 1991
- R. Baierlein: Newton to Einstein: The trail of light, Cambridge University Press, Cambridge, 2001
- P. Stehle, Order, chaos, order. The transition from classical to quantum physics, Oxford University Press, Oxford, 1994

Cilji in kompetence:	**Objectives and competences:**
- Pregled osnovnih konceptov teoretične klasične in moderne fizike v perspektivi zgodovinskega razvoja idej in konceptov. Pri tem bo poudarek na interakciji med teorijo in eksperimentom ter vzporednim razvojem tehnologije. - Pomen ustreznih in tudi v zgodovinski perspektivi dostopnih matematičnih orodij za reševanje problemov teoretične fizike. Pri tem bo poudarjen pomen modela v fiziki, formulacije modela in potrebnih aproksimacij oziroma poenostavitev.	- Survey of basic concepts of theoretical classical and modern physics from the historical point of view of development of ideas and concepts. The interaction of theory and experiment with concomitant technological development will be emphasized. - To emphasize the importance of having available mathematical tools for solving problems of theoretical physics. The role of a model in physics, its formulation and related approximations and simplifications will be stressed.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • Študent razume obravnavane fizikalne zakonitosti, sposoben je kvantitativno opisati izbrane fizikalne probleme, napovedati rezultate z relevantnimi	Knowledge and Understanding: • A student understands laws in physics. He knows to formulate physical problems in a quantitative way, to make predictions by the use of relevant

matematičnimi modeli in jih interpretirati. Znanje in razumevanje: • Študent razume obravnavane fizikalne zakonitosti, sposoben je kvantitativno opisati izbrane fizikalne probleme, napovedati rezultate z relevantnimi matematičnimi modeli in jih interpretirati.	mathematical models and to interpret the predictions. Transferable/Key Skills and other attributes: • A student knows to apply the knowledge and tools in mathematics to cases in physics considered. He gets acquainted with basic methods of measurements in physics.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja Seminar Seminarske (računske) vaje Laboratorijske vaje	Lectures Seminar Tutorial, coursework Laboratory work

Načini ocenjevanja:		**Assessment:**
	Delež (v %) / Weight (in %)	
Ustni izpit Pisni izpit Praktično delo v laboratoriju	20% 50% 30%	Oral exam Written exam Practical work in laboratory

Reference nosilca / Lecturer's references:

1. ÜLEN, Simon, GERLIČ, Ivan, SLAVINEC, Mitja, REPNIK, Robert. Evaluating the effectiveness of physlet-based materials in supporting conceptual learning about electricity. Journal of science education and technology, ISSN 1059-0145, 2017, vol. 26, iss. 2, str. 151-160, tabele, doi: 10.1007/s10956-016-9661-1.

2. SLAVINEC, Mitja, REPNIK, Robert, KLEMENČIČ, Eva. The impact of moisture on thermal conductivity of fabrics = Meritve vpliva vlage na toplotno prevodnost tkanin. Anali PAZU, ISSN 2232-416X, nov. 2016, letn. 6, št. 1/2, str. 8-12, ilustr., graf. prikazi. http://www.anali-pazu.si/?q=sl/vsebina/meritve-vpliva-vlage-na-toplotno-prevodnost-tkanin.

3. SLAVINEC, Mitja, KLEMENČIČ, Eva, AMBROŽIČ, Milan, KRAŠNA, Marjan. Impact of nanoparticles on nematic ordering in square wells. Advances in condensed matter physics, ISSN 1687-8108, 2015, vol. 2015, art. ID 532745, str. 1-11, ilustr., doi: 10.1155/2015/532745.

4. ÜLEN, Simon, SLAVINEC, Mitja, GERLIČ, Ivan. Konceptualni pouk fizike v srednji šoli = Conceptual teaching of physics in secondary schools. Anali PAZU, ISSN 2232-416X, 2014, letn. 4, št. 1, str. 6-17, ilustr. http://www.anali-pazu.si/sites/default/files/Separat_Konceptualni_pouk....pdf.

5. ÜLEN, Simon, ČAGRAN, Branka, SLAVINEC, Mitja, GERLIČ, Ivan. Designing and evaluating the effectiveness of Physlet-based learning materials in supporting conceptual learning in secondary school physics. Journal of science education and technology, ISSN 1059-0145, 2014, vol. 23, iss. 5, str. 658-667, tabele, doi: 10.1007/s10956-014-9492-x.