Univerza v Mariboru

FAKULTETA ZA NARAVOSLOVJE IN MATEMATIKO
Koroška cesta 160
2000 Maribor, Slovenija
www.fnm.um.si

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Uvod v kvantno mehaniko
Course title:	Introduction to Quantum Mechanics

Študijski program in stopnja **Study programme and level**	**Študijska smer** **Study field**	**Letnik** **Academic year**	**Semester** **Semester**
Fizika, 1. stopnja		**3**	**5**
Physics, level 1		**3**	**5**

Vrsta predmeta / Course type	izbirni / elective
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**
40		**20**			**120**	**6**

Nosilec predmeta / Lecturer:	prof. dr. Nataša Vaupotič

Jeziki / Languages:	**Predavanja / Lectures:**	**slovensko / Slovenian**
	Vaje / Tutorial:	**slovensko / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Predznanje iz moderne fizike in osnov algebre.	Pre-knowledge of the Modern Physics and basic Algebra.

Vsebina:

- Matematična orodja v kvantni mehaniki: Hilbertov prostor in valovne funkcije, Diracova notacija, operatorji, delta-funkcija, reprezentacija v diskretni in zvezni bazi, transformacija med bazami.
- Postulati v kvantni mehaniki: stanje sistema, verjetnostna gostota, princip superpozicije, opazljivke in operatorji, merjenja v KM, pričakovane vrednosti, princip nedoločenosti, časovni razvoj sistema, simetrije in ohranitveni zakoni.
- 1D primeri: potencialni skok, potencialna jama, harmonični oscilator, numerično reševanje Schroedingerjeve enačbe.
- Vrtilna količina: orbitalna, spinska, skupna.
- 3D primer: vodikov atom

Content (Syllabus outline):

- Mathematical methods in quantum mechanics: Hilbert space and wave functions, Dirac notation, operators, delta function, representation in discrete and continuous bases, change of bases.
- Postulates in quantum mechanics: state of the system, probability density, principle of superposition, observables and operators, measurements in QM, expectation values, uncertainty relations, time evolution of the system's state, symmetries and conservation laws.
- One-dimensional problems: potential step, potential well, harmonic oscillator, numerical solutions of the Schrödinger equation.
- Angular momentum: orbital angular momentum, spin.
- Three-dimensional problems: H-atom.

Temeljni literatura in viri / Readings:

1. N. Zettili, Quantum Mechanics – Concepts and Applications (Wiley, Chichester, 2005).
2. M. C. Rogalski, S. B. Palmer, Quantum Physics (Gordon and Breach, Amsterdam, 1999).
3. D. J. Griffits, Introduction to Quantum Mechanics (Prentice Hall, Upper Saddle River, 1994).
4. Y. Peleg, R. Pnini, E. Zaarur, Schaum's outlines – Quantum Mechanics (McGraw Hill, New York, 1998).
5. katerakoli knjiga, ki ima v naslovu Kvantna mehanika ali Uvod v kvantno mehaniko ali Osnove kvantne mehanike…

Cilji in kompetence:

Študenti usvojijo temeljne koncepte kvantne mehanike.

Znajo kvantitativno obravnavati osnovne probleme moderne fizike ob uporabi dostopnih uporabniških matematičnih programov.

Objectives and competences:

Students learn the basic concepts of Quantum Mechanics.

Students can describe quantitatively the basic problems of modern physics. They become versatile in programming with mathematical software.

Predvideni študijski rezultati:

Intended learning outcomes:

Znanje in razumevanje:	Knowledge and Understanding:
Kvalitativno in kvantitativno razumejo osnove kvantne fizike.	Qualitative and quantitative understanding of quantum physics.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja	Lectures
Seminarske vaje	Theoretical excercises
Tutorsko delo	Tutorial work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
ustni kolokvij iz seminarskih vaj (opravljen ustni kolokvij je pogoj za pristop k pisnemu izpitu)	70%	oral test from theoretical exercises (this test is a condition to apply for the written exam)
pisni izpit	30%	Written exam

Reference nosilca / Lecturer's references:

1. SZCZYTKO, Jacek, VAUPOTIČ, Nataša, MADRAK, Karolina, SZNAJDER, Paweł, GÓRECKA, Ewa. Magnetic moment of a single metal nanoparticle determined from the Faraday effect. *Phys. rev., E Stat. nonlinear soft matter phys. (Print)*, 2013, vol. 87, no. 3, 033201-1-033201-6
2. SZCZYTKO, Jacek, VAUPOTIČ, Nataša, OPISOV, Mihail A., MADRAK, Karolina, GÓRECKA, Ewa. Effect of dimerization on the field-induced birefringence in ferrofluids. *Phys. rev., E Stat. nonlinear soft matter phys. (Print)*, 2013, vol. 87, no. 6, str. 062322-1-062322-6
3. VAUPOTIČ, Nataša, POCIECHA, Damian, GÓRECKA, Ewa. Polar and apolar columnar phases made of bent-core mesogens. *Top. curr. chem.*, 2012, vol. 318, str. 281-302
4. GUO, Lingfeng, VAUPOTIČ, Nataša, ČEPIČ, Mojca, GORNIK, Kristina. Ferroelectric behavior of orthogonal smectic phase made of bent-core molecules. *Phys. rev., E Stat. nonlinear soft matter phys. (Print)*, 2011, vol. 84, no. 3, str. 031706-1-031706-8
5. VAUPOTIČ, Nataša et al. Structure studies of the nematic phase formed by bent-core molecules. *Phys. rev., E Stat. nonlinear soft matter phys. (Print)*, 2009, vol. 80, no. 3, str. 030701-1-030701-4
6. VAUPOTIČ, Nataša, POCIECHA, Damian, ČEPIČ, Mojca, GOMOLA, Kinga, MIECZKOWSKI, Jozef, GÓRECKA, Ewa. Evidence for general tilt columnar liquid crystalline phase. *Soft matter*, 2009, vol. 5, no. 11, str. 2281-2285.
7. POCIECHA, Damian, VAUPOTIČ, Nataša, GÓRECKA, Ewa, MIECZKOWSKI, Jozef, GOMOLA, Kinga. 2-D density-modulated structures in asymmetric bent-core liquid crystals. *J. mater. chem. (Print)*. [Print ed.], 2008, vol. 18, no. 8, str. 881-885.