**Nazwa przedmiotu:**

Physics I

**Koordynator przedmiotu:**

dr inż. Cezariusz Jastrzębski

**Status przedmiotu:**

Obowiązkowy

**Poziom kształcenia:**

Studia I stopnia

**Program:**

Aerospace Engineering

**Grupa przedmiotów:**

Wspólne

**Kod przedmiotu:**

ANW126

**Semestr nominalny:**

6 / rok ak. 2009/2010

**Liczba punktów ECTS:**

3

**Liczba godzin pracy studenta związanych z osiągnięciem efektów uczenia się:**

**Liczba punktów ECTS na zajęciach wymagających bezpośredniego udziału nauczycieli akademickich:**

**Język prowadzenia zajęć:**

polski

**Liczba punktów ECTS, którą student uzyskuje w ramach zajęć o charakterze praktycznym:**

**Formy zajęć i ich wymiar w semestrze:**

|  |  |
| --- | --- |
| Wykład:  | 30h |
| Ćwiczenia:  | 0h |
| Laboratorium:  | 0h |
| Projekt:  | 0h |
| Lekcje komputerowe:  | 0h |

**Wymagania wstępne:**

Basic knowledge of mathematics and elementary course of physics

**Limit liczby studentów:**

**Cel przedmiotu:**

The objective of the subject is to acquaint students with elements of modern physics especially quantum mechanics and to present its recent history, importance in general word perception and particularly its importance in physics, chemistry, modern electronics and materials science. Another objective is to teach students the skills of defining correctly area of physics and nanoscience where classical approach fails and quantum mechanical approach is needed to understand the physical phenomena. The scope covered by the subject is basis of quantum mechanics and its applications in atomics physics , chemistry and materials science . Basic level skills of quantum mechanical problems solving complete the task.

**Treści kształcenia:**

Lecture 1 Fundamental assumptions of classical and quantum mechanics, where classical physics fails, blackbody radiation, Plancks formula, de Broglie waves, optical spectra of light atoms, photoelectric effect. Lecture 2 Electron and photons waves and particles. Thomson cathode ray experiment, e/m calculation. Compton effect. Light and photon diffraction. Wave particle duality solution, one and two slits electron diffraction. X-ray production and diffraction. Lecture 3. Uncertainity principle, energy uncertainity, momentum uncertainity, Quantum states. Expectation values. Superposition of states. Probability, wave function and Copenhagen interpretation. Examples. Lecture 4 Wave motion. Light and matter - Schrӧdinger equation. General solution of Schrӧdinger equation. Classical examples. Schrӧdinger equation of a free particle. Particle in a finite and infinite potential well. Lecture 5. Schrӧdinger equation continued.. Properties of valid wave function. Time independent Schrӧdinger equation. Stationary states.. Particle in a box. Potential barrier. Schrӧdinger equation solutions, classical and quantum approach. Reflection and transmission of electron wave. Wave particle duality solution, one and two slits electron diffraction. Lecture 6. Harmonic oscillator-recall. Classical and quantum solution of harmonic oscillator. equation. Analogy with optics. Application in nuclear physics. Alpha particle decay. Structure of the atom. Thomson model of atom. Rutherford scattering experiment. Rutherford model of atom Successes and failures. Bohr model of atom. The correspondence principle. Limitations of the Bohr model. Lecture 7. Schrӧdinger equation in three dimensions. Spherical coordinates. Separable solution. Solution of Schrӧdinger equation for hydrogen atom. Lecture 8 Quantum numbers in spherical coordinates, principal quantum number, magnetic (azimuthal) quantum number, spin quantum number. Magnetic effects on atomic spectra the Zeeman effect. Energy levels on electrons in atom. Optical spectra and selection rules. The role of spin. Lecture 9 Atomic structure many electron atoms. Electronic structure of many electron atoms. Building principle. The periodic table. Lecture 10 Molecules. Molecular bonding and spectra. Molecular bonds; ionic bonds, covalent bonds, Van der Waals bonds, hydrogen bonds, metallic bonds. Molecular orbitals, orbitals overlap, bonding and antibonding orbital. Classification of molecular states. Vibrations of molecules. Rotational and vibrational states Lecture 11 Quantum mechanics applications in solid state physics. Fourier analysis of solid state physics of crystals. Bloch theory of electron in a periodic crystal lattice. Energy bands. Velocity of electron in Bloch formalism. Effective mass. “Free” Bloch electrons vs. tight binding. Lecture 12 Crystal and amorphous solids. Dielectrics, semiconductors, metals. Fermi level. X-ray and neutron analysis of solids. Bragg formula. Electron diffraction in solid state physics. Surface analysis. RHEED. Lecture 13 Quantum mechanics applications in modern optics. Blackbody and laser. Stimulated and spontaneous emission. Inversion of electron population. Three and four step laser model.. Examples of lasers; gas laser semiconductor laser, cascade laser. Lecture 14 Analogy between optics and solid state physics. Optical constants-recall, wave equation and Schrӧdinger equation. Light in periodic structures. Photonic crystals. Energy gap in a crystal and in a photonic crystal. Lecture. 15 Entangled quantum states. Principles of quantum computing. Build a quantum computer, what it means. How to build it? Introduction to quantum cryptography.

**Metody oceny:**

e.g. , 100% exam

**Egzamin:**

**Literatura:**

To be decided later on the basis of availability of books, internet sources etc.

**Witryna www przedmiotu:**

**Uwagi:**

## Efekty przedmiotowe