Course descriptions

Course name: Physics of Information Technology and Bionics - II	Credits: 5
Class type: 3 + 1 hours per week:	
Type of the exam: Two mid term exams and final exam presentation	
Prerequisities (if exist): Final Exam from Mathematics (Matematika szigorlat)	
Course description:	
The Bohr model of the atom. Wave-particle duality of light. Interference and collision. Particle-wave duality of the electron. Louis de Broglie wave. Nature of the matter-wave: complex-valued wave-function with probabilistuic interpretation of the absolute square. Particles and waves: the free-particle Schrödinger equation. The Schrödinger Theory of Quantum Mechanics. The time-dependent Schrödinger equation. Quantum Mechnaical expectation values. The time-independent Schrödinger equation. Qualitative interpretation of the solutions of the Schrödinger equation. Elementary soleutions of the Schrödinger equation. Transmission of a particle through a potential barrier (quantum tunneling). The harmonic oscillator. The hydrogen atom. Principal, orbital, magnetis and spin quantum numbers. Features of the atomic wave functions. Periodic Table of the Elements. Molecules: the chemical bond. Principles of quantum mechanics. Quantum Statistics. Many body problem with negligible interactions. Systems of identical perticles: fermions and bosons. Microstate and macrostate in quantum statistcs: closed system. Thermodynamic prbability for bosons, fermions and classical molecules. Thermal equilibrium: the most probable macrostate. The Maxwell Boltzmann, the Bose Einstein and the Fermi Dirac statistics. Electron gas in a large “box”: distribution functions of the Fermi-Dirac statistics. The Sommerfeld model of metals. Thermal emission of electrons from metals: Richardson-Dushman equation. Single electron in electrostatic field of periodic potential. Potential in crystalline solids (Cubis, BCC and FCC crystals) The one-dimensional approximation: the Kronig-Penney model. Allowed and forbidden energy bands. The W(k) function. Energy bands derived from the splitting of 1s, 2s, 2p, 3s, 3p, etc. energy levels. Occupation of the bands by electrons at T = 0 in conductors and insulators. The effective mass The Fermi level of conductors. Qualitative description of Brillouin zones in silicon and GaAs. Intrinsic semiconductors: electrons and holes. Electron and hole densities in intrinsic semiconductors at thermal equilibrium . The Fermi level of intrinsic semiconductors. The principle of charge neutrality. Carrier densities and Fermi levels in n –type and p – type semiconductors. Carrier transport in semiconductors: drift and diffusion. Carrier generation and recombination in semiconductors. Metal – metal junction : the contact potential. Band scheme of a p – n junction diode : contact potential. Equilibrium currents across the p – n junction Interaction of an atom with electromagnetic radiation. Two-level atoms in resonant electromagnetic field Photon absorption, spontaneous emission and stimulated emission. Stimulated coherence. Light Amplification .by Stimulated Emission of Radiation (LASER). Three level and four level lasers. Photodetecting devices and semiconductor lasers.. Intruduction to quantum electrodynamics (QED) and Cirsuit QED.	
Required reading:	
Csurgay Árpád –Simonyi Károly, Az információtechnika fizikai alapjai, Mérnöktovábbképző, Budapest, 1997 David B. Miller, Quantum Mechanics for Scientists and Engineers, Cambridge University Press, 2008	
Recommended reading:	
Lecturer (*name, position, degree):* Professor Árpád Csurgay, DSc, Member of HAS	
Additional lecturers, if exist (*name, position, degree):* Imre Juhasz, PhD Student	