Course title: Understanding the Physics of the Hardware	**Neptun code:** **GEFIT421-a**
Course coordinator: Dr. Endre Kovács, PhD, associate professor	
type of lesson and number of lessons: **lecture (2)**	
method of evaluation: colloquium	
curriculum location of the subject: (autumn/spring semester): autumn and spring	
pre-study conditions *(if any)*: -	
The task and purpose of the subject:	
To understand the operation of the most important parts of the computer hardware, e.g. the CPU and the hard disk, based on a brief introduction to the fundamental concepts, phenomena, models and laws of electrodynamics and modern physics, especially some basic elements of condensed matter physics. To prepare for the future technologies, such as quantum computers.	
Course description:	
An overview of electrodynamics, Maxwell equations. Dia-, para- and ferromagnetism, hysteresis. Nanomagnetism, magnetic data recording. Spintronics. Magnetoresistive random-access memory (MRAM). Fundamentals of quantum physics, the Schrödinger equation. Tunnel effect and its applications. Structure of atoms and molecules. Fundamentals of solid state physics. Electrons in a periodic potential field, Bloch theorem, band theory of solids. Classification of crystals on the basis of the band theory. Intrinsic and doped semiconductors. Mechanism of the electric conduction in semiconductors, the Hall-effect. The p-n junction. Diodes, LEDs, semiconductor lasers. Tunnel-diodes. Transistors, FETs. Behaviour of the different materials in electric and magnetic fields. Ferroelectricity, multiferroics, ferroelectric RAMs. Superconductivity, Cooper-pairs, Josephson-effect. Applications. Physics of nanostructures. Graphene and silicene. Ballistic conduction. Nanotubes and nanoribbons. Single electron effects, Coulomb blockade, quantum dots. Memristors, RRAMs. Fundamentals of quantum computing. Qubits, entanglement, decoherence. Physical realizations.	
Required literature:	
1. Halliday, Resnick, Walker: Fundamentals of Physics, John Wiley 1981., 2008., 2011. 2. N. Gershenfeld: The Physics of Information Technology, Cambridge University Press, 2000. 3. N. DasGupta- A. DasGupta: Semiconductor Devices, Modelling and Technology, PHI Learning, 2011.	
Recommended literature:	
1. R. Waser: Nanoelectronics and Information Technology, Wiley, 2012. 2. D. Jiles: Introduction to Magnetism and Magnetic Material, Taylor &Francis, 1998.	