Assessment and subject description

Óbuda University Kandó Kálmán Faculty of Electrical Engineering			Institute of Microelectronics and Technology	
Subject name and code**:** **Engineering Physics KMEMF1ENNM** **Credits: 3** **Full-time, Fall Semester**				
Course: ***BGK, M.Sc. Mechatronics, full-time,. Semester I., Year of 2017-2018.***				
Responsible:	**Dr. Ervin Rácz Ph.D.** associate professor	Lecturers:	**Dr. Emőke Imre Ph.D.** assoc. professor	
Prerequisites:				
Contact hours per week:	Lecture: 2	Class discussion: -	Lab hours: -	Tutorial: -
Assessment and evaluation:	midterm marks			

Subject description

Aims:

- Improving and widening physics skills and axiomatic reorganizing of the physics topics have been studied during B.Sc. Physics classes.
- Systematic study of mathematical methods needed for higher level Physics and special courses will be studied in the future (such as Thermodynamics, Engineering Optics,…)
- Studying some special courses missed from B.Sc. study such as ground of Quantum physics, and introduction of some fields of applications.

Topics to be covered:

Part one (Mechanics): kinetic energy, a Lagrange function, Hamilton´s principle., Euler–Lagrange equation, general forces in Physics, Lagrange multiplicators, waves, hydrodynamics. Part two: electrical charge, Field quantities, Stokes theorem, Maxwell´s equations in integral and differential forms. Part three: phenomenological theory of thermodynamics, fundamental laws of thermodynamics, statistics, non-linear systems. Part four: optics, electrodynamics. Part five: quantum mechanics, electron structure of solid states, electric conduction effects, crystal-diffraction, Fermi surfaces, system investigations, boundary effects.

Topics	Week	Lessons
Introduction. Background from Mathematics. Real numbers, complex numbers. Vector space (linear field), vectors. Relations. General description of a function. Real-valued functions: single-valued and multivalued functions. (Differential functions). About vector-valued functions. Tensors.	**1.** **2017.09.11.**	**2**
Chapters from theoretical mechanics part 1. Newton´s laws of motion. Phase space. About the variation theory. (Euler-Lagrange equation).	**2.** **2017.09.18.**	**2**
Test #1., *Chapters from theoretical mechanics part 2.* General coordinates. Energies in mechanics. Lagrange function. Hamilton´s principle.	**3.** **2017.09.25**	**2**
Tensors. Tensors in mechanics. Tensor. Inertia tensor. Dilatation tensor. Stress tensor.	**4.** **2017.10.02.**	**2**
Basics of Thermodynamics. *Ideal Gases* Status number. Energy. Work. General force. (0. 1., 2. 3.)	**5.** **2017.10.09.**	**2**

Thermodynamics. Main laws of thermodynamics. (0. 1., 2. 3.)	**6.** **2017.10.16.**	**2**
Break	**7.** **2017.10.23.**	**2**
Test #2., *Quantum mechanics part cont.* Blackbody radiations. Compton effect. Specific heat of solids. Uncertainty principle from Heisenberg-Schrödinger equation. Several applications of Schrödinger equation: particle in a one-dimensional box, particle in potential valley, linear harmonic oscillator. Hilbert space. Electron spin. Many body problem in quantum mechanics. Adiabatic approximation.	**8.** **2017.10.30.**	**2**
Solid state physics. Ideal crystals (unit cell, Bravais lattice, base vectors, reciprocal lattice, Miller index), real crystals (Chrystal defects). Drude model. Sommerfeld model. Band theory of solids. Hall effect. Nucleation.	**9.** **2017.11.06.**	**2**
Electrodynamics Basics. Field quantities. Maxwell´s equations in integral and differential forms. Continuity equation. Frames of reference in the classical mechanics and electrodynamics. (Einstein-postulates – Postulates of special relativity, Lorentz transformation). Minkowski space.	**10.** **2017.11.13.**	**2**
Elements of statistical mechanics. Basic concepts and theorems of the statistical mechanics. Phase space. Distributions. (Micro canonical, canonical, grand canonical thermodynamic systems).	**11.** **2017.11.20.**	**2.**
Break	**12.** **2017.11.27.**	**2**
Test #3., *Principles of material and structure investigations. Basics of spectroscopy, and microscopy.* Structure monitoring systems (monitoring with x-rays and particle sources). Some kinds of microscopies.	**13.** **2017.12.04.**	**2**
Presentations. Discussions. Evaluation.	**14.** **2017.12.11.**	**2**
Assessment and evaluation Requirements of the signature: less than 30% missed classes, write the tests, prepare the essay/presentation. Evaluation: Average of the grades of the tests and essay.		

Suggested:

1. Ilja N. Bronstein, Konstantin A. Semendjajew: Handbook of Mathematics, Springer, ISBN 978-3871446443
2. Herbert B. Callen: Thermodynamics and Introuction to Thermostatistics, 2nd Edition, John Wiley & Sons, New York, Chichester, Brisbane, Toronto, Singapore, 1985, ISBN 0-471-86256-8 (in library)
3. Dilip Kondepudi, Ilya Prigogine: Modern Thermodynamics – From Heat Engines to Dissipative Structures, John Wiley & Sons, Chichester, England, 1998, ISBN 0471 97394 7 (paperback)
4. Karoly Simonyi: Theoretische Electrotechnik, Johann Abrosius Bart, ISBN 978-3335003755
5. Charles Kittel: Introduction to Solid State Physics, John Wiley & Sons, Inc., ISBN 0-471-41526-X
6. David J. Griffits: Introduction to Quantum Mechanics
7. Claude Cohen–Tannoudji, Bernard Diu, Franck Laloe: Quantum Mechanics, Wiley-VCH, ISBN: 978-0-471-56952-7
8. Petr Semenovic. Kirijev: Semiconductor Physics, MIR 1978. (University of Michigan)

Suggested material

M Mansfield, C O`Sullivan: Understanding Physics (John Wiley & Sons, Praxis, 1998. or newer edition)

Robert G. Brown : Introductory Physics I, II. Duke Univ. Durham.

The Feynman Lectures on Physics.

Comment: