ENGINEERING PHYSICS II.

Earth Science Engineering MSc / Geophysical Engineering specialization

2017/2018 2. Semester

COURSE COMMUNICATION FOLDER

University of Miskolc
Faculty of Earth Science and Engineering
Institute of Geophysics and Geoinformatics

Course datasheet

Course Title: Engineering physics II. **Responsible instructor** (name, position, scientific degree)**:** Dr. Tamás Fancsik, associate professor	**Neptun code:** MFGFT720011 **Responsible department/institute:** Institute of Geophysics and Geoinformatics / Department of Geophysics **Type of course: C**
Position in Curriculum (which semester): 2	**Pre-requisites (if any):** MFGFT7100011
Number of Contact Hours per Week (lec.+prac.): 1+1	**Type of Assessment (examination / practical mark / other):** practical mark
Credits: 2	**Course:** full-time **Program:** Earth Science Engineering MSc / Geophysical Engineering

Course Description:
Within the framework of the Geophysical Engineering MSc program, the students gain the deepening knowledge in those fields of the electrodynamics, which are the necessary to understand deeper the geological processes and geophysical methods.

Competencies to evolve:

Knowledge: T1, T2

Ability: -

Attitude: A3, A4, A5, A7

Autonomy and responsibility: F1, F2, F3, F4, F5

The short curriculum of the subject:
The main chapters of the subject: basic equations of the electromagnetic field, material equations, the special phenomena of the electromagnetic field. The electrodynamics as continuum theory, definition of the charge density. Introduction of the electromagnetic parameters based on continuum physics. Maxwell's equations in integral and differential forms. Special electromagnetic phenomena and their conditions. Completeness of the Maxwell's equations. Introduction of the electromagnetic potentials, potential equations. Scale transformation. Lorentz condition. Solutions of potential equations, retarded potential. The homogeneous wave equation and its major solutions. Electromagnetic potentials in conductors. Electromagnetic wave propagation in homogeneous, isotropic, infinite insulators and conductors. Telegraphs equations. Electromagnetic wave propagation on the boundary of an infinite conductor half-space. Properties of electromagnetic wave fields in infinite insulator in case of electrical dipole. Properties of electromagnetic wave fields in infinite insulator in case of magnetic dipole. Wave propagation in weakly inhomogeneous space, eikonal equation. Wave propagation in weakly inhomogeneous space, WKB method.

Assessment and grading:
Attendance at lectures is regulated by the university code of education and examination and two individual assignments during the semester are the requirements of signature.

Exam grading scale: unsatisfactory (0-45%), satisfactory (46-60%), medium (61-70%), good (71-85%), excellent (86-100%).

The 3-5 most important compulsory, or recommended literature (textbook, book) resources:

L. D. Landau, E. H. Lifshitz (1976) Course of Theoretical Physics Volume 2. The Classical Theory of Fields. Pergamon Press

Dobróka M. (2017): Engineering physics 2 (.pdf) university text book

M. Zhdanov (2009) Geophysical Electromagnetic Theory and Methods, Volume 43. Elsevier Science

M. Dobróka (1984) Love seam-waves in an inhomogeneous 3-layered medium. Geophysical Transactions Vol. 30. No. 3. 237-251.

M. Dobróka (1975) Small amplitude hydromagnetic waves in wave-guides, treated by generalized polytropic equations of state. Plasma Physics, Vol. 17. 1171-1172

Syllabus of the semester

Week	Lecture
1	The electrodynamics as continuum theory, definition of the charge density.
2	Introduction of the electromagnetic parameters based on continuum physics. Maxwell's equations in integral and differential forms.
3	Special electromagnetic phenomena and their conditions, electrostatics and magnetostatics, special phenomena and their conditions, field of stationary and quasi-stationary current.
4	Completeness of the Maxwell's equations. Introduction of the electromagnetic potentials, potential equations. Scale transformation.
5	Solutions of potential equations, retarded potential. The homogeneous wave equation and its major solutions.
6	1st mid-term test.
7	Electromagnetic potentials in conductors, telegraph equations.
8	Electromagnetic wave propagation in homogeneous, isotropic, infinite insulators.
9	Electromagnetic wave propagation in homogeneous, isotropic, infinite conductors. Skin-effect.
10	Electromagnetic waves propagation on the boundary of an infinite conductor half-space.
11	Properties of electromagnetic wave fields in infinite insulator in case of electrical dipole.
12	Properties of electromagnetic wave fields in infinite insulator in case of magnetic dipole.
13	Wave propagation in weakly inhomogeneous space, eikonal equation, WKB method.
14	2nd mid-term test.

Week	Seminar
1	The electrodynamics as continuum theory, continuum mechanical similarities, definition of the charge density and density of dipole moment.
2	Maxwell’s equations in integral and differential forms – repeating of the deductions, exercise of the derivative operators.
3	Special electromagnetic phenomena and their conditions, electrostatics and magnetostatics, special phenomena and their conditions, field of stationary and quasi-stationary current – exercise of the deductions.
4	Completeness of the Maxwell’s equations. Persistency of charge as an independent law of nature.
5	Introduction of the electromagnetic potentials, potential equations. Scale transformation. Lorentz condition. Solutions of potential equations, retarded potential. The homogeneous wave equation and its major solutions Exercise of the deductions.
6	1st mid-term test.
7	Electromagnetic potentials in conductors, telegraph equations. Exercises, examples.
8	Electromagnetic wave propagation in homogeneous, isotropic, infinite insulators. Exercise of deductions. Deepening of the knowledge. Examples.
9	Electromagnetic wave propagation in homogeneous, isotropic, infinite conductors. Skin-effect. Exercise of deductions. Deepening of the knowledge. Examples.
10	Electromagnetic waves propagation on the boundary of an infinite conductor half-space. Exercise of deductions. Deepening of the knowledge, Examples.
11	Properties of electromagnetic wave fields in infinite insulator in case of electrical dipole. Exercise of deductions. Deepening of the knowledge. Examples.
12	Properties of electromagnetic wave fields in infinite insulator in case of magnetic dipole. Exercise of deductions. Deepening of the knowledge. Examples.
13	Wave propagation in weakly inhomogeneous space, eikonal equation. and WKB method. Examples. Relationship with the Snellius-Descartes law.
14	2nd mid-term test.

Sample for the mid-term exam

Please, write down the differential forms of Maxwell's equations and introduce the electromagnetic potentials by application of scale transformation.

The solution can be found in the university text book „Engineering physics II".