MISKOLCI EGYETEM

MŰSZAKI FÖLD- ÉS KÖRNYEZETTUDOMÁNYI KAR

# ENGINEERING PHYSICS

Earth Science Engineering MSc

2023/2024 1. Semester

COURSE COMMUNICATION FOLDER

**University of Miskolc**
**Faculty of Earth and Environmental Sciences and Engineering**
**Institute of Exploration Geosciences**

## *Course datasheet*

<table>
<tr><td rowspan="2">Course Title: Engineering physics<br>Responsible instructor (name, position, scientific degree): Dr. Mihály Dobróka, professor emeritus<br>Dr. Tamás Fancsik, associate professor</td><td>Neptun code: MFGFT7100011<br>Responsible department/institute:<br>Institute of Exploration Geosciences / Department of Geophysics</td></tr>
<tr><td>Type of course: K</td></tr>
<tr><td>Position in Curriculum (which semester): 1</td><td>Pre-requisites (if any): none</td></tr>
<tr><td>Number of Contact Hours per Week (lec.+prac.): 2+1</td><td>Type of Assessment (examination / practical mark / other): exam</td></tr>
<tr><td>Credits: 4</td><td>Course: full-time<br>Program: Earth Science Engineering MSc</td></tr>
<tr><td colspan="2">Course Description:<br>Within the framework of the Earth Science Engineering MSc program, the students gain the deepening knowledge in those fields of the continuum physics, which are necessary to understand the geological processes and geophysical methods.<br>Competencies to evolve:<br>Knowledge: T1, T2<br>Ability: -<br>Attitude: A3, A4, A5, A7<br>Autonomy and responsibility: F1, F2, F3, F4, F5</td></tr>
<tr><td colspan="2">The short curriculum of the subject:<br>The principles of continuum physics. The relationship between the micro- and macroscopic descriptions, averaging in time and space. The kinematical principles of deformable continuum, deformation tensor. Volume and surface forces, stress tensor. Basic equations of continuum mechanics, continuity theories. The equation of motion of elastic continuum, integral and differential forms. Law of conservation of mass, continuity equation. Extensive and intensive quantities, the $0^{th}$ law of thermodynamics. General forms of law of conservation of mass. Material equations, Curie's law. Perfectly elastic body, linearly elastic body. Equation of motion of Hooke body. Fluid models, ideal fluids, viscous fluids. Newton body, Navier-Stokes body. Rheological models, Kelvin-Voight model, Maxwell model, Poynting-Thomson's law for material and motion equation of standard body. Wave propagation in linearly elastic medium. Solutions of wave equation. Wave propagation in different rocks, dispersion, absorption. Disperse waves.</td></tr>
<tr><td colspan="2">Assessment and grading:<br>Attendance at lectures is regulated by the university code of education and examination. Writing two tests at least satisfactory level, respectively during the semester is the requirement of signature.<br><br>Exam grading scale: unsatisfactory (0-45%), satisfactory (46-60%), medium (61-70%), good (71-85%), excellent (86-100%).</td></tr>
<tr><td colspan="2">The 3-5 most important compulsory, or recommended literature (textbook, book) resources:<br><br>1.Dobróka M., Somogyiné M. J. 2014: An introduction to continuum mechanics and elastic wave propagation Lecture notes. University of Miskolc.<br>2.K. Aki and P. Richards. Quantitative seismology. vol. 1: Theory and Methods. W H Freeman & Co (1980)<br>3.K. Aki and P. G. Richards. Quantitative seismology. vol. 2: Theory and Methods. W H Freeman & Co (1980)<br>4. Hudson J.A.1980. The excitation and propagation of seismic waves. Cambridge University Press<br>5. Schön J. 1998. Physical properties of Rocks. In. Seismic Exploration vol. 18.</td></tr>
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## *Syllabus of the semester*

| Week | Lecture |
|---|---|
| September 11. | The principles of continuum physics. The relationship between the micro- and macroscopic descriptions, averaging in time and space. |
| September 18. | The kinematical principles of deformable continuum, deformation tensor. |
| September 25. | Volume and surface forces, stress tensor. Basic equations of continuum mechanics, continuity theories. |
| October 2. | The equation of motion of elastic continuum, integral and differential forms. |
| October 9. | Law of conservation of mass, continuity equation. |
| October 16. | Extensive and intensive quantities, the $0^{th}$ law of thermodynamics. General forms of law of conservation of mass. Material models, Curie's law. |
| October 23. | National Holiday |
| October 30. | Holiday declared by Rector |
| November 6. | Perfectly elastic body, linearly elastic body. The moduli and their relationship in Hooke body. Equation of motion of Hooke body. |
| November 13. | Fluid models, ideal fluids, viscous fluids. Newton body, Navier-Stokes body. |
| November 20. | Rheological models, Kelvin-Voight model, Maxwell model, Poynting-Thomson's law for material and motion equation of standard body. |
| November 27. | Wave propagation in linearly elastic medium. Solutions of wave equation. |
| December 4. | Midterm test. Solution of plane and spherical wave, complex waves. Law of reflection and refraction. |
| December 11. | Repeat midterm test. Wave propagation in different rocks, dispersion, absorption. Disperse waves. |

| Week | Seminar |
|---|---|
| September 11. | The principles of continuum physics. The relationship between the micro- and macroscopic descriptions, averaging in time and space. |
| September 18. | The meaning of elements of deformation tensor. Volume and surface forces, stress tensor. The meaning of elements of stress tensor. |
| September 25. | Deformation and stress spherical tensor and deviator tensor. |
| October 2. | The equation of motion of elastic continuum, integral and differential forms. Exercise of deductions. |
| October 9. | Law of conservation of mass, continuity equation. Samples. |
| October 16. | Material equations, Curie's law. Relationship to thermodynamics. Samples. |
| October 23. | National Holiday |
| October 30. | Holiday declared by Rector |
| November 6. | The moduli and their relationship in Hooke body. Samples. Thermodynamically relations. |
| November 13. | Equation of motion of Hooke body, forms of Lamé equations. |
| November 20. | Pascal body. Newton body, Navier-Stokes body. First and second viscosity. Volumetric viscosity. |
| November 27. | Kelvin-Voight body, Maxwell body, Poynting-Thomson's law for material and motion equation of standard body. Creep, relaxation. Special loading examples. |
| December 4. | Monochromatic solution of wave equation, meanings of the parameters. Phase velocity, group velocity. |
| December 11. | Law of reflection and refraction. Exercise of deductions. Deepening of the knowledge. Examples. Dispersion, absorption, examples. |

## *Sample for the mid-term exam*

Please, give the definitions of 2 parameters of the linear elastic body. Show the different choosing possibilities and their conversion into eachother.

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

## *Sample for the written exam*

Please, write down the material equation of Hooke-body and deduce the motion of equation.

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