

Semmelweis University, Faculty of Dentistry - undivided, one-tier training in dentistry

Name of the host institution (and any contributing institution):

Biofizikai és Sugárbiológiai Intézet

Name of subject in Hungarian: Physical Foundations of Dental Materials Science

Name of subject in English: Physical Foundations of Dental Materials Science

Name of subject in German: Physical Foundations of Dental Materials Science

Credit value of the course: 2

Semester: 1st semester

(in which the subject is taught according to the curriculum)

Weekly hours	Lecture	Practice	Seminar
2.0	2.0	0.0	0.0

Semester hours	Lecture	Practice	Seminar
28.0	28.0	0.0	0.0

Type of course:

obligatory

Academic year:

2026/27

Language of instruction (for optional and elective subjects):

Angol

Course code:

FOKOFIZ307_1A

(in the case of a new course, to be completed by the Dean's Office, following approval)

Course coordinator name: Dr. Mártonfalvi Zsolt

Course coordinator location of work, telephone availability: SE, Department of Biophysics and Radiation Biology; +36-1-4591500/60231

Course coordinator position: associate professor

Course coordinator Date and number of habilitation: -

Objectives of the course, and its place in the curriculum of the medical training program:

- To provide knowledge in the fundamental physical phenomena, quantities and context related to dental materials science, odontotechnology, implantology and orthodontics.
- To impart knowledge about the structure and physical properties of materials commonly used in dental practice.
- To study the logic of scientific approach and to reveal the importance of materials science for future dentist.

Format of the course (lectures, group work, practical lessons, etc.):

lectures

Competencies acquired through completion of course:

- Knowledge about the fundamental physical and mechanical concept of materials science.
 - Knowledge about the physical and mechanical properties of dental material families.
 - Knowledge about the fundamental physical concept related to implantology, odontotechnology and orthodontics.
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Course outcome (names and NEPTUN ID of related subjects):

Prerequisites for course registration and completion: (NEPTUN ID):

In the case of multi-semester courses, position on the possibility of and conditions for concurrent registration:

The number of students required to start the course (minimum, maximum), method of selecting participants:

Detailed course syllabus (if the course can be divided into modules, please indicate): (Theoretical and practical instruction must be broken down into hours (weeks), numbered separately; names of instructors and lecturers must be listed, indicating guest lecturers/instructors. It cannot be attached separately! For guest lecturers, attachment of CV is required in all cases!)

Lectures (weekly):

1. **Foundamentals of material structure.**
Atomic interactions, bonds. Multiatomic systems, gases. Interpretation of temperature, Boltzmann-distribution.
2. Fluids, solids, liquid crystals.
3. Cohesion, adhesion, interfacial phenomena. Phase, phase diagram, phase transitions.
4. Methods for structural examination (diffraction, microscopic, spectroscopic methods)
5. Crystallisation. Metals, alloys, ceramics.
6. Polymers, composites.
7. **Mechanical and other properties of material families.**
Mechanical properties of materials 1. Elasticity.
8. Mechanical properties of materials 2. Plasticity, hardness.
9. Mechanical properties of materials 3. Rheological properties, viscoelasticity.
10. Thermal and electrical properties of materials.
11. Optical properties of materials. Comparison of the properties of dental materials based on their structure.

12. Foundations of biomechanics.

Structure, mechanical and other properties of dental tissues.

13. Physical bases of implantology.

14. Physical bases of orthodontics.

Lecturers: Gergely AGÓCS, Zsolt MÁRTONFALVI

Other courses with overlapping topics (obligatory, optional, or elective courses) in interdisciplinary areas. To minimize overlaps, topics should be coordinated. NEPTUN ID(s) of courses (to be provided):

FOKOFIZ378_1A

Requirements for attendance, options for making up missed sessions, and method of absence justification:

None.

Assessment methods during semester (number, topics, and dates of midterms and reports, method of inclusion in the course grade, opportunities for make-up and improvement of marks):

(number, topics, and dates of midterms and reports, method of inclusion in the course grade, opportunities for make-up and improvement of marks)

None.

Number and type of individual assignments to be completed, submission deadlines:

None.

Requirements for the successful completion of the course:

None.

Type of assessment:

terminal examination

Exam requirements (list of topics, topics of the test exam, and the optional project topics accepted as an exam)

The topic list for the written and oral exam:

1. Atomic interactions, bonds. Multiatomic systems, gases. Interpretation of temperature, Boltzmann-distribution.

2. Fluids, water, liquid crystals.
3. Solids. Crystalline and amorphous materials.
4. Cohesion, adhesion, interfacial phenomena.
5. Phase, phase diagram, phase transitions.
6. Methods for structural examination I. (light and electron microscope)
7. Methods for structural examination (diffraction-based methods, scanning methods)
8. Physical and mechanical properties of metals and alloys.
9. Physical and mechanical properties of ceramics.
10. Physical and mechanical properties of polymers, composites.
11. Mechanical properties of materials 1: types of deformation, stress-strain diagram. Description of elasticity.
12. Mechanical properties of materials 2: Description of plasticity, hardness.
13. Mechanical properties of materials 3. Fractures, fatigue, impact test
14. Mechanical properties of materials 4. Viscoelasticity.
15. Thermal, electrical and optical properties of materials.
16. Comparison of the properties of dental materials based on their structure.
17. Biomechanics 1. Forces, levers related to human body. Mandible as a lever, masticatory forces.
18. Mechanical, electrical, optical and thermal properties of dental tissues.
19. Biomechanics 2. Physical bases of implantology.
20. Biomechanics 3. Physical bases of orthodontics.

The oral part consists of plots. The plots are available on the moodle page of the course.

The written part of the exam consists of closed moodle test questions (single and multiple choice, plots, etc.) that are available before the exam on the moodle page of the course.

Clear, specific minimum requirements for assessment. (The list of mandatory concepts, parameters, diagrams, calculations, and practical skills required to obtain a passing grade, as well as the criteria for the completion and evaluation of project assignments accepted as an exam.) A link published on the department's website referring to the minimum requirements of the course.

The minimum requirement for the written exam is to achieve at least 50% on the test. If the student does not reach this threshold, there is an opportunity during the oral exam to explain the answers to these questions. Based on this, the examiner may decide to modify the grade—provided that the student is able to explain the key concepts related to the topics listed above and can perform the necessary calculations.

Method and type of grading (Share of theoretical and practical examinations in the overall evaluation. Inclusion of the results in the end-of-term assessment. Possibilities of and conditions for offered grades.): (Share of theoretical and practical examinations in the overall evaluation, Inclusion of the results in the end-of-term assessment, Possibilities of and conditions for offered grades)

- The exam starts with the written moodle quiz that contains mostly theoretical questions from the material and 10% calculations. This test has 30 questions in total and 45 min is the time cap.

- Grading of the test:
75,01-100% 4
62,51-75,00% 3
50,0-62,50% 2
0-49,99% 1
- Those who scored below 50%, are allowed to increase their score in the oral part. The examiner may decide to modify the grade—provided that the student is able to explain the key concepts related to the topics listed above and can perform the necessary calculations.
- Those who scored above 75%, and want better than grade 4, will continue with the oral part. In the oral part the topic list is composed of figures and graphs that are selected from the material. This oral part is planned to be a short max. 10 min of explanation what the figure represents. The grade 4 is guaranteed regardless of the result of the oral part.

Artificial intelligence systems used in the teaching of the subject and the manner of their application

It may be used for preparation; however, it requires careful and critical handling. It may not be used during the exam.

Signature of habilitated instructor (course coordinator) announcing the course:

Signature of the director of the host institution:

Date of submission:
