

<b>2023/2024. ACADEMIC YEAR</b>	
<b>PROGRAM OF STUDY (FOR STUDENTS OF 2ND YEAR)</b>	
<b>Full (Hun) name of the subject: Nanotechnológia (elmélet+gyakorlat)</b>	
<b>Program: Undivided program (pharmaceutical)</b>	
<b>Schedule: full-time</b>	
<b>Short name of the subject:</b>	
<b>English name of the subject:</b> Nanotechnology (theory+practice)	
<b>German name of the subject:</b> Nanotechnologie (Vorlesung+Praktikum)	
<b>Type of registration: obligatory/obligatory elective/elective/criteria requirement</b>	
<b>Neptun code of the subject:</b> GYKGYI078G1A	
<b>Responsible Department:</b> Semmelweis University, Department of Pharmaceutics	
<b>Responsible tutor</b> Dr. István Antal	<b>Title, academic degree:</b> professor
<b>Contact information:</b> - <b>phone:</b> +36 1 217 0914 - <b>email:</b> antal.istvan@semmelweis.hu	
<b>Name of the persons responsible for the teaching of the subject:</b> Dr. István Antal Dr. Romána Zelkó Dr. Andrea Kovács Dr. Csaba Dobó-Nagy Dr. Angéla Jedlovszky-Hajdú Dr. Nikolett Kállai-Szabó Dr. Nóra Mike-Kaszás Dr. Lívia Budai Dr. Bálint Basa Dr. Bence Borbás Dr. Zsófia Kohod Dr. Zsófia Vilimi	<b>Title, academic degree:</b>  professor professor assistant lecturer professor associate professor associate professor assistant lecturer senior lecturer resident resident resident resident
<b>Class per week:</b> 2 hours lectures 2 hours practices	<b>Credit point(s):</b> 4 credits
<b>Professional content, intent of acquirement and it's function in order to implement the goals of the program:</b>  The aim of the 'Nanotechnology' subject is to acquaint the pharmacy student with the basics of nanotechnology, different types of nanoparticles and nanostructures, important physicochemical properties, physiological and toxicological aspects. It also aims to provide insight into the different areas of application of nanotechnology through practical examples in addition to general knowledge. In addition to general knowledge about nanotechnology, the subject provides practical insights into various areas of application of nanotechnology through practical examples.	
<b>Short description of the subject:</b>  The subject "Nanotechnology" provides an overview of the main concepts of nanotechnology, the importance of different nanoparticles, their possible applications, and preparation methods. The potential toxicological aspects of drug delivery systems used in nanomedicine will be also discussed.	
<b>Course data</b>	

Recommended term	Contact hours (lecture)	Contact hours (practice)	Contact hours (seminar)	Individual lectures	Total number of contact hours/semester	Normal course offer	Consultations
4th semester	2	2	-	-	56	Autumn semester* <u>Spring semester</u> Both semesters (* Please underline)	-

**Program of semester\*\***

**Topics of theoretical classes (pro week):**

1. Week: Introduction to nanotechnology, its history, and significance. Nanotechnology concepts, definitions, classifications (nanoparticles, nanostructures, nanomaterials)
2. Week: Particle size reduction I: particle characteristics
3. Week: Particle size reduction II: Effect of particle characteristics on dissolution; nanomilling
4. Week: Vesicular systems: micelles, liposomes
5. Week: Quantum dots and nanoparticles
6. Week: Solid state, amorphous form
7. Week: Nano- and microemulsion systems
8. Week: Characterization methods in nanotechnology
9. Week: Nanofibers as drug delivery systems
10. Week: Bioactive materials, orthopedic implants, bone grafting, and bactericidal surfaces
11. Week: Nanochemistry and biomedical applications
12. Week: Nanomaterials in dentistry
13. Week: Physiological and toxicological aspects of nanotechnology
14. Week: Nanomedicine: Nanotechnology in drug therapy, targeted drug delivery, medical imaging, and diagnostics

**Topics of practical classes (pro week):**

1. Week: Introduction to nanotechnology laboratory practices, methods, and devices
2. Week: Preparation of quantum dots
3. Week: Preparation, examination and evaluation of liposomes
4. Week: Inhibition and study of the eutectic formation
5. Week: Morphological characterization of nanoparticles, related calculations, SEM/TEM image analysis, particle size, and distribution analysis and evaluation; modelling
6. Week: Written test
7. Week: Nanosuspension preparation, examination and evaluation
8. Week: Preparation, examination and evaluation of nanoemulsions/microemulsions
9. Week: Preparation, examination and evaluation of nano-, microfibers
10. Week: Project work and presentations: On the topic of nanoparticles and nanomedicine
11. Week: Project work and presentations: On the topic of nanotechnology in different industries
12. Week: Holiday
13. Week: Written test
14. Week: Consultation, replacement practice

**Other subjects (both compulsory and optional) relating to the transversal issues of the subject. Possible overlaps between subjects:**

Physical Chemistry, Colloid Chemistry, Pharmaceutical Technology

**Schedule of consultations:**

At the times indicated in the practice schedule or at an agreed time according to the individual student's needs.

***Course requirements*****Prerequisites:**

Colloid Chemistry

**Conditions of attending the classes, amount of acceptable absents, way of presentation of leave, opportunity for makeup:**

Up to 25% of the practices (3 practices) can be missed, with the possibility of making up the time according to the practice schedule (on the 14<sup>th</sup> weeks), in the event of an additional absence, the head of the institute/head of subject determines the conditions of signing and the order of replacement.

**The grading method; the conditions for getting the signature; the number, topic(s) and date(s) of the mid-term assessments, (reports, term tests), and the process in which they contribute to the final grade; and the possibility of their retake or their upgrading retake (as provided in §§ 25-28 of the STUDY AND EXAMINATION REGULATIONS):**

Mid-term assessments:

1. The completion of 2 written tests (on 6<sup>th</sup> and 13<sup>th</sup> weeks) from the material of the lectures and practices with the results at least 50% of each of the written tests. Possibility of retake according to the Examination and Studies Regulation.
2. There are 6 practice-related Moodle tasks during the semester divided into two blocks the final deadline for completing the tasks is Friday midnight (on 5<sup>th</sup> and 12<sup>th</sup> weeks) before the written midterms.
3. The students must work in groups to develop and present a pre-determined nanotechnological topic within the framework of project work during the 10<sup>th</sup> and 11<sup>th</sup> educational weeks.

At the end of the semester, the grade is determined as follows:

Based on a percentage calculation from the sum of the points obtained on the two written tests (max. 36-36 points), the points of the practice-related tasks (max. 12 points) and the points received for the project work (max. 16 points), as follows:

90,00-100%	excellent (5)
80,00-89,99%	good (4)
63,00-79,99%	medium (3)
50,00-62,99%	sufficient (2)
0-49,99%	insufficient (1)

**Requirements of signature(as provided for in STUDY AND EXAMINATION REGULATIONS § 29):**

Completion according to the SE Examination and Studies Regulation, completion of the practices and laboratory reports, as well as with a minimum of 50% in each written test and preparation of the student project work.

**Number and type of projects students have to perform independently during the semester and their deadlines:**

The completion of 6 practice-related Moodle tasks (deadline: Friday midnight on 5<sup>th</sup> and 12<sup>th</sup> weeks), preparation and presentation of a project work in groups (the deadline of the Moodle uploading: 10<sup>th</sup> weeks Monday 8:00 am., presentation weeks: on 10<sup>th</sup> and 11<sup>th</sup> educational week), 2 written tests (on 6<sup>th</sup> and 13<sup>th</sup> weeks).

**Type of the semester-end examination:** signature\*/practical grade\*/ comprehensive examination\*/final/end-term examination\*

**Examination requirements:** as published by the education-research department on the MOODLE interface by the start of the academic term.

**Form of the semester-end examination:** written\*/oral\*/combinated examination/**practical examination/the assessment of completing project work (according to STUDY AND EXAMINATION REGULATIONS 30.§)\*** (*Please underline*)

**The possibility and conditions for offering grades:**

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**A list of the basic notes, textbooks, resources and literature that can be used to acquire the knowledge necessary to master the curriculum and to complete the assessments, ~~\*\*\*\*~~with exact description about which of them is required to acquire which part of the syllabus (e.g. description based on topics)), as well as the main technical and other aids and study aids that can be used:**

The lectures are presented in slides in an extracted form, which contain the most important theoretical knowledge.

Materials are provided to help students to carry out and learn the practices.

A guide to the literature research needed to complete the project work.

**In the case of a subject lasting more than one semester, the position of the teaching/research department on the possibility of parallel enrolment and the conditions for admission\*\*\*\*:**

yes\*/no\*/on and individual assesment basis\* (*Please underline*)

**The course description was prepared by:**

Dr. Andrea Kovács, Dr. István Antal