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1) 064 – 1010: Basic Principles I

COURSE OUTLINE

GENERAL

SCHOOL	HEALTH SCIENCES, NATIONAL and KAPODISTRIAN UNIVERSITY OF ATHENS		
DEPARTMENT	SCHOOL OF MEDICINE & PHARMACY DEPARTMENT		
LEVEL OF EDUCATION	POSTGRADUATE		
COURSE CODE	064-101	SEMESTER	WINTER
COURSE TITLE	Basic Principles I		
INDEPENDENT TEACHING ACTIVITIES		TEACHING HOURS	CREDIT UNITS
Different forms of teaching		11	3
COURSE TYPE:		General background, Skill development	
PREREQUISITE COURSES:			
LANGUAGE OF TEACHING AND EXAMINATION:		ENGLISH	
THE COURSE IS OFFERED TO ERASMUS STUDENTS:		NO	
COURSE WEBPAGE (URL)		https://nanomed.med.uoa.gr/	

LEARNING RESULTS

Learning Results
<p>This course is the first introductory course in the concepts that govern the scientific field of nanotechnology applications in medicine. More specifically, the course curriculum aims to introduce students to the sciences related to the explanation of phenomena at the nanoscale, namely Physics, Chemistry, Biology and Pharmacy. In addition, an introduction is given to how a graduate student searches and selects appropriate literature in the first degree and implements the writing of a scientific article in the second degree.</p> <p>At the end of this course, the students are also divided into groups of three or four, in order to be assigned the group work of the first module.</p> <p>Upon successful completion of the course, students are able to:</p> <ul style="list-style-type: none"> - Have an understanding of the basic sciences that play an important role in the development of nanotechnology - Have understood the general context of the various applications of nanotechnology in medicine - Search for scientific articles using the most important search engines and use appropriate filters for a more efficient search - Know the basic structure of a scientific article - Collaborate with other students to create an action plan on the successful completion of the group work of module 1.
General Skills
<p>Searching, analysing and synthesising data and information, using the necessary technologies, Adapting to new situations, Working independently, Working in teams, Working in an interdisciplinary environment, Generating new research ideas, Designing and managing projects, Respecting diversity and multiculturalism, Promoting free, creative and inductive thinking.</p>

COURSE CONTENT

Lesson 1.1: Basic Principles I

Nanoscience and Nanotechnology are relatively young scientific and nanotechnological fields which investigate the structure, properties, morphology and functionality of nanomaterials and nanostructures. Nanotechnology is a collective term for a range of scientific fields, technologies, techniques, processes and applications that involve the treatment and the investigation of matter at nanoscale. Nanoscience and nanotechnology can offer advantages in the development process of new drugs and they represent a new approach to research in this field. These areas offer benefits for the development of innovative products and promote new properties of the materials used, which could be essential in the effectiveness of the final product. Scientists in this field work at the atomic, molecular and supramolecular levels, and can manufacture new nanodevices and nanosystems with new properties and functions. Nanotechnology is the scientific area of the design and the development of devices at the mesoscopic and molecular scale. These systems could be correlated to the living organisms due to their self-assembly properties, their hierarchical structural organization, as well as to their biocompatibility and biodegradability characteristics.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY METHOD.	Face-to-face and distance learning by conducting Group Counselling Meetings on students' progress on deliverables	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	In meetings and/or tasks they are used: - remote meeting tools (webex), - presentation software (powerpoint). In addition, students use office automation tools, web browsers and e-readers for digital books.	
TEACHING ORGANISATION	Activity	Semester Workload
	Lectures	11
	Personal Study and Exam Preparation for Unit 1 Exams	35
	Group work of the 1st unit	30
	Course Total	76
STUDENT ASSESSMENT	The language of assessment for students is English. Preparation of a written work of medium length (3,000 words) in the form of a scientific article and presentation of the same, with a weighting factor of 30% in the final grade of the course. The grade of the paper is independent of whether the final or re-examination score is above the pass mark (greater than or equal to 5). The written examinations of the respective Thematic Unit have a weighting factor of 70%. Participation in the final examinations is granted if at least 80% of the courses are attended.	

RECOMMENDED BIBLIOGRAPHY

1. Costas Demetzos, Panagiotis Vlamos, & Dimitrios Vlachakis. (2022). *PERSPECTIVES TO FIGHT VIRUSES. THE EXAMPLE OF SARS-CoV-2*. <https://doi.org/10.5281/zenodo.7137844>
2. *Low-Temperature Polycondensation Processes*, P. W. MORGAN, DOI: 10.1021/ba-1962-0034.ch014
3. Vedant Gadekar, Yogeshwari Borade, Suraj Kannaujia, Kuldeep Rajpoot, Neelima Anup, Vishakha Tambe, Kiran Kalia, Rakesh K. Tekade. *Nanomedicines accessible in the market for clinical interventions*, *Journal of Controlled Release*, Volume 330, Pages 372-397, <https://doi.org/10.1016/j.jconrel.2020.12.034>
4. Alyssa B. Chinen, Chenxia M. Guan, Jennifer R. Ferrer, Stacey N. Barnaby, Timothy J. Merkel, Chad A. Mirkin. *Nanoparticle Probes for the Detection of Cancer Biomarkers, Cells, and Tissues by Fluorescence*, Alyssa B. Chinen et al., *Chem. Rev.* 2015, 115, 10530–10574, <https://doi.org/10.1021/acs.chemrev.5b00321>
5. Hanžić N, Horvat A, Bibić J, Unfried K, Jurkin T, Dražić G, Marijanović I, Slade N, Gotić M. *Syntheses of gold nanoparticles and their impact on the cell cycle in breast cancer cells subjected to megavoltage X-ray irradiation*. *Mater Sci Eng C Mater Biol Appl.* 2018 Oct 1;91:486-495. doi: 10.1016/j.msec.2018.05.066. Epub 2018 May 22. PMID: 30033280.
6. Sun H, Jia J, Jiang C, Zhai S. *Gold Nanoparticle-Induced Cell Death and Potential Applications in Nanomedicine*. *Int J Mol Sci.* 2018 Mar 7;19(3):754. doi: 10.3390/ijms19030754. PMID: 29518914; PMCID: PMC5877615.
7. Patra, J.K., Das, G., Fraceto, L.F. et al. *Nano based drug delivery systems: recent developments and future prospects*. *J Nanobiotechnol* 16, 71 (2018). <https://doi.org/10.1186/s12951-018-0392-8>

2) 064 – 1020: Basic Principles II

COURSE OUTLINE

GENERAL

SCHOOL	HEALTH SCIENCES, NATIONAL and KAPODISTRIAN UNIVERSITY OF ATHENS		
DEPARTMENT	SCHOOL OF MEDICINE & PHARMACY DEPARTMENT		
LEVEL OF EDUCATION	POSTGRADUATE		
COURSE CODE	064-102	SEMESTER	WINTER
COURSE TITLE	Basic Principles II		
INDEPENDENT TEACHING ACTIVITIES		TEACHING HOURS	CREDIT UNITS
Different forms of teaching		33	7
COURSE TYPE:		General background, Skill development	
PREREQUISITE COURSES:			
LANGUAGE OF TEACHING AND EXAMINATION:		ENGLISH	
THE COURSE IS OFFERED TO ERASMUS STUDENTS:		NO	
COURSE WEBPAGE (URL)		https://nanomed.med.uoa.gr/	

LEARNING RESULTS

Learning Results
<p>The course is the second basic introductory course in the concepts that govern the scientific field of nanotechnology applications in medicine. More specifically, the course syllabus, taking into account the knowledge acquired in the first course, introduces students to the basic types of nanosystems, as well as nanoparticles. In addition, reference is made to physicochemical techniques for characterizing such systems as well as a more general reference to the principles underlying nanomedicine. Finally, this course concludes the second part of the course on the implementation of a scientific article, where students are asked to give a short presentation on the methodology followed.</p> <p>Upon successful completion of the course, students are able to:</p> <ul style="list-style-type: none"> - Have an understanding of the basic types of nanosystems - Have an understanding of the basic types of nano-particles - Recognise the physico-chemical mechanisms by which such nanosystems are characterised - They can present in a short time the methodology followed in writing a scientific article
General Skills
<p>Searching, analysing and synthesising data and information, using the necessary technologies, Adapting to new situations, Working independently, Working in teams, Working in an interdisciplinary environment, Generating new research ideas, Designing and managing projects, Respecting diversity and multiculturalism, Promoting free, creative and inductive thinking.</p>

COURSE CONTENT

Lesson 1.2. Basic Principles II

The main types of nanosystems are lipid (i.e. liposomes, trasferosomes etc.); polymeric (i.e. micelles, polymersomes etc.) and inorganic (i.e. gold nanoparticles etc.). The physicochemical characteristics of nanosystems (play a key role on administration, distribution, metabolism, and excretion (ADME profile) of the encapsulated Active Pharmaceutical Ingredients (APIs) or the imaging agent. The most important techniques including light scattering (dynamic, static, and electrophoretic), thermal analysis (especially differential scanning calorimetry), and imaging techniques are presented for the physico-chemical characterization of nanosystems. These techniques are used extensively for the detailed characterization of nanosystems, i.e. in the research and development of innovative nanocarriers, and are required from the regulatory authorities.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY METHOD	Face-to-face and distance learning by conducting Group Counselling Meetings on students' progress on deliverables	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	In meetings and/or tasks they are used: <ul style="list-style-type: none"> - remote meeting tools (webex), - presentation software (powerpoint). In addition, students use office automation tools, web browsers and e-readers for digital books.	
TEACHING ORGANISATION	Activity	Semester Workload
	Lectures	33
	Personal Study and Exam Preparation for Unit 1 Exams	80
	Group work of the 1st unit	80
	Course Total	193
STUDENT ASSESSMENT	The language of assessment for students is English. Preparation of a written work of medium length (3,000 words) in the form of a scientific article and presentation of the same, with a weighting factor of 30% in the final grade of the course. The grade of the paper is independent of whether the final or re-examination score is above the pass mark (greater than or equal to 5). The written examinations of the respective Thematic Unit have a weighting factor of 70%. Participation in the final examinations is granted if at least 80% of the courses are attended.	

RECOMMENDED BIBLIOGRAPHY

1. Patra, J.K., Das, G., Fraceto, L.F. et al. Nano based drug delivery systems: recent developments and future prospects. *J Nanobiotechnol* 16, 71 (2018). <https://doi.org/10.1186/s12951-018-0392-8>
2. Her S, Jaffray DA, Allen C. Gold nanoparticles for applications in cancer radiotherapy: Mechanisms and recent advancements. *Adv Drug Deliv Rev.* 2017 Jan 15;109:84-101. doi: 10.1016/j.addr.2015.12.012. Epub 2015 Dec 19. PMID: 26712711.
3. Spyratou E, Makropoulou M, Efstathiopoulos EP, Georgakilas AG, Sihver L. Recent Advances in Cancer Therapy Based on Dual Mode Gold Nanoparticles. *Cancers (Basel).* 2017 Dec 19;9(12):173. doi: 10.3390/cancers9120173. PMID: 29257070; PMCID: PMC5742821.
4. Kong FY, Zhang JW, Li RF, Wang ZX, Wang WJ, Wang W. Unique Roles of Gold Nanoparticles in Drug Delivery, Targeting and Imaging Applications. *Molecules.* 2017 Aug 31;22(9):1445. doi: 10.3390/molecules22091445. PMID: 28858253; PMCID: PMC6151763.
5. Yulia Eygeris, Siddharth Patel, Antony Jozic, and Gaurav Sahay. Deconvoluting Lipid Nanoparticle Structure for Messenger RNA Delivery. *Nano Letters* **2020** 20 (6), 4543-4549. DOI: 10.1021/acs.nanolett.0c01386
6. Cooper ID. How to write an original research paper (and get it published). *J Med Libr Assoc.* 2015 Apr;103(2):67-8. doi: 10.3163/1536-5050.103.2.001. PMID: 25918483; PMCID: PMC4404856.

3) 064 – 1030: Basic Principles III

COURSE OUTLINE

GENERAL

SCHOOL	HEALTH SCIENCES, NATIONAL and KAPODISTRIAN UNIVERSITY OF ATHENS		
DEPARTMENT	SCHOOL OF MEDICINE & PHARMACY DEPARTMENT		
LEVEL OF EDUCATION	POSTGRADUATE		
COURSE CODE	064-103	SEMESTER	WINTER
COURSE TITLE	Basic Principles III		
INDEPENDENT TEACHING ACTIVITIES		TEACHING HOURS	CREDIT UNITS
Different forms of teaching		22	5
COURSE TYPE:		General background, Skill development	
PREREQUISITE COURSES:			
LANGUAGE OF TEACHING AND EXAMINATION:		ENGLISH	
THE COURSE IS OFFERED TO ERASMUS STUDENTS:		NO	
COURSE WEBPAGE (URL)		https://nanomed.med.uoa.gr/	

LEARNING RESULTS

Learning Results
<p>This course is the third and last basic introductory course in the concepts that govern the scientific field of nanotechnology applications in medicine.</p> <p>More specifically, the course introduces students to the basic imaging methods used in medicine for the diagnosis and treatment of diseases in which there are applications of nanotechnology.</p> <p>Finally, this course also completes the group work of the students of the first thematic unit, which they are required to submit in writing in the form of a scientific article and present to the lecturers in charge.</p> <p>Upon successful completion of the course, students are able to:</p> <ul style="list-style-type: none"> - Have an understanding of the basic principles on which the most important imaging techniques are based - Know the applications of nanotechnology in both the diagnosis and treatment of therapies - Cultivate skills and competences related to the writing of their first scientific article (group work) - Present the work briefly and concisely, but in a comprehensible manner and without missing important points, and answer questions adequately
General Skills
<p>Searching, analysing and synthesising data and information, using the necessary technologies, Adapting to new situations, Working independently, Working in teams, Working in an interdisciplinary environment, Generating new research ideas, Designing and managing projects, Respecting diversity and multiculturalism, Promoting free, creative and inductive thinking.</p>

COURSE CONTENT

Lesson 1.3. Basic Principles III

This lesson addresses the applications of quantitative imaging to study multiple physiological variables of living tissues. Protocols are presented for investigations ranging from in vitro cell and tissue approaches to in vivo imaging of intact organs. These include the measurement of cytosolic parameters both in vitro and in vivo. Additionally, Magnetic Resonance Imaging (MRI), an imaging technique primarily used as diagnostic tool in clinical/preclinical research, will be analyzed in depth. Cell and Molecular Biology area will focus on cancer, cell biology and cellular dynamics, plant biology and bioenergetics. Experimental approaches in cell signaling and differentiation, molecular biology, proteomics, genomics and genetics, and advanced cell imaging are interwoven throughout these major focus areas.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY METHOD	Face-to-face and distance learning by conducting Group Counselling Meetings on students' progress on deliverables	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	<p>In meetings and/or tasks they are used:</p> <ul style="list-style-type: none"> - remote meeting tools (webex), - presentation software (powerpoint). <p>In addition, students use office automation tools, web browsers and e-readers for digital books.</p>	
TEACHING ORGANISATION	Activity	Semester Workload
	Lectures	22
	Personal Study and Exam Preparation for Unit 1 Exams	55
	Group work of the 1st unit	50
	Course Total	127
STUDENT ASSESSMENT	<p>The language of assessment for students is English.</p> <p>Preparation of a written work of medium length (3,000 words) in the form of a scientific article and presentation of the same, with a weighting factor of 30% in the final grade of the course.</p> <p>The grade of the paper is independent of whether the final or re-examination score is above the pass mark (greater than or equal to 5).</p> <p>The written examinations of the respective Thematic Unit have a weighting factor of 70%.</p> <p>Participation in the final examinations is granted if at least 80% of the courses are attended.</p>	

RECOMMENDED BIBLIOGRAPHY

1. Gholami YH, Maschmeyer R, Kuncic Z. Radio-enhancement effects by radiolabeled nanoparticles. *Sci Rep.* 2019 Oct 4;9(1):14346. doi: 10.1038/s41598-019-50861-2. PMID: 31586146; PMCID: PMC6778074.
2. *Physico-chemical Characterization and Basic Research Principles of Advanced Drug Delivery Nanosystems.* Natassa Pippa, Natassa Pippa, Stergios Pispas, Costas Demetrios. First published: 17 October 2016.
<https://doi.org/10.1002/9781119242628.ch5>

3. Newell DW, Shah MM, Wilcox R, Hansmann DR, Melnychuk E, Muschelli J, Hanley DF. Minimally invasive evacuation of spontaneous intracerebral hemorrhage using sonothrombolysis. *J Neurosurg.* 2011 Sep;115(3):592-601. doi: 10.3171/2011.5.JNS10505. Epub 2011 Jun 10. PMID: 21663412; PMCID: PMC3785332.
4. Nacu A, Kvistad CE, Naess H, Øygarden H, Logallo N, Assmus J, Waje-Andreassen U, Kurz KD, Neckelmann G, Thomassen L. NOR-SASS (Norwegian Sonothrombolysis in Acute Stroke Study): Randomized Controlled Contrast-Enhanced Sonothrombolysis in an Unselected Acute Ischemic Stroke Population. *Stroke.* 2017 Feb;48(2):335-341. doi: 10.1161/STROKEAHA.116.014644. Epub 2016 Dec 15. PMID: 27980128; PMCID: PMC5266415.
5. Tian, Furong & Bonnier, Franck & Casey, Alan & Shanahan, Anne & Byrne, Hugh. (2014). Surface Enhanced Raman Scattering with gold nanoparticles: Effect of particle shape. *Anal. Methods.* 6. 10.1039/C4AY02112F.
6. Wang Y, Lee K, Irudayaraj J. SERS aptasensor from nanorod-nanoparticle junction for protein detection. *Chem Commun (Camb).* 2010 Jan 28;46(4):613-5. doi: 10.1039/b919607b. Epub 2009 Nov 18. PMID: 20062879.

4) 064–1040: Basics of Nanomedicine

COURSE OUTLINE

GENERAL

SCHOOL	HEALTH SCIENCES, NATIONAL and KAPODISTRIAN UNIVERSITY OF ATHENS		
DEPARTMENT	SCHOOL OF MEDICINE & PHARMACY DEPARTMENT		
LEVEL OF EDUCATION	POSTGRADUATE		
COURSE CODE	064-104	SEMESTER	WINTER
COURSE TITLE	Basic of nanomedicine		
INDEPENDENT TEACHING ACTIVITIES		WEEKLY TEACHING HOURS	CREDIT UNITS
Different forms of teaching		11	5
COURSE TYPE:		General background, General knowledge specialisation, Skills development	
PREREQUISITE COURSES:			
LANGUAGE OF TEACHING AND EXAMINATION:		ENGLISH	
THE COURSE IS OFFERED TO ERASMUS STUDENTS:		NO	
COURSE WEBPAGE (URL)		https://nanomed.med.uoa.gr/	

LEARNING RESULTS

Learning Results
<p>This course is the first course of the second thematic unit, where the introduction of students to the most basic concepts of the scientific field related to nanotechnology and its applications in medicine has been completed. In this course, students are introduced to more specialized concepts of Nanomedicine, such as pharmacokinetics and the mechanisms of application of nanoparticles in vaccines. At the end of the course, students are again divided into groups of three or four and assigned the topics of the second module assignments.</p> <p>Upon successful completion of the course, students are able to:</p> <ul style="list-style-type: none"> - Have knowledge about nanoparticle immunology and biology in the microcosm - Have an understanding of concepts such as pharmacokinetics, pharmacodynamics as well as drug stability - Have an understanding of the applications of nanotechnology directly related to the manufacture of mRNA vaccines
General Skills
<p>Searching, analysing and synthesising data and information, using the necessary technologies, Adapting to new situations, Working independently, Working in teams, Working in an interdisciplinary environment, Generating new research ideas, Designing and managing projects, Respecting diversity and multiculturalism, Promoting free, creative and inductive thinking.</p>

COURSE OUTLINE

Lesson 2.1. Basics of Nanomedicine

This lesson is an introduction in topics such as pharmacokinetics, pharmacodynamics, metabolism and absorption of nanodrugs, as well as in their role in immunology and more precisely their application in procedures regarding vaccination. Mainly this course includes information about lipid nanosystems found in modern vaccines and in polymers used in pharmaceuticals. In addition to that, there is an introduction in nanomedicine and its application cosmetology, as the mechanisms that nanoparticles interact with the skin were discussed. Finally, the stability of those nanoparticle-based drugs is discussed.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY METHOD	Face-to-face and distance learning by conducting Group Counselling Meetings on students' progress on deliverables	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	<p>In meetings and/or tasks they are used:</p> <ul style="list-style-type: none"> - remote meeting tools (webex), - presentation software (powerpoint). <p>In addition, students use office automation tools, web browsers and e-readers for digital books.</p>	
TEACHING ORGANISATION	Activity	Semester Workload
	Lectures	33
	Personal Study and Exam Preparation for Unit 1 Exams	55
	Group work of the 1st unit	50
	Course Total	138
STUDENT ASSESSMENT	<p>The language of assessment for students is English.</p> <p>Preparation of a written work of medium length (3,000 words) in the form of a scientific article and presentation of the same, with a weighting factor of 30% in the final grade of the course.</p> <p>The grade of the paper is independent of whether the final or re-examination score is above the pass mark (greater than or equal to 5).</p> <p>The written examinations of the respective Thematic Unit have a weighting factor of 70%.</p> <p>Participation in the final examinations is granted if at least 80% of the courses are attended.</p>	

RECOMMENDED BIBLIOGRAPHY

1. Jackson T.C., Patani B. O., Ekpa D. E. *Nanotechnology in Diagnosis: A Review. Advances in Nanoparticles*, 2017,6:93-102.
2. Pippa N, Gazouli M, Pispas S. *Recent Advances and Future Perspectives in Polymer-Based Nanovaccines. Vaccines (Basel)*. 2021 May 26;9(6):558. doi: 10.3390/vaccines9060558. PMID: 34073648; PMCID: PMC8226647.
3. Perrie Y, Kastner E, Kaur R, Wilkinson A, Ingham AJ. *A case-study investigating the physicochemical characteristics that dictate the function of a liposomal adjuvant. Hum Vaccin Immunother*. 2013 Jun;9(6):1374-81. doi: 10.4161/hv.24694. Epub 2013 Apr 12. PMID: 23584249; PMCID: PMC3901835.
4. Gupta AK, Singh A, Singh S. *Diagnosis of Tuberculosis: Nanodiagnosics Approaches. NanoBioMedicine*. 2019 Sep 25:261–83. doi: 10.1007/978-981-32-9898-9_11. PMCID: PMC7122355.
5. Rizvi SB, Ghaderi S, Keshtgar M, Seifalian AM. *Semiconductor quantum dots as fluorescent probes for in vitro and in vivo bio-molecular and cellular imaging. Nano Rev*. 2010;1. doi: 10.3402/nano.v1i0.5161. Epub 2010 Aug 16. PMID: 22110865; PMCID: PMC3215221.
6. Iglesias MS, Grzelczak M. *Using gold nanoparticles to detect single-nucleotide polymorphisms: toward liquid biopsy. Beilstein J Nanotechnol*. 2020 Jan 31;11:263-284. doi: 10.3762/bjnano.11.20. PMID: 32082965; PMCID: PMC7006498.
7. Pericleous P, Gazouli M, Lyberopoulou A, Rizos S, Nikiteas N, Efsthathopoulos EP. *Quantum dots hold promise for early cancer imaging and detection. Int J Cancer*. 2012 Aug 1;131(3):519-28. doi: 10.1002/ijc.27528. Epub 2012 Mar 29. Erratum in: *Int J Cancer*. 2015 Jul 1;137(1):1. PMID: 22411309

5) 064 – 1050: Basic Applications of Nanotechnology in Therapy

COURSE OUTLINE

GENERAL

SCHOOL	HEALTH SCIENCES, NATIONAL and KAPODISTRIAN UNIVERSITY OF ATHENS		
DEPARTMENT	SCHOOL OF MEDICINE & PHARMACY DEPARTMENT		
LEVEL OF EDUCATION	POSTGRADUATE		
COURSE CODE	064-105	SEMESTER	WINTER
COURSE TITLE	Basic Applications of Nanotechnology in Therapy		
INDEPENDENT TEACHING ACTIVITIES		WEEKLY TEACHING HOURS	CREDIT UNITS
Different forms of teaching		11	5
COURSE TYPE:		General background, General knowledge specialisation, Skills development	
PREREQUISITE COURSES:			
LANGUAGE OF TEACHING AND EXAMINATION:		ENGLISH	
THE COURSE IS OFFERED TO ERASMUS STUDENTS:		NO	
COURSE WEBPAGE (URL)		https://nanomed.med.uoa.gr/	

LEARNING RESULTS

Learning Results
<p>This lesson is the second lesson of the second thematic unit, which analyses the basic applications of nanotechnology in the treatment of various diseases. More specifically, students are familiarised with the applications of nanotechnology in areas such as the treatment of heart disease, pharmacology, skin diseases and nuclear medicine and radiotherapy. In addition, students will be introduced to the innovative field of theranostics, which is a combination of diagnosis and treatment using drugs composed of nanomaterials. This field is discussed in detail in the next course.</p> <p>Upon successful completion of the course, students will be able to:</p> <ul style="list-style-type: none"> - Know the applications of nanotechnology in the treatment of heart and skin diseases, as well as in nuclear medicine and radiotherapy - Be familiar with the applications of nanotechnology in surgery and orthopaedics - Get in touch with the rapidly growing field of theranostics
General Skills
<p>Searching, analysing and synthesising data and information, using the necessary technologies, Adapting to new situations, Working independently, Working in teams, Working in an interdisciplinary environment, Generating new research ideas, Designing and managing projects, Respecting diversity and multiculturalism, Promoting free, creative and inductive thinking.</p>

COURSE CONTENT

Lesson 2.2. Basic Applications of Nanotechnology in Therapy

This lesson is dedicated to the utilization of nanotechnology into treating several types of diseases, in cardiology and pharmacology, as well as in skin diseases. Additionally, applications in radiotherapy, orthopedics and in surgery are discussed.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY METHOD	Face-to-face and distance learning by conducting Group Counselling Meetings on students' progress on deliverables	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	<p>In meetings and/or tasks they are used:</p> <ul style="list-style-type: none"> - remote meeting tools (webex), - presentation software (powerpoint). <p>In addition, students use office automation tools, web browsers and e-readers for digital books.</p>	
TEACHING ORGANISATION	Activity	Semester Workload
	Lectures	22
	Personal Study and Exam Preparation for Unit 1 Exams	55
	Group work of the 1st unit	50
	Course Total	127
STUDENT ASSESSMENT	<p>The language of assessment for students is English.</p> <p>Preparation of a written work of medium length (3,000 words) in the form of a scientific article and presentation of the same, with a weighting factor of 30% in the final grade of the course.</p> <p>The grade of the paper is independent of whether the final or re-examination score is above the pass mark (greater than or equal to 5).</p> <p>The written examinations of the respective Thematic Unit have a weighting factor of 70%.</p> <p>Participation in the final examinations is granted if at least 80% of the courses are attended.</p>	

RECOMMENDED BIBLIOGRAPHY

1. Li M, Du C, Guo N, Teng Y, Meng X, Sun H, Li S, Yu P, Galons H. Composition design and medical application of liposomes. *Eur J Med Chem.* 2019 Feb 15;164:640-653. doi: 10.1016/j.ejmech.2019.01.007. Epub 2019 Jan 7. PMID: 30640028.
2. Akbarzadeh, A., Rezaei-Sadabady, R., Davaran, S. et al. Liposome: classification, preparation, and applications. *Nanoscale Res Lett* 8, 102 (2013). <https://doi.org/10.1186/1556-276X-8-102>.
3. Allen TM, Cullis PR. Liposomal drug delivery systems: from concept to clinical applications. *Adv Drug Deliv Rev.* 2013 Jan;65(1):36-48. doi: 10.1016/j.addr.2012.09.037. Epub 2012 Oct 1. PMID: 23036225.

4. Targeted radiotherapy with gold nanoparticles: current status and future perspectives. Wilfred Ngwa, Rajiv Kumar et al. *Nanomedicine* (2014) 9(7), 1063–1082
5. Monte Carlo studies in Gold Nanoparticles enhanced radiotherapy: The impact of modelled parameters in dose enhancement. Elena Vlastou, Stefanos Diamantopoulos, Efsthios P. Efsthathopoulos *Physica Medica* 80 (2020) 57–64
6. Haume K, Rosa S, Grellet S, Śmiatek MA, Butterworth KT, Solov'yov AV, Prise KM, Golding J, Mason NJ. Gold nanoparticles for cancer radiotherapy: a review. *Cancer Nanotechnol.* 2016;7(1):8. doi: 10.1186/s12645-016-0021-x. Epub 2016 Nov 3. PMID: 27867425; PMCID: PMC5095165.
7. Smith et al *BMC Musc Disorders* 2018, 19:67

6) 064 – 1060: Theranostics and regenerative medicine

COURSE OUTLINE

GENERAL

SCHOOL	HEALTH SCIENCES, NATIONAL and KAPODISTRIAN UNIVERSITY OF ATHENS		
DEPARTMENT	SCHOOL OF MEDICINE & PHARMACY DEPARTMENT		
LEVEL OF EDUCATION	POSTGRADUATE		
COURSE CODE	064-106	SEMESTER	WINTER
COURSE TITLE	Theranostics and regenerative medicine		
INDEPENDENT TEACHING ACTIVITIES		WEEKLY TEACHING HOURS	CREDIT UNITS
Different forms of teaching		11	5
COURSE TYPE:		General background, General knowledge specialisation, Skills development	
PREREQUISITE COURSES:			
LANGUAGE OF TEACHING AND EXAMINATION:		ENGLISH	
THE COURSE IS OFFERED TO ERASMUS STUDENTS:		NO	
COURSE WEBPAGE (URL)		https://nanomed.med.uoa.gr/	

LEARNING RESULTS

Learning Results
<p>This lesson is the third and last lesson of the second thematic unit, where the concepts of regenerative medicine and theranostics are analysed. More specifically, students become familiar with the field of theranostics, which is a modern field where the diagnosis and treatment of diseases is done by administering corresponding drugs, for the manufacture of which nanomaterials are used. In addition, this course also emphasizes the use of nanomaterials in applications related to regenerative medicine. Finally, the students' group projects of the second module are completed in this course, which they are required to submit in writing in the form of a scientific article and to present them to the lecturers in charge.</p> <p>Upon successful completion of the course, students are able to:</p> <ul style="list-style-type: none"> - Be familiar with the basic properties of smart biomaterials - Know the applications of smart biomaterials in regenerative medicine - Have knowledge about the applications of biosensors in the fields of medicine, environmental studies and food industry - Cultivate skills and competencies related to writing and presenting a scientific article as they complete the work in Module 2 - Present the paper briefly and concisely, but in a comprehensible manner and without missing important points, and answer questions adequately
General Skills
<p>Searching, analysing and synthesising data and information, using the necessary technologies, Adapting to new situations, Working independently, Working in teams, Working in an interdisciplinary environment, Generating new research ideas, Designing and managing projects, Respecting diversity and multiculturalism, Promoting free, creative and inductive thinking.</p>

COURSE CONTENT

Lesson 2.3. Theranostics and regenerative medicine

Theranostics is a new field of medicine which combines specific targeted therapy based on specific targeted diagnostic tests. The theranostics paradigm involves using nanotechnology to unite/combine diagnostic and therapeutic applications to form a single nanocarrier, allowing for diagnosis, drug delivery and treatment response monitoring. Micro-nano fabrication and cell patterning, Molecular markers for medical imaging and Image processing will be analyzed for building up nanoparticle-based theranostics.

Tissue engineering evolved from the field of nanobiomaterials development and refers to the practice of combining biopolymers, scaffolds, cells, and biologically active molecules into functional tissues. The goals of tissue engineering and regenerative medicine are to assemble functional constructs that restore, maintain, or improve damaged tissues or whole organs using types of embryonic, fetal and adult stem cells.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY METHOD	Face-to-face and distance learning by conducting Group Counselling Meetings on students' progress on deliverables	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	<p>In meetings and/or tasks they are used:</p> <ul style="list-style-type: none"> - remote meeting tools (webex), - presentation software (powerpoint). <p>In addition, students use office automation tools, web browsers and e-readers for digital books.</p>	
TEACHING ORGANISATION	Activity	Semester Workload
	Lectures	11
	Personal Study and Exam Preparation for Unit 1 Exams	35
	Group work of the 1st unit	30
	Course Total	76
STUDENT ASSESSMENT	<p>The language of assessment for students is English.</p> <p>Preparation of a written work of medium length (3,000 words) in the form of a scientific article and presentation of the same, with a weighting factor of 30% in the final grade of the course.</p> <p>The grade of the paper is independent of whether the final or re-examination score is above the pass mark (greater than or equal to 5).</p> <p>The written examinations of the respective Thematic Unit have a weighting factor of 70%.</p> <p>Participation in the final examinations is granted if at least 80% of the courses are attended.</p>	

RECOMMENDED BIBLIOGRAPHY

1. Mingyuan Li, Chunyang Du, Na Guo, Yuou Teng, Xin Meng, Hua Sun, Shuangshuang Li, Peng Yu, Hervé Galons, *Composition design and medical application of liposomes*, *European Journal of Medicinal Chemistry*, Volume 164, Pages 640-653, <https://doi.org/10.1016/j.ejmech.2019.01.007>.
2. Wibroe PP, Ahmadvand D, Oghabian MA, Yaghmur A, Moghimi SM. *An integrated assessment of morphology, size, and complement activation of the PEGylated liposomal doxorubicin products Doxil®, Caelyx®, DOXOrubicin, and SinaDoxosome*. *J Control Release*. 2016 Jan 10;221:1-8. doi: 10.1016/j.jconrel.2015.11.021. Epub 2015 Nov 26. PMID: 26608877.
3. Jeffrey D. Newman, Anthony P.F. Turner. *"Home Blood Glucose Biosensors: A Commercial Perspective"* *Biosensors and Bioelectronics*, Volume 20, Issue 12, 20th Anniversary of Biosensors and Bioelectronics, 15 June 2005, Pages 2435-2453
4. Englehardt, Kirk J. *"Food Safety Biosensor That Detects Pathogens Is Tested in Metro Atlanta Processing Plant."* Georgia Tech Research Institute: Industry Solutions 2010. Web.
5. Sun, D.Z., Abelson, B., Babbar, P. et al. *Harnessing the mesenchymal stem cell secretome for regenerative urology*. *Nat Rev Urol* 16, 363–375 (2019). <https://doi.org/10.1038/s41585-019-0169-3>
6. Yin JQ, Zhu J, Ankrum JA. *Manufacturing of primed mesenchymal stromal cells for therapy*. *Nat Biomed Eng*. 2019 Feb;3(2):90-104. doi: 10.1038/s41551-018-0325-8. Epub 2019 Jan 28. PMID: 30944433.
7. European Association for the Study of the Liver. *Electronic address: easloffice@easloffice.eu; European Association for the Study of the Liver. EASL Clinical Practice Guidelines on hepatitis E virus infection*. *J Hepatol*. 2018 Jun;68(6):1256-1271. doi: 10.1016/j.jhep.2018.03.005. Epub 2018 Mar 31. PMID: 29609832.

7) 064 -2010: Toxicity Aspects

COURSE OUTLINE

GENERAL

SCHOOL	HEALTH SCIENCES, NATIONAL and KAPODISTRIAN UNIVERSITY OF ATHENS		
DEPARTMENT	SCHOOL OF MEDICINE & PHARMACY DEPARTMENT		
LEVEL OF EDUCATION	POSTGRADUATE		
COURSE CODE	064-201	SEMESTER	SPRING
COURSE TITLE	Toxicity Aspects		
INDEPENDENT TEACHING ACTIVITIES		WEEKLY TEACHING HOURS	CREDIT UNITS
Different forms of teaching		11	3
COURSE TYPE:		General background, General knowledge specialisation, Skills development	
PREREQUISITE COURSES:			
LANGUAGE OF TEACHING AND EXAMINATION:		ENGLISH	
THE COURSE IS OFFERED TO ERASMUS STUDENTS:		YES	
COURSE WEBPAGE (URL)		https://nanomed.med.uoa.gr/	

LEARNING RESULTS

Learning Results
<p>This course is the first course of the 3rd thematic unit, where the introduction of students to the most basic concepts of the scientific field related to nanotechnology and their familiarization with the most basic applications of nanotechnology in medicine has been completed. In this course, students are familiar with the toxicity aspect related to the use of nanoparticles. At the end of the course, the students are again divided into groups of three or four and assigned the topics for the assignments of the third and final module.</p> <p>Upon successful completion of the course, students are able to:</p> <ul style="list-style-type: none"> - Know the possible causes of nanotoxicity - Be familiar with the interactions and distribution of nanoparticles in the human body - They have been informed through the presentation of the most recent research in the field of nanotoxicity
General Skills
<p>Searching, analysing and synthesising data and information, using the necessary technologies, Adapting to new situations, Working independently, Working in teams, Working in an interdisciplinary environment, Generating new research ideas, Designing and managing projects, Respecting diversity and multiculturalism, Promoting free, creative and inductive thinking.</p>

COURSE CONTENT

Lesson 3.1. Toxicity Aspects

Nanotoxicology involves different aspects of science, from molecular biology to quantum physics and chemistry and lays the foundations for eliminating all risks related to nanoparticles manufacturing and their applications. The major obstacle associated with nanoparticles hazardous impact determination is the variety of parameters that are suspects of their adverse effects. It is widely known that nanoparticles, dosage, size, composition, aggregation, surface charge, structure and chemistry even the route of administration and the exposure duration, are the main characteristics upon which Nanotoxicity depends.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY METHOD	Face-to-face and distance learning by conducting Group Counselling Meetings on students' progress on deliverables	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	<p>In meetings and/or tasks they are used:</p> <ul style="list-style-type: none"> - remote meeting tools (webex), - presentation software (powerpoint). <p>In addition, students use office automation tools, web browsers and e-readers for digital books.</p>	
TEACHING ORGANISATION	Activity	Semester Workload
	Lectures	11
	Personal Study and Exam Preparation for Unit 1 Exams	35
	Group work of the 1st unit	30
	Course Total	76
STUDENT ASSESSMENT	<p>The language of assessment for students is English.</p> <p>Preparation of a written work of medium length (3,000 words) in the form of a scientific article and presentation of the same, with a weighting factor of 30% in the final grade of the course.</p> <p>The grade of the paper is independent of whether the final or re-examination score is above the pass mark (greater than or equal to 5).</p> <p>The written examinations of the respective Thematic Unit have a weighting factor of 70%.</p> <p>Participation in the final examinations is granted if at least 80% of the courses are attended.</p>	

RECOMMENDED BIBLIOGRAPHY

1. Akçan R, Aydoğan HC, Yildirim MŞ, Taştekin B, Sağlam N. Nanotoxicity: a challenge for future medicine. *Turk J Med Sci.* 2020 Jun 23;50(4):1180-1196. doi: 10.3906/sag-1912-209. PMID: 32283898; PMCID: PMC7379444.

2. Khanna P, Ong C, Bay BH, Baeg GH. Nanotoxicity: An Interplay of Oxidative Stress, Inflammation and Cell Death. *Nanomaterials (Basel).* 2015 Jun 30;5(3):1163-1180. doi: 10.3390/nano5031163. PMID: 28347058; PMCID: PMC5304638.

3. Kim, I.Y.; Kwak, M.; Kim, J.; Lee, T.G.; Heo, M.B. *Comparative Study on Nanotoxicity in Human Primary and Cancer Cells*. *Nanomaterials* 2022, 12, 993. <https://doi.org/10.3390/nano12060993>
4. Akçan R, Aydoğan HC, Yildirim MŞ, Taştekin B, Sağlam N. *Nanotoxicity: a challenge for future medicine*. *Turk J Med Sci*. 2020 Jun 23;50(4):1180-1196. doi: 10.3906/sag-1912-209. PMID: 32283898; PMCID: PMC7379444.
5. Anand Babu Perumal, Reshma B. Nambiar, Periyar Selvam Sellamuthu, Emmanuel Rotimi Sadiku, *Nanotoxicity of nanoparticles, Nanomedicine Manufacturing and Applications*, Elsevier, Pages 125-147, <https://doi.org/10.1016/B978-0-12-820773-4.00019-6>.
6. Bhavna Saini and Sumit Srivastava 2018 *IOP Conf. Ser.: Mater. Sci. Eng.* 348 012005, DOI 10.1088/1757-899X/348/1/012005

8) 064 – 2020: Current Nanodrugs

COURSE OUTLINE

GENERAL

SCHOOL	HEALTH SCIENCES, NATIONAL and KAPODISTRIAN UNIVERSITY OF ATHENS		
DEPARTMENT	SCHOOL OF MEDICINE & PHARMACY DEPARTMENT		
LEVEL OF EDUCATION	POSTGRADUATE		
COURSE CODE	064-202	SEMESTER	SPRING
COURSE TITLE	Current Nanodrugs I		
INDEPENDENT TEACHING ACTIVITIES		WEEKLY TEACHING HOURS	CREDIT UNITS
Different forms of teaching		11	4
COURSE TYPE:		General background, General knowledge specialisation, Skills development	
PREREQUISITE COURSES:			
LANGUAGE OF TEACHING AND EXAMINATION:		ENGLISH	
THE COURSE IS OFFERED TO ERASMUS STUDENTS:		YES	
COURSE WEBPAGE (URL)		https://nanomed.med.uoa.gr/	

LEARNING RESULTS

Learning Results
<p>This course is the second course of the 3rd thematic unit and its purpose is to familiarize students with nanomedicines that are approved by both European and American organizations and are either in clinical trials or in clinical use.</p> <p>Upon successful completion of the course, students will be able to:</p> <ul style="list-style-type: none"> - Know the approved and widely used clinical nanomedicines - Are fully familiar with the use of nanoparticles in cancer treatment
General Skills
<p>Searching, analysing and synthesising data and information, using the necessary technologies, Adapting to new situations, Working independently, Working in teams, Working in an interdisciplinary environment, Generating new research ideas, Designing and managing projects, Respecting diversity and multiculturalism, Promoting free, creative and inductive thinking.</p>

COURSE CONTENT

<p>Lesson 3.2. Current Nanodrugs</p> <p>Clinical Nanomedicine deals with the use of nanomedicines in clinical use and practice. Special attention will be given to cancer nanotherapy. There are several liposomal and polymeric drugs in market approved by FDA and EMA. In this lesson, case studies and examples will be presented focusing on the advantages of nanocarriers in clinical use.</p>

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY METHOD	Face-to-face and distance learning by conducting Group Counselling Meetings on students' progress on deliverables	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	<p>In meetings and/or tasks they are used:</p> <ul style="list-style-type: none"> - remote meeting tools (webex), - presentation software (powerpoint). <p>In addition, students use office automation tools, web browsers and e-readers for digital books.</p>	
TEACHING ORGANISATION	Activity	Semester Workload
	Lectures	11
	Personal Study and Exam Preparation for Unit 1 Exams	35
	Group work of the 1st unit	30
	Course Total	76
STUDENT ASSESSMENT	<p>The language of assessment for students is English.</p> <p>Preparation of a written work of medium length (3,000 words) in the form of a scientific article and presentation of the same, with a weighting factor of 30% in the final grade of the course.</p> <p>The grade of the paper is independent of whether the final or re-examination score is above the pass mark (greater than or equal to 5).</p> <p>The written examinations of the respective Thematic Unit have a weighting factor of 70%.</p> <p>Participation in the final examinations is granted if at least 80% of the courses are attended.</p>	

RECOMMENDED BIBLIOGRAPHY

1. Vedant Gadekar, Yogeshwari Borade, Suraj Kannaujia, Kuldeep Rajpoot, Neelima Anup, Vishakha Tambe, Kiran Kalia, Rakesh K. Tekade, Nanomedicines accessible in the market for clinical interventions, *Journal of Controlled Release*, Volume 330, Pages 372-397, <https://doi.org/10.1016/j.jconrel.2020.12.034>.
2. S.A.A. Rizvi, A.M. Saleh, Applications of nanoparticle systems in drug delivery technology, *Saudi Pharm. J.* 26 (2018) 64–70.
3. C. Truillet, P. Bouziotis, C. Tsoukalas, J. Brugière, M. Martini, L. Sancey, T. Brichart, F. Denat, F. Boschetti, U. Darbost, I. Bonnamour, D. Stellas, C.D. Anagnostopoulos, V. Koutoulidis, L.A. Mouloupoulos, P. Perriat, F. Lux and O. Tillement, "Ultrasmall particles for Gd-MRI and 68Ga-PET dual imaging", *Contrast Media and Molecular Imaging*, 2015.
4. Bouziotis P, Stellas D., Thomas E., Truillet C., Tsoukalas C., Lux F., Tsotakos T., Xanthopoulos S., Paravatou-Petsotas M., Gaitanis A., Mouloupoulos L., Koutoulidis V., Anagnostopoulos C.D., Tillement O., "68Ga-radiolabeled AGuIX nanoparticles as dual-modality imaging agents for PET/MRI guided radiation therapy", *Nanomedicine*, July 2017
5. A proof-of-concept study on the therapeutic potential of Au nanoparticles radiolabeled with the alpha-emitter Actinium-225. Evangelia-Alexandra Salvanou, Dimitrios Stellas, Charalampos Tsoukalas, Barbara Mavroidi, Maria Paravatou-Petsotas, Nikolaos Kalogeropoulos, Stavros Xanthopoulos, Franck Denat, Gautier Laurent, Rana Bazzi, Stephane Roux and Penelope Bouziotis, *Pharmaceutics* 2020

6. McLaughlin, M., Woodward, J., & Boll, R., Rondinone, A., Mirzadeh, S., Robertson, J.. (2013). Gold-coated lanthanide phosphate nanoparticles for an Ac-225 in vivo alpha generator. *Radiochimica Acta*. 101. 595-600.

9) 064 -2030: Ethics and Regulatory Aspects

ΠΕΡΙΓΡΑΦΜΑ ΜΑΘΗΜΑΤΟΣ

ΓΕΝΙΚΑ

SCHOOL	HEALTH SCIENCES, NATIONAL and KAPODISTRIAN UNIVERSITY OF ATHENS		
DEPARTMENT	SCHOOL OF MEDICINE & PHARMACY DEPARTMENT		
LEVEL OF EDUCATION	POSTGRADUATE		
COURSE CODE	064-203	SEMESTER	SPRING
COURSE TITLE	Ethics and Regulatory Aspects		
INDEPENDENT TEACHING ACTIVITIES		WEEKLY TEACHING HOURS	CREDIT UNITS
Different forms of teaching		11	3
COURSE TYPE:	General background, General knowledge specialisation, Skills development		
PREREQUISITE COURSES:			
LANGUAGE OF TEACHING AND EXAMINATION:	ENGLISH		
THE COURSE IS OFFERED TO ERASMUS STUDENTS:	YES		
COURSE WEBPAGE (URL)	https://nanomed.med.uoa.gr/		

LEARNING RESULTS

Learning Results
<p>This course is the third and final course of the third module and its purpose is to introduce students to regulatory and ethical issues related to the use of nanoparticles. More specifically, ethical issues related to the application of nanotechnology to medical issues are discussed, as well as the regulations established by various institutions and states regarding the safety of nanotechnology applications. Finally, this course also completes the students' group projects of the third thematic unit, which they are required to submit in writing in the form of a scientific article and to present them to the lecturers in charge.</p> <p>Upon successful completion of the course, students are able to:</p> <ul style="list-style-type: none"> - Become familiar with ethical issues regarding the use of nanoparticles - Be familiar with the interactions and distribution of nanoparticles in the human body - Have been informed through the presentation of the most recent research in the field of nanotoxicity
General Skills
<p>Searching, analysing and synthesising data and information, using the necessary technologies, Adapting to new situations, Working independently, Working in teams, Working in an interdisciplinary environment, Generating new research ideas, Designing and managing projects, Respecting diversity and multiculturalism, Promoting free, creative and inductive thinking.</p>

COURSE CONTENT

Lesson 3.3. Ethics and Regulatory Aspects

III.1. Regulatory and Ethics in Nanomedicine.

III.2 Intellectual properties. Patenting and Commercialization of Biotech and Medtech Inventions

The entire "product life cycle," from the creation of nanomedical products to their final market introduction will be discussed in the above lesson. While focusing on critical issues relevant to nanoprodukt development and translational activities, it tackles topics such as regulatory science, patent law, FDA and EMA law, ethics, personalized medicine, risk analysis, toxicology, nano-characterization and commercialization activities.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY METHOD	Face-to-face and distance learning by conducting Group Counselling Meetings on students' progress on deliverables	
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	<p>In meetings and/or tasks they are used:</p> <ul style="list-style-type: none"> - remote meeting tools (webex), - presentation software (powerpoint). <p>In addition, students use office automation tools, web browsers and e-readers for digital books.</p>	
TEACHING ORGANISATION	Activity	Semester Workload
	Lectures	11
	Personal Study and Exam Preparation for Unit 1 Exams	35
	Group work of the 1st unit	30
	Course Total	76
STUDENT ASSESSMENT	<p>The language of assessment for students is English.</p> <p>Preparation of a written work of medium length (3,000 words) in the form of a scientific article and presentation of the same, with a weighting factor of 30% in the final grade of the course.</p> <p>The grade of the paper is independent of whether the final or re-examination score is above the pass mark (greater than or equal to 5).</p> <p>The written examinations of the respective Thematic Unit have a weighting factor of 70%.</p> <p>Participation in the final examinations is granted if at least 80% of the courses are attended.</p>	

RECOMMENDED BIBLIOGRAPHY

1. Shreya Kaul, Neha Gulati, Deepali Verma, Siddhartha Mukherjee, Upendra Nagaich, "Role of Nanotechnology in Cosmeceuticals: A Review of Recent Advances", *Journal of Pharmaceutics*, vol. 2018, Article ID 3420204, 19 pages, 2018. <https://doi.org/10.1155/2018/3420204>

2. Shokri J. *Nanocosmetics: benefits and risks*. *Bioimpacts*. 2017;7(4):207-208. doi: 10.15171/bi.2017.24. Epub 2017 Nov 16. PMID: 29435427; PMCID: PMC5801531.
3. Fytianos, G.; Rahdar, A.; Kyzas, G.Z. *Nanomaterials in Cosmetics: Recent Updates*. *Nanomaterials* 2020, 10, 979. <https://doi.org/10.3390/nano10050979>
4. Isles MP. *Nanomedicines and Nanosimilars-Why a Robust Centralised Regulatory Framework Is Essential to Enhance Patient Safety*. *Front Pharmacol*. 2022 Feb 24;12:787239. doi: 10.3389/fphar.2021.787239. PMID: 35280250; PMCID: PMC8907565.
5. Sainz V, Conniot J, Matos AI, Peres C, Zupancic E, Moura L, Silva LC, Florindo HF, Gaspar RS. *Regulatory aspects on nanomedicines*. *Biochem Biophys Res Commun*. 2015 Dec 18;468(3):504-10. doi: 10.1016/j.bbrc.2015.08.023. Epub 2015 Aug 8. PMID: 26260323.
6. Bawa, R., Johnson, S. (2009). *Emerging Issues in Nanomedicine and Ethics*. In: Allhoff, F., Lin, P. (eds) *Nanotechnology & Society*. Springer, Dordrecht. https://doi.org/10.1007/978-1-4020-6209-4_11