AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Physics of nanomagnetism and some biomedical applications.

Academic year: 2016/2017 Code: JBF-3-024-s ECTS credits: 4

Faculty of: Physics and Applied Computer Science

Field of study: Biophysics Specialty: —

Study level: Third-cycle studies Form and type of study: Full-time studies

Lecture language: English Profile of education: Academic (A) Semester: 0

Course homepage: —

Responsible teacher: prof. dr hab. Burda Kvetoslava (kvetoslava.burda@fis.agh.edu.pl)

Academic teachers:

Module summary

Physical background of magnetism and interactions between magnetic nanoparticles and biomaterials will be presented. Their potential applications in new biotechnologies and medicine will be discussed.

Description of learning outcomes for module

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Connections with FLO	Method of learning outcomes verification (form of completion)
Social competence			
M_K001	Student will understand the importance of continuous learning and combining knowledge from different fields of knowledge. Student will be able to formulate new problems and search for their solution.	BF3A_K01	Participation in a discussion
Skills			
M_U001	Student will understand physical background of magnetism and interactions between magnetic nanoparticles and biomaterials. Student will be able to indicate their potential applications in new biotechnologies and medicine.	BF3A_U02, BF3A_U01	Presentation
M_U002	Student is capable of reading and understanding papers on a given scientific problem. Student can present seminar using this knowledge.	BF3A_U02	Presentation
Knowledge			

M_W001	Student will acquire knowledge about the magnetic nanoparticles and their potential applications in biomedicine.	BF3A_W01, BF3A_W02	Presentation

FLO matrix in relation to forms of classes

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Form of classes										
		Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Others	E-learning
Social competence												
M_K001	Student will understand the importance of continuous learning and combining knowledge from different fields of knowledge. Student will be able to formulate new problems and search for their solution.	+	-	-	-	-	+	-	-	-	-	-
Skills												
M_U001	Student will understand physical background of magnetism and interactions between magnetic nanoparticles and biomaterials. Student will be able to indicate their potential applications in new biotechnologies and medicine.	+	-	-	-	-	+	-	-	-	-	-
M_U002	Student is capable of reading and understanding papers on a given scientific problem. Student can present seminar using this knowledge.	+	-	-	-	-	+	-	-	-	-	-
Knowledge												
M_W001	Student will acquire knowledge about the magnetic nanoparticles and their potential applications in biomedicine.	+	-	-	-	-	+	-	-	-	-	-

Module content

Lectures

Physics of nanomagnetism and some biomedical applications.
I.INTRODUCTION

1.History of magnetic materials.
2.Current state: nanomagnetism, nanomaterials and nanotechnology.
II.THE (SHORT) CRASH-COURSE ON NANOMAGNETISM
3.The magnetic behavior of bulk materials.
4.Magnetism at small dimensions: the collapse of magnetic domains.
5.There can be only one: the single domain particle. Superparamagnetism.
6.The magnetic fingerprints of magnetic nanoparticles.
7.The surface magnetic disorder: I see dead layers.
III.MAGNETIC NANOPARTICLES AND MAGNETIC FIELDS
8.Magnetic fields: the invisible stranger.
9.Why my Pin sticks to my refrigerator? The static H-M interaction.
10.Why my mobile charger heat up while charging? Magnetic Losses and Power absorption
11.Dancing under magnetic fields: magnetic nanoparticles under radiofrequency fields.
12.The magnetic parameters: figuring out what's really important
13.Size matters: effect of particle size and aggregation on the power absorption efficiency.
14.Physical effects of magnetic fields on biological systems. Do you care about your mobile radiation? Myths and facts.
15.Safety and limits for the magnetic field. To be or not to be (afraid of the Wifi)
IV.DO IT YOURSELF: NANOMATERIALS
16.Chemical Synthesis of magnetic nanoparticles
17.Physical Synthesis of magnetic nanoparticles
18.Functionalization of MNPs: in situ vs. ex situ methods.
19.Characterization of magnetic nanoparticles.
20.Magnetic colloids: biocompatibility, stability, reproducibility.
21.MNPs in physiological environments.
V.THE BIO-NANO INTERACTION
22.MNPs and the eukaryotic cell: a subtle interaction
23.MNPs uptake and trafficking pathways.
24.Toxicity of nanomaterials at the cell level.
25.Magnetized cells: potential for nanodiagnosis and nanotherapy.
VI.BIOMEDICAL APPLICATIONS OF MAGNETIC NANOPARTICLES: POSSIBILITIES AND LIMITATIONS.
26.Nanotechnology into the Clinics.
27.Future diagnosis and therapy protocols: here comes the sun.
VII.CONCLUSIONS

Seminar classes

Nanomagnetism and selected biomedical applications
Oral presentations

Method of calculating the final grade

Grading
Oral presentation: 35 %
Paper discussions: 35 %
Debates: 30 %
Final grade
50% failed
50-60% 3,0
61-70% 3,5

71-80% 4,0
81-90% 4,5

Prerequisites and additional requirements
Basic knowledge in physics, chemistry, biophysics and biochemistry.

Recommended literature and teaching resources
Will be given during the lectures.

Scientific publications of module course instructors related to the topic of the module
According to the list of publications available on the Web of Science.

Additional information
Teacher responsible for the classes
Dr. Gerardo F. Goya
Instituto Universitario de
Investigación en Nanociencia de Aragón (INA).
Universidad de Zaragoza
Mariano Esquillor s/n
50018-Zaragoza
web:http://www.unizar.es/gfgoya/

Student workload (ECTS credits balance)

Student activity form	Student workload
Participation in seminar classes	20 h
Participation in lectures	40 h
Contact hours	10 h
Preparation for classes	20 h
Summary student workload	90 h
Module ECTS credits	4 ECTS