COURSE DESCRIPTION CARD - SYLLABUS

Course name

Physics of magnetism - from single atoms to functional nanostructures

Course

Field of study

Technical Physics

Year/Semester

III/5

Area of study (specialization)

-

Profile of study

general academic

Level of study

First-cycle studies

Course offered in

Polish

Form of study

full-time

Requirements

elective

Number of hours

Lecture

30

Laboratory classes

Other (e.g. online)

Tutorials

Projects/seminars

Number of credit points

Lecturers

Responsible for the course/lecturer:

dr hab. inż. Piotr Kuświk prof. IFM PAN

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Zakład Cienkich Warstw

Instytut Fizyki Molekularnej PAN

ul. M. Smoluchowskiego 17, Poznań

Responsible for the course/lecturer:

dr inż. Maciej Bazarnik

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Instytut Fizyki

Wydział Inżynierii Materiałowej i Fizyki Technicznej Politechniki Poznańskiej

ul. Piotrowo 3, Poznań

Prerequisites

A prerequisite to participation in the curse is knowledge in experimental physics, atomic physics, and solid state physics. In particular, knowledge of basic concepts in quantum physics and surface physics. The ability to tackle problems in physics and material engineering and efficient use of available resources such as books and publications pointed out by the lecturer are also necessary. A surge for new knowledge as well as an active attitude during problem-solving is essential.

Course objective

1. Presentation of knowledge in magnetism and particular applications of magnetic nanostructures in computer science, electronics, and medicine.

2. Familiarize students with issues related to the methods of preparation and structurization of magnetic materials as well as characterization of their magnetic properties.

Course-related learning outcomes

Knowledge

As an effect of the course, a student has:

1. a detailed knowledge about magnetic materials, in particular, he or she understands the mechanisms responsible for magnetic properties of matter and the role of magnetic interactions in the creation of magnetic structures

2. necessary skills to characterize physical properties of magnetic materials and, in particular magnetic nanostructures.

3. an overview of state of the art in applied magnetic nanostructures in computer science and medicine and the newest trends in spin-based electronics.

Skills

A student can:

1. analyze problems in the physics of magnetism and solve them using his or her knowledge.

2. compare and choose the most appropriate tool for the characterization of magnetic materials.

3. understand and use given sources of knowledge and gain knowledge from other resources, including the internet

Social competences

The student will gain competence allowing for:

1. Engaging in basic task solving and independent building of their skills.

2. Understanding the importance of modern magnetic nanostructures for computer science, electronics, medicine, and the broadly understood civilization progress.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

written/oral exam

3: 50.1%–70.0%

4: 70.1%–90.0%

5: od 90.1%

Programme content

1) Basic concepts of the physics of magnetism - magnetic anisotropy, magnetic domains, magnetic ordering, domain walls, the magnetization reversal process.

2) Thin film deposition techniques

3) Measurement of magnetic properties of nanostructures

4) Topological patterning

5) Magnetic patterning

6) Magnetic nanostructures and their applications

7) Hybridization of atoms and molecules with the substrate - The theory of the crystal field

8) Direct and indirect magnetic interactions

9) Magnetic non-collinear structures

10) Magnetism of organic and organometallic compounds

11) Measurements of magnetic properties on the atomic scale

Teaching methods

Lecture: presentation illustrated with examples given on the board.

Bibliography

Basic

C. Kittel, Wstęp do fizyki ciała stałego, PWN, Warszawa (2011)

A. Szewczyk, A. Wiśniewski, R. Puźniak, H. Szymczak, Magnetyzm i nadprzewodnictwo, PWN, Warszawa 2021

A. H. Morrish, Fizyczne podstawy magnetyzmu, PWN, Warszawa 1970.

Artykuły naukowe w zakresie wytwarzania i charakteryzacji magnetycznych nanostruktur

Additional

A.Oleś, „Metody doświadczalne fizyki cała stałego”, Wydawnictwo Naukowo Techniczne, Warszawa 1998

Breakdown of average student's workload

	Hours	ECTS
Total workload		
Classes requiring direct contact with the teacher		
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]		

[1] delete or add other activities as appropriate