COURSE DESCRIPTION CARD - SYLLABUS

Course name
Quantum Nanoelectronics

Course

Field of study
Technical Physics

Year/Semester

Area of study (specialization)

Profile of study

Błąd! Nie zdefiniowano zakładki.

Level of study
Second-cycle studies

Course offered in

Form of study
full-time

Requirements

Number of hours

Lecture
30

Laboratory classes

Other (e.g. online)

Tutorials

Projects/seminars

Number of credit points

2

Lecturers

Responsible for the course/lecturer:
Błąd! Nie zdefiniowano zakładki.

Responsible for the course/lecturer:

Prerequisites

Knowledge of quantum mechanics and the elements of solid state theory. The basics of nanostructures' manufacturing methods.

Course objective

The course starts with the discussion of traditional semiconductor devices and later moves into the nanoscale with the discussion of various nanostructures with possible future (or in some cases current) applications in electronics. These includes e.g. qauntum dots, point contacts, carbon nanostructures, spintronic devices etc. We shall discuss both the basic physical principles but also the specific proposed and/or demonstrated devices.

Course-related learning outcomes

Knowledge

1. The physical principles of the charge and spin transport in the nanoscale [K2_W02]

2. The basics of modeling of the nanodevices. [K2_W01]

3. The most important, currently researched topics for the advancement of the electronics. [K2_W10]

Skills

1. Ability to present and prepare the report in a form resembling the scientific paper or conference contribution. [K2_U03]

Social competences

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

	Assesment criteria	
K2_W01, K2_W02, K2_W10	written final exam	50.1-70% (3), 7.1-90% (4), 90-100% (5)
K2_UO3	written final exam	50.1-70% (3), 7.1-90% (4), 90-100% (5)
K2_K04	activity during lectures	50.1-70% (3), 7.1-90% (4), 90-100% (5)

Programme content

1. Introductory material: the elements of solid state theory, the properties of semiconductors.

2. The contemporary electronics: *pn* junction, other kinds of diodes, the MOSFET transistor, the challenges of miniaturization

3. The survey of low dimensional structures, characteristic physical variables,

4. Ballistic transport and ballistic nanodevices, Quantum Hall Effect

5. Quantum dots – from Coulomb blockade to Kondo effect

6. Spintronics

7. Graphene and other graphene-like nanostructures

Teaching methods

multimedia presentation using an overhead projector

Bibliography

Basic

1. Ashcroft and Mermin “Solid state physics” and/or other textbooks on the same topic

2. S.M.Sze “Physics of Semiconductor Devices” and “Semiconductor Devices: Physics and Technoogy”

3. S. Datta, ”Electronic transport in mesoscopic systems”

Additional

Various publications from the professional press

Breakdown of average student's workload

	Hours	ECTS
Total workload		
Classes requiring direct contact with the teacher	30	**Błąd! Nie zdefiniowano zakładki.**
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