COURSE DESCRIPTION CARD - SYLLABUS

Course name
Quantum Nanoelectronics [S2FT2>Nanoelekwant]

Course

Field of study
Technical Physics

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
0

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

1,00

Coordinators

dr hab. Maciej Zwierzycki

Lecturers

Prerequisites

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

Course objective

1. The course aims to give students the knowledge about fundamentals of charge and spin transport in the nanostructures, with emphasis on the possibility of their application in nanoelectronics. 2. The development of students' ability to find and present information in organized fashion

Course-related learning outcomes

Knowledge:
1. The physical principles of the charge and spin transport in the nanoscale
2. The basics of modeling of the nanodevices
3. The most important, currently researched topics for the advancement of the electronics

Skills:
Ability to prepare and present the well organized report on the subject of study.

Social competences:
Understanding the need and knowing of the possibilities of constantly updating ones professional skills and knowledge.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

In terms of the methods used to verify the achieved learning outcomes, the following grade thresholds are used:
50.1-60% - 3,0;
60.1-70% - 3.5;
70.1-80% - 4.0
80.1-90% - 4.5
from 90.1% - 5.0.
The grade is based on individual written work and/or oral response.

Programme content

The lecture begins with the discussion of the fundamentals of present day semiconductor-based electronics: pn-juction and MOSFET transistor, and the challenges of their further miniaturization. Later on we shall discuss the selected research areas and physical systems (materials and nanostructures) giving hopes for replacing or supplementing current devices. Examples include: ballistic systems, quantum dots, spintronics and spinorbitronics and topological insulators.

Course topics

1. Introductory material: the elements of solid state theory, the properties of semiconductors.
2. The contemporary electronics: pn junction, various 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. Topological insulators

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	25	1,00
Classes requiring direct contact with the teacher	15	0,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	10	0,50