DOCTORAL SCHOOL OF WROCŁAW UNIVERSITY OF SCIENCE AND TECHNOLOGY

SUPERVISOR DECLARING/CONDUCTING COURSE: PAWEL HAWRYLAK
DEPARTMENT: WPPT
SCIENTIFIC DISCIPLINE: PHYSICS

COURSE CARD

Course name in Polish: Warsztat Badacza w dziedzinie fizyki ciala stalego
Course name in English: Research skills in condensed matter physics
Course language: english
The course is intended for all PhD students: YES
1) BASIC COURSE
2) SPECIALIST COURSE
3) SEMINAR
4) HUMANISTIC COURSE
5) LANGUAGE
6) RESEARCH SKILLS

Subject code: NFQ100279W

* delete as applicable

	Lecture	Foreign language course	Seminar	Mixed forms
Number of hours of organized classes in university (ZZU)	**30**			
Grading	**Exam**	Exam	Oral presentation	Exam, inspection, evaluation classes

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. GOOD COMMAND OF ENGLISH
2. INTRODUCTION TO SOLID STATE PHYSICS

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COURSE OBJECTIVES
C1 . TO INTRODUCE STUDENTS TO RESEARCH SKILLS,TOOLS AND CONCEPTS NEEDED IN THE FIELD OF CONDENSED MATTER PHYSICS AND QUANTUM TECHNOLOGIES

PROGRAM CONTENTS

Form of classes - Lecture		Number of hours
	Introduction to methods of many-body physics (many-body problem, second quantisation, Feynman diagrams, HF, DFT, correlations, exact diagonalisation)	8

	Linear response theory (Kubo, Landauer Buttiker, Bethe-Salpeter,RPA, dielectric function)	5
	Quasiparticles (HO in Qdots, Dirac Fermions, massive DF in 2D materials, Composite Fermions, Majoranas, Jordan-Wigner)	6
	Superconductivity (Cooper pairs, BCS, Nambu, Josephson junction)	4
	Selected models (Hubbard, Anderson resonance, Fermi edge singularity, Kondo)	3
	Phase transitions (Landau, Landau-Ginzburg, topological, SSH model)	3
	Total hours	**30**

TEACHING TOOLS USED
N1. **IN PERSON LECTURES** **N2. AUDIOVISUAL TOOLS**

ACHIEVED SUBJECT LEARNING OUTCOMES		
Type of learning outcome	Code of learning outcome	Assessment of learning outcome
Knowledge	P8U_WG	Students learn selected advanced topics of the solid state physics, learn the modern techniques and are able to judge on the validity and importance of the contemporary research

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- Piers Coleman, Introduction to Many-body Physics
- Guclu, Potasz, Korkusinski, Hawrylak, Graphene quantum dots, Springer (2014)
- Grosso and Parravicini, Solid State Physics, 2nd Ed. (2013)
- G.D.Mahan, Many-Particle Physics

SECONDARY LITERATURE:

- Ashcroft and Mermin, Solid State Physics (1976).

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

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