

**DOCTORAL SCHOOL OF WROCLAW UNIVERSITY OF SCIENCE AND  
TECHNOLOGY**

**SUPERVISOR/TEAM/ DECLARING/CONDUCTING COURSE:** Prof. dr hab. Marcin Mierzejewski

**DEPARTMENT:** Faculty of Basic Technical Problems W11

**SCIENTIFIC DISCIPLINE:** Physical Sciences

**COURSE CARD**

**Course name in Polish:** Teoria ciała stałego

**Course name in English:** Theoretical solid state physics

**Course language Polish**

**University-wide general course type\*:**

**The course is intended for all PhD students: YES / NO**

~~1) BASIC COURSE~~

2) **SPECIALIST COURSE**

~~3) SEMINAR~~

~~4) HUMANISTIC COURSE~~

~~5) LANGUAGE~~

**Subject code: NFQ100052W**

\* 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
Number of ECTS points	<b>0</b>			

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Basic knowledge of mathematical analysis and linear algebra
2. Basic knowledge of quantum mechanics
3. Basic knowledge of statistical physics
4. Ability of reading scientific literature in English

**COURSE OBJECTIVES**

- C1 Students learn the basic concepts and methods of theoretical solid state physics  
C2 Students learn the main open problems in the theoretical solid state physics

**DOCTORAL SCHOOL OF WROCLAW UNIVERSITY OF SCIENCE AND  
TECHNOLOGY**

**PROGRAM CONTENTS**

<b>Form of classes – lecture (Lec)</b>		Number of hours
Lec1	Introduction: Basic formalism for quantum many-body systems	4
Lec2	Selected tight-binding models (Heisenberg, Ising, Hubbard, t-J) and construction of the matrix elements of selected Hamiltonians	3
Lec3	Selected representations of the spin operators via fermionic and bosonic operators	3
Lec4	Quasiparticles: magnons in ferromagnet	3
Lec5	Susceptibilities and the linear response theory	3
Lec6	Basic properties of the thermodynamic Green functions	3
Lec7	Electron-phonon interaction	2
Lec8	Superconductivity	3
Lec9	Superfluidity	2
Lec10	Peierls instability and charge-density waves	2
Total hours:		<b>30</b>

**TEACHING TOOLS USED**

N1. Lecture and discussion

**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
Knowledge		
...		
Skills		
Skills		
...		
Social competence		
Social competence		
...		

**DOCTORAL SCHOOL OF WROCLAW UNIVERSITY OF SCIENCE AND  
TECHNOLOGY**

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**

Józef Spalek, „Wstęp do fizyki fazy skondensowanej”, PWN

**SECONDARY LITERATURE:**

Gerald D. Mahan., „Many-particle physics”, Springer

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

**Marcin Mierzejewski, marcin.mierzejewski@pwr.edu.pl**