**WROCŁAW UNIVERSITY OF TECHNOLOGY – PHD STUDIES**

**FACULTY OF …….**

# SUBJECT CARD

| |
|---|
| Course name in Polish |
| Course name in English |
| Course language |
| University-wide general course type:<br>1)basic course (mathematics, **physics**, chemistry, other)<br>2) humanity course<br>3) managerial skills<br>4) English language<br>5) other modern language<br>Departmental course developing professional skills:<br>1) specialized course<br>**2) interdisciplinary course**<br>3) seminar (interdisciplinary, specialized, departmental) |
| Type of course (obligatory, optional) |
| **Educational effects according to ZW 26/2017:** P8U_W, P8U_U, P8U_K<br>Knowledge in Selected Aspects of Solid State Physics |
| |
| Subject code |

*delete as applicable

| | Lecture | Laboratory | Seminar |
|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | |
| Number of hours of total student workload (CNPS) | 90 | | |
| Form of crediting | Examination ** | Exam / crediting with grade* | Oral presentation |
| Number of ECTS points | 3 | | |
| including number of ECTS points for practical (P) classes | 2 | | |
| including number of ECTS points for direct teacher-student contact (BK) classes | 1 | | |

*delete as applicable **In case of didactic courses also inspections and evaluation classes

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

1. Basic knowledge in quantum mechanics
2. This course program provides means to acquire skill in selected topics on Selected Aspects of Solid State Physics

| **SUBJECT OBJECTIVES** | |
|---|---|
| C1 | This course program provides knowledge in calculations of energy band structure |
| C2 | This course program provides knowledge in electrical phenomena in solid states |
| C3 | This course program provides knowledge in interactions of electrons and holes with external magnetic and electric fields |
| C4 | This course program provides knowledge in low dimensional semiconductor structures |

## WROCŁAW UNIVERSITY OF TECHNOLOGY – PHD STUDIES

**SUBJECT EDUCATIONAL EFFECTS**

**Relating to knowledge:**

PEK_W01 Student acquire knowledge in calculations of energy band structure
PEK_W02 Student acquire knowledge in electrical phenomena in solid states
PEK_W03 Student acquire knowledge in interactions of electrons and holes with external magnetic and electric fields
PEK_W04 Student acquire knowledge in low dimensional semiconductor structures

**Relating to skills:**

PEK_U01 Student acquire skills in calculations of energy band structure
PEK_U02 Student acquire skills in electrical phenomena in solid states.
PEK_U03 Student acquire skills in interactions of electrons and holes with external magnetic and electric fields
PEK_U04 Student acquire kskills in low dimensional semiconductor structures

**Relating to social competences:**

PEK_K01 Student acquire skills in interdisciplinary cooperation work
PEK_K02 Student acquire skills in popular role of science in society …

| **PROGRAM CONTENTS** | | |
|---|---|---|
| **Form of classes – lecture** | | Number of hours |
| Lec. 1,2 | Methods of energy band calculations | 4 |
| Lec. 3 | Methods of calculations of electrons and holes densities in solid states | 2 |
| Lec. 4 | Boltzmann equation | 2 |
| Lec. 5 | Ohm law | 2 |
| Lec.6. | Classical and Quantum Hall Effect | 2 |
| Lec.7 | Complex reflective index and conductivity | 2 |
| Lec.8 | Landau levels | 2 |
| Lec. 9 | Stark Effect | 2 |
| Lec. 10, 11 | Low dimensional semiconductor structures | 4 |
| Lec. 12, 13 | Optical studies of low dimensional semiconductor structures | 4 |
| Lec. 14, 15 | Graphen and transition metal dichalcogenides | 4 |
| | Total hours | **30** |

| **TEACHING TOOLS USED** | |
|---|---|
| N1 | Form of the teaching: traditional + e-learning) |
| N2 | Student self-work |
| N3 | Consultations |

## WROCŁAW UNIVERSITY OF TECHNOLOGY – PHD STUDIES

| EVALUATION OF ACHIEVED SUBJECT EDUCATIONAL EFFECTS | | |
|---|---|---|
| **Evaluation:**<br>F – forming (partial)<br>C – concluding | Educational effect number | Way of evaluating achievement of educational effects |
| F1 | PEK_U01 – U04 | Discussion |
| F2 | PEK_U01 – U44 | Discussion |
| … | | |
| **C=F2** | | |

### PRIMARY AND SECONDARY LITERATURE

**PRIMARY LITERATURE:**

[1] H. Ibach, H. Luth, Fizyka Ciała Stałego, Państwowe Wydawnictwo Naukowe. Warszawa 1996
[2] N.W. Ashcroft, N.D. Mermin, Fizyka Ciała Stałego, Państwowe Wydawnictwo Naukowe, Warszawa 1986
[3] G. Bastard, Wave Mechanics Applied to Semiconductor Heterostructures. J. Willey, NY 1988
[4] Articles in scientific jpurnals

**SECONDARY LITERATURE:**

[1] P. Yu, M. Cardona, Fundamentals of Semiconductors, Springer, Berlin 1996
[2] Yehuda B. Band, Light and Matter, Willey, West Sussex, 2006
[3] John J. Quinn, Kyung Soo Yi, Solid State Physics: Principles And Modern Applications", Springer (2009)

| SUBJECT SUPERVISOR<br>(NAME AND SURNAME, E-MAIL ADDRESS) |
|---|
| **Dr hab. inż. Leszek Bryja, prof. PWr, Leszek.Bryja@pwr.edu.pl** |