WROCŁAW UNIVERSITY OF TECHNOLOGY – PHD STUDIES

FACULTY OF FUNDAMENTAL PROBLEMS OF TECHNOLOGY

SUBJECT CARD

Course name in Polish: **Metody funkcji Greena w fizyce fazy skondensowanej**

Course name in English: **Green functions methods in statistical quantum physics**

Course language: **polish**

~~University-wide general course type:~~
~~1)basic course (mathematics, physics, chemistry, other)~~
~~2) humanity course~~
~~3) managerial skills~~
~~4) English language~~
~~5) other modern language~~
Departmental course developing professional skills:
1) specialized course
~~2) interdisciplinary course~~
3) ~~seminar (interdisciplinary, specialized, departmental)~~

Type of course (obligatory, optional): obligatory

Educational effects according to ZW 26/2017:
Categories of acquired qualifications characteristics:
- Knowledge: P8U_W, P8S_WG
- Skills: P8U_U, P8S_UW, P8S_UO
- Social competencies: P8U_K, P8S_KK, P8S_KR

(advanced level of knowledge acquired in the field of Green functions theory, statistical quantum physics and methods of theoretical description of condensed matter physics problems; preparation to scientifically solve complex problems in those fields as well as initial preparation for the scientific work in fields of physics related to the course topic).

Subject code **FZP9087**

*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	Exam **	Exam / crediting with grade*	Oral presentation
Number of ECTS points	3		
including number of ECTS points for practical (P) classes			
including number of ECTS points for direct teacher-student contact (BK) classes	2		

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of quantum mechanics and statistical physics

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SUBJECT OBJECTIVES	
C1	Acquire knowledge in the field of quantum statistical physics
C2	Acquire knowledge of the perturbation methods and Feynman graphs
C3	Acquire knowledge in the field of Green function theory

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge:

PEK_W01 has knowledge in the field of quantum statistical physics
PEK _W02 has knowledge of the perturbation methods and Feynman graphs
PEK _W03 has knowledge in the field of Green function theory

Relating to skills:

PEK _U01 able to choose the proper theoretical tools for advanced studies of condesed matter systems
PEK_U02 able to further developed skills in Green function methods

Relating to social competences:

PEK _K01 understands the importance of research and teaching

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours
Lec1	Linear response theory by Kubo	2
Lec2	Correlation function and spectral intensity	2
Lec3	Retarded and advanced Green functions	2
Lec4	Fourier analysis of linear reaction	2
Lec5	Kremers Kronig spectral theorem	2
Lec6	Perturbation expansion in quantum statistical physics	2
Lec7	Imaginary time Green Matsubara functions	2
Lec8	Fourier picture of Matsubara Green functions for bosons and fermions	2
Lec9	Analytic continuation of Fourier transform and link to retarded and advanced Green functions	2
Lec10	Dyson equation and mass operator	2
Lec11	Theorem of Wick, Bloch, de Dominicis for fermions, bosons and spin	
Lec12	Feynman graphs and irreducible compact graphs	2
Lec13	T-exponent and applications	2
Lec14	Vertex function and ideas of advanced theory of metals	2
Lec15	Green functions for superfluid systems	2
	Total hours	**30**

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TEACHING TOOLS USED	
N1	Lectures
N2	Materials prepared by the author available via internet
N3	Individual study and preparation for the exam

EVALUATION OF ACHIEVED SUBJECT EDUCATIONAL EFFECTS		
Evaluation: F – forming (partial) C – concluding	Educational effect number	Way of evaluating achievement of educational effects
C	PEK_W01, PEK_W02, PEK_W03, PEK_U01, PEK_U02, PEK_K01	Examination

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] *Methods of quantum field theory in statistical physics,* A. Abrikosov, L. Gorkov, I. Dzialoshinskii, Dover Publ. Inc., Dover, 1975.
[2] *Kwantowa teoria układów wielu cząstek,* A Fetter, J. Walecka, PWN 1988
[3] written materials to the lectures

SECONDARY LITERATURE:

[1] *Statisical Physics II*, I. Lifshitz, Pitaevskij, Nauka, Moskva 1982
[2] *Polevije metody w fizike ferromagnetisma*, J. Iziumow, F. Kassan-Ogly, J. Skriabin,
[3] Nauka 1974

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

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