AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Quantum Mechanics

Academic year: 2016/2017 Code: JFI-3-201-s ECTS credits: 5

Faculty of: Physics and Applied Computer Science

Field of study: Physics Specialty: —

Study level: Third-cycle studies Form and type of study: Full-time studies

Lecture language: English Profile of education: Academic (A) Semester: 2

Course homepage: —

Responsible teacher: prof. dr hab. inż. Szafran Bartłomiej (bszafran@agh.edu.pl)

Academic teachers:

Module summary

Students acquire knowledge of physical and mathematical foundations of advanced quantum mechanics. Students perform calculations of illustrative basic and advanced problems of quantum mechanics.

Description of learning outcomes for module

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Connections with FLO	Method of learning outcomes verification (form of completion)
Skills			
M_U001	Students are capable of carrying out coordinate transformations in quantum mechanical problems	FI3A_U01	Activity during classes, Examination
M_U002	Students are capable of performing calculations in the Fock space using the Hartree-Fock approximation	FI3A_U01	Activity during classes, Examination
M_U003	Students know how to solve basic scattering problems in particular using the Born-Oppenheimer formalism	FI3A_U01	Activity during classes, Examination
M_U004	Students knows how to construct the Bell inequalities in accordance with the local formalism approach and falsify them using the quantum mechanics principles	FI3A_U01	Activity during classes, Examination
Knowledge			

M_W001	Students acquire knowledge of physical and mathematical foundations of quantum mechanics; they understand the origin of quantization of physical quantities	FI3A_W01	Activity during classes, Examination
M_W002	Students understand the relations between transformations of coordinates and symmetries existing in quantum systems	FI3A_W01	Activity during classes, Examination
M_W003	Students understands quantum description of indistinguishable (indiscernible) particles	FI3A_W01	Activity during classes, Examination
M_W004	Students understand the standard quantum-mechanical interpretation in the quantum entanglement context	FI3A_W04, FI3A_W01	Activity during classes, Examination

FLO matrix in relation to forms of classes

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Form of classes										
		Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Others	E-learning
Skills												
M_U001	Students are capable of carrying out coordinate transformations in quantum mechanical problems	-	+	-	-	-	-	-	-	-	-	-
M_U002	Students are capable of performing calculations in the Fock space using the Hartree-Fock approximation	-	+	-	-	-	-	-	-	-	-	-
M_U003	Students know how to solve basic scattering problems in particular using the Born-Oppenheimer formalism	-	+	-	-	-	-	-	-	-	-	-
M_U004	Students knows how to construct the Bell inequalities in accordance with the local formalism approach and falsify them using the quantum mechanics principles	-	+	-	-	-	-	-	-	-	-	-
Knowledge												
M_W001	Students acquire knowledge of physical and mathematical foundations of quantum mechanics; they understand the origin of quantization of physical quantities	+	-	-	-	-	-	-	-	-	-	-

M_W002	Students understand the relations between transformations of coordinates and symmetries existing in quantum systems	+	-	-	-	-	-	-	-	-	-	-
M_W003	Students understands quantum description of indistinguishable (indiscernible) particles	+	-	-	-	-	-	-	-	-	-	-
M_W004	Students understand the standard quantum-mechanical interpretation in the quantum entanglement context	+	-	-	-	-	-	-	-	-	-	-

Module content

Lectures

Lecures' content

Physical and mathematical principles of quantum mechanics: Kinematics, Dynamics Transformations of space coordinates in quantum mechanics, symmetry in quantum systems:_ Translations and momentum, Rotations and angular momentum. Discrete transformations: parity. Examples of other groups of transformations – internal symmetries (isospin, colour SU (3) etc.) Systems of identical particles. Groups of permutations and their representations.
Multiparticle systems: bosons, Multiparticle systems: fermions, Fock space and elements of quantum field theory, Fock space and elements of quantum field theory. Applications and examples: Elements of scattering theory, Many-body systems: methods of Hartree and Fock, Born-Oppenheimer approximation, Berry phase, etc., Interpretations of quantum mechanics. EPR paradox and Bell inequalities

Auditorium classes

Illustration of topics discussed during lectures; presentation and discussion of the solutions of various problems handed-out to the Ph.D. students.

Method of calculating the final grade
Oral exam grade

Prerequisites and additional requirements
Basic knowledge of classical physics

Recommended literature and teaching resources
1.L. Schiff, Mechanika kwantowa,. Wydawnictwo Naukowe PWN, Warszawa, 1977

Scientific publications of module course instructors related to the topic of the module
Additional scientific publications not specified

Additional information
None

Student workload (ECTS credits balance)

Student activity form	Student workload
Participation in lectures	30 h
Realization of independently performed tasks	30 h
Preparation for classes	30 h
Examination or Final test	2 h
Participation in auditorium classes	30 h
Summary student workload	122 h
Module ECTS credits	5 ECTS