Study programmes: BACHELOR STUDIES – Astronomy and Astrophysics

Course name: Mathematical Physics 2

Lecturers: Tatjana Vuković, Saša Dmitrović, Milan Damnjanović, Ivanka Milošević and other lecturers

Status: Optional

ECTS: 7

Attendance prerequisites: Mathematics 1, Mathematics 2, Mathematics 3, Mathematics 4.

Course aims: Acquiring the basic knowledge necessary for understanding quantum mechanics as well as the other areas of contemporary physics.

Course outcome: To master the basic concepts and techniques of the theory of Hilbert spaces, finite and Lie groups, important in physics, at the level of understanding their application in physics courses of the third and fourth year..

Course content:

1. Metric and topological spaces and manifolds: continuity and differentiability of physical fields, connectivity, compactness.
2. Hilbert and Lebesque spaces: infinite-dimensional spaces of state, distribution, d-function, plane waves, orthonormal basis, equipped Hilbert space.
3. Operators and hypergeometric equation: spectrum of physical observables, distribution and continuous spectrum, second order equations in physics, orthogonal polynomials and special functions, harmonic and Coulomb potential.
4. Final groups: structure, symmetry and groups of transformations in physics, factor group, products of groups.
5. Representation theory of groups: unitary representations and quantum probability, decomposable and irreducible representations.
6. Transformation properties of physical quantities, characters, group projectors.
7. Sum and product of representations, selection rules.
8. Lie algebras: structural constants, representations, classification, Heisenberg algebra.
9. Semisimle Lie algebras, physical observables, roots and weights, representations, Casimir operators.
10. Lie groups: topological features.
11. Covering group and its algebra, generators, translation and impulses, representations and unitarity.
12. Multi-valued representations, direct products of representations.
13. Lie Groups and algebras of particular importance in physics: SO(3, R), SU(2), Lorentz group. Poincare group, its representations, mass and spin of elementary particles.

Literature:

1. M.Damnjanović, Hilbertovi prostori i grupe, Fizički fakultet, Beograd 2000 (recenziran udžbenik sa zadacima).
2. Richtmyer R., Principles of Advanced Mathematical Physics, Springer, Berlin, 1978.
3. J. P. Elliot, P. G. Dawber, Symmetry in Physics, London, Macmillan, 1979.

Number of hours: 8	**Lectures**: 4	**Tutorials**: 4	**Laboratory**: -	**Research**: -

Teaching and learning methods:

Lectures, written exercises (solving problems, homework). Written exercises: elaboration of terms used in lectures, solving problems and examples relevant for physics.

Assessment (maximal 100 points)

Course assignments	points	Final exam	points
Lectures	5	Written exam	30
Exercises / Tutorials	-	Oral exam	50
Colloquia	-	Written-oral exam	-
Essay / Project	15		