Study programmes: BACHELOR STUDIES – Astronomy and Astrophysics

Course name: Fundamentals of Mathematical Physics

Lecturers: Saša Dmitrović and other lecturers

Status: Optional

ECTS: 5

Attendance prerequisites: Mathematics 1, Mathematics 2

Course aims: Adopting the concepts of finite-dimensional vector spaces and mastering linear algebra and vector analysis necessary for undergraduate physics studies.

Course outcome: Applicable knowledge about vector and unit (euclidean) spaces, linear mappings, and spectral theory of normal operators used in physics. Acquired basic knowledge from vector analysis and the properties of vector and scalar fields in physics.

Course content:

1. Definition of the vector space; dimension and base. Examples of vector spaces important for physics.
2. Vector space isomorphism.
3. Scalar product. Unitary and euclidean space.Examples in physics.
4. Bessel's and Schwarz's inequality.
5. Gram-Schmitt's orthonormalization process.
6. Linear operators and their geometry. Examples of operators in physics.
7. Operators in inner product spaces. Adjoint operator, normal operators.
8. Hermitian operators. Projectors. Unitarian and orthogonal operators.
9. An eigenproblem problem (geometry, eigenvector and eigenvalue). Operator spectrum and eigenspaces.
10. Eigen-projectors and spectral form.
11. Spectral characterization of normal operators. Spectral theorem in Euclidean space.
12. Scalar, vector fields. Gradient, divergence, curl,directional derivative. Hamilton's operator.
13. Special types of vector fields. Curvilinear coordinates. Hamilton and Laplace's operator in the orthogonal curvilinear system. Cylindrical and spherical coordinates.

Literature:

1. T. Vuković, S. Dmitrović: Osnovi matematicke fizike, Univerzitet u Beogradu, Fizički Fakulete (2017).
2. I. Milošević , «Vektorski prostori i elementi vektorske analize», Beograd, Fizički fakultet (1997), recenziran udžbenik.
3. M. Vujičić, Linear Algebra (thoroughly explained), Springer, Berlin, 2007.

Number of hours: 4	**Lectures**: 2	**Tutorials**: 2	**Laboratory**: -	**Research**: -

Teaching and learning methods:

Lectures, Examples: elaboration of terms used in lectures, solving problems and examples of the essentials for physics

Assessment (maximal 100 points)

Course assignments	points	Final exam	points
Lectures	5	Written exam	40
Exercises / Tutorials	5	Oral exam	30
Colloquia	-	Written-oral exam	-
Essay / Project	20		