Study Program: Physics				
Type and level of studies: Bachelor studies				
Course name: Mathematical Physics				
Lecturer**: Branko Drljača**				
Status: Compulsory				
ECTS: 6				
Attendance prerequisites: Mathematics 1,2; Mechanics and Thermodynamics 1,2				

Course aims

The students should grasp the basics of mathematical formalism necessary for attending classes in theoretical physics.

Course outcome

The students have gained knowledge of vector and vector field calculations; use of Fourier analysis; use of operators, solving specific operator and tensor problems; formulation of partial differential equations in three dimensions and their solution or the formulation of an approach for their numerical solution; performing integral transforms and their use in solving differential equations; application of group theory methods for solving various physics problems.

Course content

Theoretical part

Elements of vector algebra and analysis. Vector: the concept and basic operations. Scalar and vector product. Vector triple product and double vector product. Vector function of scalars. Integrals of vector functions. Scalar field and gradient. Hamiltonian operator. Vector fields. Divergence and rotor. Integral theorems. Spatial derivatives of I and II order. Classification vector fields and vector potential theory. Generalized coordinates. Examples. Metric form, Lamé coefficients. Spatial derivatives. Application of Fourier analysis to problems in physics. Trigonometric and exponential shape of the Fourier series. Transition to the Fourier integral. Dirac delta-function. RLC circuit. Ordinary differential equations of importance for physics: equations of theI and II order and systems of differential equations. Linear spaces. Operators, tensors and matrices. Definition of linear space. Linear vector independence, basis and coordinates. Scalar product. Euclidean space. Orthonormal basis. N-dimensional complex space. Hilbert space. Operator product: unit operator, diagonal matrices. Inverse operator and matrix. Joining matrices to vectors. 3D tensors, examples. Adjugated operator and conjugated tensor. Hermitian operator and symmetric tensor. Unitary operator and orthogonal tensor. Unitary transformations. Eigenvalue problems of the operator and tensor. Hamilton's (characteristic) tensor equation. Eigenvalue problem of an Hermitian operator and a 3D symmetric tensor. Partial differential equations in mathematical physics. Problem posing and problem-solving methods. Integral transforms and their application in solving differential and partial equations. Integral equations. Fredholm and Volterra integral equations with difference kernel. Fredholm integral equation with degenerate kernel. Abel's integral equation.

Practical part

Computational exercises in the field of vector algebra and analysis, Fourier analysis, Operators, tensors and matrices and Partial differential equations of mathematical physics

Literature

1. Ђ.Мушицки, Б.Милић: Математичке основе модерне физике, (различити издавачи)
2. D.S.Mitrinović: Uvod u specijalne funkcije, Gradjevinska knjiga, Beograd 1972.
3. G.Arfken, H.Weber: Mathematical Methods for Physicists, Academic Press (2001) San Diego, London

Number of active classes				Other classes
Lectures: 2	Practical classes: 2	Other forms of teaching:		

Teaching methods

Lectures (2 classes per week during the semester), computational exercises.

Assessment (maximum 100 points)

Course assignments	**points**	Final exam	**Points**
Lectures	20	written exam	30
Computational exercises	20	oral exam	30
		....	
Total	**40**		60