Course: Lie groups and algebras

Course instructors: Vladimir Dragović, Borislav Gajić, Božidar Jovanović, Milena Radnović

Course type: elective

Credit points: 10 ECTS

Prerequisites: -

Course objectives:

The course is devoted to the theory of Lie groups and algebras with emphasis on its connections with differential geometry and Hamiltonian dynamics.

Learning outcomes:

Students will learnt the fundamental relationship between Lie groups and Lie algebras, the basic of classification of semisimple Lie algebras and compact Lie groups, as well as the structure of symmetric spaces, Lie-Poisson brackets and Euler equations.

Course description (outline):

Theory

1. Lie groups and algebras, exponential mapping, homomorphisms, subgroups and subalgebras, representations and actions, homogeneous spaces, fundamental group and universal covering of a Lie group,.

2. Killing forms, semisimple, solvable and nilpotent Lie groups and algebras, Lie and Engel theorems, real forms, compact real forms.

3. Root systems and Dynkin diagrams, classification of semisimple Lie Algebras.

4. Compact Lie groups, maximal tori, Weyl group, fundamental group.

5. Symmetric spaces, Cartan decomposition, symmetric spaces of classical groups.

6. Geodesic flows on Lie groups and homogeneous spaces, Li-Poisson bracket, basic examples of integrable systems on Lie algebras

Practice

Homework, Seminars talks

References:

1. S. Helgason, Differential Geometry, Lie Groups, and Symmetric Spaces. AMS, 2001.

2. A. W. Knapp, Lie groups Beyond an Introduction, Birkhauser, 1996.

3. J. F. Adams, Lectures on Lie Groups, University of Chicago Press, 1982.

4. V. V. Gorbatsevich, A. L. Onishchik and E. B. Vinberg, Lie groups and Lie algebras I, Springer, 1993.

5. W. Ziller, Lie Groups. Representation Theory and Symmetric Spaces, University of Pennsylvania, 2010.

6. В. В. Трофимов, А. Т. Фоменко, Алгебра и геометрия интегрируемых гамильтоновых дифференциальных уравнений, Факториал, Москва 1995.

Active teaching hours: 5	Theoretical classes:	Practice classe	s:
Methods of teaching:			
Lectures and practice, with active participation of the students, discussion, seminars, etc.			
Grading structure (100 points)			
Pre-exam obligations Homework (30 points), Seminar talk	(30 points)	
Exam Oral Exam	(40 points)		