Mathematical Institute
Polish Academy of Sciences

COURSE DESCRIPTION

Course name	Geometric Foundations of Mechanics and Field Theory
Course type	reading course (wrd)
Supervisor	Janusz Grabowski
ECTS credit allocation	4 – IM PAN Ph. D. program; 6 - recommended for MA programs
Duration	One semester
Number of hours	30
Language	English or Polish, if every participant speaks Polish
Prerequisites	Basic knowledge in the field of Linear Algebra, Algebra, Calculus and Differential Geometry on graduate level.
Course content	Applications of differential geometry, graded geometry, and supergeometry to Analytical Mechanics and classical Field Theory. Foundations of Variational Calculus. Geometric description of the Lagrangian and Hamiltonian formalisms. Hamilton and Euler-Lagrange equations. Legendre transformation.
Recommended reading	[1] R. Abraham, J. Marsden, Foundations of Mechanics, AMS Chelsea Publishing, 2008. [2] V. I. Arnold, Mathematical Methods of Classical Mechanics, Springer, NY, 2005. [3] T. Aubin, A Course In Differential Geometry, AMS, Providence, 2000. [4] L. Auslander, Introduction to Differential Manifolds, New York : Mc-Graw-Hill Book Company, Inc., 1963. [5] I. M. Gelfand, S. V. Fomin, Calculus of Variations, Dover Publications, Mineola, N.Y, 2000. [6] C. J. Isham, Modern Differential Geometry for Physicists, World Scientific, London 1999. [7] P. Libermann, C.-M. Marle, Symplectic Geometry and Analytical Mechanics. [8] A. Spivak, Comprehensive Introduction to Differential Geometry, Publish or Perish, Houston, 1999. [9] S. Sternberg, Lectures on Differential Geometry, Englewood Cliffs, N. J., Prentice Hall, 1964.
Learning outcomes	The active participant should gain basic knowledge about the geometrical language used in calculus of variations, Analytical Mechanics and Classical Field Theories. He or she should be able to prepare a talk in some fields of mathematical physics based on the appropriate literature. He or she should also be able to formulate questions, derive equations, and solve elementary problems related to mechanical systems.
Assessment methods and criteria	Assessment is based on attendance and activity of the student and written exam.
Remarks	