Adam Mickiewicz University in Poznan

Doctoral School of Exact Sciences AMU

Waves and interactions

Prof. UAM dr hab. Jarosław W. Kłos

Field of science	physics
Teaching method	lecture
Language	English
Numbers of hours	15
Aims of the course	The purpose of this lecture is to introduce students to the description of wave dynamics in nanostructures. The course presents continuous models of spin, elastic, and electromagnetic wave dynamics, in which geometric factors play a significant role in shaping wave behavior. This approach allows us to solve practical problems and design devices for wave-based information processing. The lecture will also briefly cover selected numerical tools, techniques, and experimental methods for studying wave dynamics in nanostructures.
Course contents	1. Wave equation: basic concepts (U1) 2. Elastic and electromagnetic waves (U1, W2) 3. Spin wave dynamics: a phenomenological approach (U2) 4. Waves in a periodic medium: photonic, photonic, and magnonic crystals (U1, U2, W2) 5. Magnetoelastic interaction (W1) 6. Linearization and the eigenvalue problem for PDEs describing wave dynamics (U2, U3) 7. Experimental techniques for studying magneto- and elasto-dynamics (W2)
Prerequisites and co-requisites	- Basic knowledge of mechanics, electromagnetism, and wave dynamics, as covered in the Berkeley physics course. - Basic knowledge of differential equations and methods for solving linear differential equations.

Learning outcomes

On completion of the course PhD candidates will be able to:	Assessment mode
U1. give a formal description of the dynamics of volume elastic waves and TEM electromagnetic waves in an isotropic and uniform medium (E_U01, E_U05); U2. linearize the Landau-Lifshitz equation (E_U01, E_U05); U3. interpret the dispersion relation for exchange spin waves and volume elastic waves (E_U01, EU_02, E_U05); W1. present the formal description of magnetoelastic interaction in a continuous medium (E_W01, E_W02); W2. discuss the principles of BLS and TR-MOKE spectroscopy (E_W01, E_W02, E_W08); K1. browse scientific journals that publish articles on wave dynamics in nanostructures; pre-screen articles by reading the abstracts, conclusions and studding the main figures (E_K01, E_05).	Project (50% contribution to final grade) and oral exam (50% contribution to final grade). Very good (5,0): 91-100% Good plus (4,5): 81-90% Good (4,0): 71-80% Satisfactory plus (3,5): 61-70% Satisfactory (3,0): 51-60% Unsatisfactory (2,0): 0-50%

Literature	1. *Spin Waves:Theory and Applications*, A. Prabhakar, D. D. Stancil, Springer 2009 2. *Photonic Crystals: Molding the Flow of Light - second edition*, J. D. Joannopoulos, S. G. Johnson, J. N. Winn, Princeton University Press (2008) 3. *Elasticity: theory, applications, and numerics,* S. H. Sadd,, Academic Press (2021) Prerequisites 4. *Mechanics*, Ch.Kittel, W. D. Knight, and M. Ruderman, Cambridge University Press, 2013 5. *Electricity and Magnetism*, E. M. Purcelll, Cambridge University Press, 2013 6. *Waves*, F. S. Crawford Jr., Cambridge University Press, 2013 7. *Introduction to the Differential Equations of Physics*, L. Hopf, Dover, 1948
Additional information	