Level: PhD

Course title: Advanced course of nonlinear phenomena in condensed systems

Status: elective

ECTS: 15

Requirements: Phase transition and critical phenomena

Learning objectives

Obtaining basic knowledge in nonlinear physics.

Learning outcomes

After taking the course, the students should have developed:

General abilities: basic knowledge in this field, following the literature, analysis of various solutions and the choice of the most adequate solution, application in practice and other subjects.

Subject-specific abilities:

- basic equations used in nonlinear physics (sine-Gordon, nonlinear Schroedinger equation);
- soliton solutions of given equations;
- application of the soliton model in biophysics; dynamics of domain walls in ferromagnetics and ferroelectrics.

Syllabus

Theoretical instruction

Nonlinear Toda–lattice and Toda solitons: application to heat conduction. Applications in biophysics; alpha helix. Sine-Gordon nonlinear equation. Solution of magnetic type; solutions of electric type. Dislocations dynamics in crystal; the motion of Bloch waves. Tunnelling Josephson effect in superconductors. Double-well potential in quasionedimensional structures. Domain wall dynamics in ferromagnets and ferroelectrics. Kink-soliton excitation in biological structures. Cubic nonlinear Schroedinger equation. Optical self-focusing and Langmuir waves in plasma. Morse potential and applications in biophysics.

Practical instruction

Weekly teaching load				Other:
Lectures: 6	Exercises:	Other forms of teaching: Seminars	Student research: 4	