Level: PhD

Course title: Theory of Disordered Systems

Status: elective

ECTS: 15

Requirements: Phase Transitions Theory, Strongly Correlated Systems

Learning objectives

Acquiring the basic theoretical knowledge of disordered systems. Introduction to percolation theory, polymer theory and theory of spin glasses.

Learning outcomes

After taking the course, the student should have developed:

General abilities: basic knowledge of 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:

Knowledge of the most frequently used models in the theory of disordered systems, ability to determine critical parameters characteristic for the phase transitions in disordered systems, application of scaling theory and renormalization group method to these systems.

Syllabus

Theoretical instruction

Introduction to percolation theory: forest fires, fractal oil fields, diffusion. Cluster numbers. Cluster structure. Finite size scaling and renormalization group method. Conductivity and related properties. Random walks: dynamics and quantum effects. Application to thermal phase transitions.

Introduction to polymer theory. Single chain. Polymer solution in good solvents. Relation between the polymer statistics and critical phenomena.

Introduction to the theory of spin glasses. Mean-filed theory of the phase transitions. Mean-field theory of the spin glasses. Spin glasses and Edwards-Anderson model. Sherrington-Kirkpatrick model. Replica-symmetric solution. Replica-symmetry breaking.

Practical instruction

Seminars.

Weekly teaching load				Other:
Lectures: 6	Exercises: 0	Other forms of teaching:	Student research: 4	