General Information

Course name	Phase Transitions and Critical Phenomena	**ECTS Credits**	4
		Semester	S

Aims

To acquaint students with based problems of the phase transitions and critical phenomena.

Content

1. Introduction to thermodynamic. Thermodynamic potentials. Maxwell relations.
2. Response function for a magnetic system: specific heats and susceptibilities.
3. Conditions for stability of magnetic systems. Systems with a varying number of particles.
4. Phase equilibrium and phase transitions. Examples of phase transitions.
5. Classification of phase transitions. Clausius-Clapeyron equation..
6. Landau´s contribution to phase transitions. Order parameter and symmetry breaking.
7. Definition of critical indices. Relations between critical indices.
8. Models of magnetic phase transitions: Heisenberg and Ising model.
9. Exact solution of the Ising model in one dimension. Transfer matrix method.
10. Gibbs energy, magnetization, susceptibility, entropy, and specific heat. Two-point correlation function for the Ising chain.
11. Mean-field theory for the Ising model: magnetization and critical temperature.
12. Susceptibility, internal energy, and specific heat within the mean-field theory.
13. Landau theory of phase transition. Second-order phase transition. Effect of an external field and susceptibility.
14. First-order phase transitions. Tricritical point.

Assessment Methods and Criteria

Oral Exam

Grading Scale (in %):

A: 91% - 100%
B: 81% - 90%
C: 71% - 80%
D: 61% - 70%
E: 51% - 60%
F: 0% - 50%

Grading System:

The University recognises the following six degrees for the evaluation of the study results:

a) A – excellent (excellent results) (numerical value 1)
b) B – very good (above average results) (1.5)
c) C – good (average results) (2)
d) D – satisfactory (acceptable results) (2.5)
e) E – sufficient (results meet the minimum criteria) (3)
f) FX –failed (requires further work) (4)

Bibliography

1. Bobák A.: Phase Transitions and Critical Phenomena, Project 2005/NP1-051 11230100466, European Social Fund, Košice 2007.
2. Stanley H.G.: Introduction to Phase Transitions and Critical Phenomena, Clarendon Press Oxford, 1971.
3. Reichel L.E.: A Modern Course in Statistical Physics, University of Texas Press, 1980.
4. Plischke M., Bergersen B.: Equilibrium Statistical Physics, World Scientific, 1994.
5. Kadanoff L.P.: Statistical Physics, Statistics, Dynamics and Renormalization, World Scientific, 2000.
6. Papon P., Leblond J., Meijer P.H.E.: The Physics of Phase Transitions, Concepts and Applications, Springer-Verlag, 2002.