(1.) Course Title: INFPHD167 Nonlinear phenomenon on lattice	**Credits: 6**
Course **Classification: Optional**	
Theoretical or Practical Nature of the Course, *'training character'*[13]: 100% theoretical (credit%)	
Type of Class: lecture and **number of hours**: **2/week** in the given semester, *(If the course is not (only) taught in Hungarian, then **the language**: **English**)* **Additional** (specific**) methods and characteristics**[2] used in delivering the knowledge *(if any)*: -	
Assessment Method (Exam / Midterm Grade / **Other**[3]): examen **Additional** (specific) **methods**[4] applied in knowledge assessment *(if any)*: -	
Course Placement in Curriculum (Semester Number): **4**	
Prerequisites (*if any*): -	

Course Description: **A concise yet informative description of the knowledge** to be acquired.

Short description :

The subject offers new information for those students who want to learn the determination of theoretical and experimental results using lattice models.
We introduce the lattice calculations which are used in the natural sciences and the application of nonlinear models. Dynamical systems are formulated by discrete lattice field theory. We discuss the numerical methods which are used to determine the theoretical values, respectively measurable quantities. The chaotic dynamics of Yang-Mills equations is characterized by the full Lyapunov spectrum.

Themes:

- Motivation
- Introduction to the basic concepts of lattice counting. (Discretization of the continuous scalar and vector field.)
- Dynamical Systems : Chaos, Lyapunov exponents, bifurcation, limit cycles, strange attractors, Kolmogorov-Sinai entropy concept and their numerical determination.
- Dynamic systems on lattice, (XY) model.
- Introduction of Nonabelian field theory
- Concept of lattice field theory

-Definition of the quantities which are used in these models (expectation value, standard deviation).

- Numerical methods: Monte Carlo method, Metropolis method, Langevin algorithm and Heat-Bath process.
- The reliability of calculated values, correction of lattice error.
- Comparison of results which are obtained from different model calculation (perturbative or nonperturbatív procedures) .

-Determination of the full spectrum of Lyapunov exponent on the lattice Yang-Mills theory.

2-5 Most Important Required and Recommended Literature

List of required and recommended literature (notes, textbooks) with bibliographic data (author, title, publication details, (possibly pages), ISBN).

-Montvay I., *Quantum Field on a Lattice*, Cambridge Monographs on Matematical Physics, Cambridge Univ. Press, (1994)
-M. Creutz, *Quark, gluons and lattices*, Cambridge University Press, (1983),
- Steven Weinberg, *The Quantum Theory of Fields*, Cambridge University Press, (1998),
-Philipp, O.J. Scherer, Computational Physics, Simulation of Classical and Quantum Systems, Springer, (2017)

List of Prescribed Professional Competencies and Competency Elements

(knowledge, skills, etc., KKK Section 8) that the course significantly contributes to developing (highlight the most important ones).

a) Knowledge

- Has a research-level understanding of the general and specific characteristics, major directions, and precisely developed boundaries of the subject area within the discipline, as well as the agreed and debated interrelations.
- Creatively comprehends the interrelations, theories, and conceptual frameworks and terminologies of the given field of study.1
- Possesses research methodology knowledge necessary for independent research in the given discipline/field.

b) Skills

- Capable of creative analysis of the field, synthesizing comprehensive and specific interrelations with a new perspective, and conducting appropriate evaluative and critical activities.
- Able to apply and further develop the specialized learning and problem-solving methods of the field.
- Can creatively elaborate on the novel, previously unknown practical implications of theoretical issues.
- Capable of planning and executing new projects, conducting research in the field, and developing new techniques and approaches.
- Able to identify unforeseen professional problems and uncover the detailed theoretical and practical background necessary for their resolution at a research level.
- Can construct and communicate new relations relevant to the field, as well as comprehensive interrelations significant for personal and communal existence.

c) Attitudes

- Represents and further develops the relations that contribute to the process of human self-creation based on the field's characteristics.
- Possesses an interest and learning ability that enable identifying and solving currently unpredictable research problems in the field.

[1] **Section 108**, Article 37 of the National Curriculum Act (Nftv.) 37. lesson: a session (lecture, seminar, exercise, consultation) requiring the personal involvement of the instructor to fulfil the academic requirements specified in the curriculum, the duration of which is at least forty-five minutes and not more than sixty minutes.
[2] e.g. case studies, role play, thematic presentations, etc.
[3] e.g. continuous debriefing, mid-year report
[4] e.g. request for case studies, thematic papers, essays, business, organisational plans, etc.

- Demonstrates a firm professional commitment, a continuous dedication to exploring new approaches, and an acceptance of the necessity for persistent effort.

d) Autonomy and Responsibility

- Builds and initiates new knowledge areas with creative independence and proposes new practical solutions.
- Participates in formulating theoretical and practical questions with a leadership role and high-level cooperation.
- Engages as an equal discussion partner with professionals in the field.
- Takes responsibility for raising and addressing new ethical questions concerning theoretical and practical aspects of the profession.

Course responsible (name, position, academic degree): **Dr. Ágnes Fülöp Habil. Associate Professor**

Instructor(s) involved in teaching the course (if any) (name, position, academic degree):
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