**Study Programme:** Master Academic Studies in Physics

**Course Unit Title:** Introduction to Effective Field Theory in Condensed Matter Systems

**Course Unit Code:** M18UETPKS

**Name of Lecturer(s):** Assistant Professor Slobodan Radošević

**Type and Level of Studies:** Master Academic Degree

**Course Status (compulsory/elective):** Elective

**Semester (winter/summer):** Summer

**Language of instruction:** English

**Mode of course unit delivery (face-to-face/distance learning):** Face-to-face

**Number of ECTS Allocated:** 8

**Prerequisites:** Mathematical Physics, Special Theory of Relativity, Theory of Gravity, Symmetries in Physics,

**Course Aims:**

Acquiring general and specific knowledge in methods of effective Lagrangians in condensed matter systems.

**Learning Outcomes:**

**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 capabilities** - mastering the method of effective Lagrangians in systems lacking Lorentz symmetry; understanding the concepts spontaneous symmetry breaking and Nambu-Goldstone bosons;

**Syllabus:**

*Theory*-Spontaneous symmetry breaking. Nambu-Goldstone theorem. Counting rules for type A/B NG bosons. Differential geometry on G/H. Coset construction of effective Lagrangian (CCWZ method based on the Maurer-Cartan form).

Nonrelativistic effective Lagrangians (Leutwyler) and WZW term. Loop expansion and power counting scheme. Application to O(3) ferromagnets.

*Practice*-Problem solving.

**Required Reading:**


1. S. Weinberg: *The Quantum theory of Fields (Vol I & Vol 2)*, Cambridge University Press, (2005)
2. H. Watanabe, H. Murayama, Phys. Rev. X **4**, 031057 (2014)
3. H. Leutwyler, Phys. Rev. D **49**, 3033 (1994)
4. C.P. Hofmann, Phys. Rev. B **60**, 388 (1999)
5. T. Brauner, Symmetry **2**, 609 (2010)
6. C. P. Burgess, Phys. Repts **330**, 193 (2000)

7. J. O. Andersen,a T. Brauner, C. P. Hofmann, A. Vuorinen, JHEP **08**, 088 (2014)
8. M. Peskin, D. Schroeder: An Introduction to Quantum Field Theory, Westview (1995)

| **Weekly Contact Hours:** | **Lectures:** 3 | **Practical work:** 2 |
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**Teaching Methods:**

Lectures, practical and group work, seminars.

**Knowledge Assessment (maximum of 100 points):**

| **Pre-exam obligations** | points | **Final exam** | points |
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| Active class participation | 10 | written exam | |
| Practical work | | oral exam | 50 |
| Preliminary exam(s) | | ……. | |
| Seminar(s) | 40 | | |

The methods of knowledge assessment may differ; the table presents only some of the options: written exam, oral exam, project presentation, seminars, etc.