Course Unit Descriptor

Study Programme: Physics

Course Unit Title: Hyperfine Interaction

Course Unit Code: F18HI

Name of Lecturer(s): Associate Professor Jovana Nikolov

Type and Level of Studies: Bachelor 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: 6

Prerequisites: -

Course Aims:

This course aims to train the students in applying earlier attained knowledge of mathematical methods and physics principles to a new field. Topics such as tensor algebra, spherical harmonics, mechanics, electromagnetism, quantum physics, atomic physics, and solid state physics are crucial elements to understand the theory of hyperfine interactions and the related experimental tools. Students who finish this course will have obtained sufficient maturity and knowledge to be able to look at new physics problems in an independent way. Furthermore the student gathers sufficient practical knowledge about different hyperfine interaction methods in order to understand the research papers and modern nuclear physics experiments which make use of these methods.

Learning Outcomes:

General Skills:

Deeper understanding of modern physics research problems which uses complicated measuring technique.

Specific Competencies:

Acquiring of practical and applicable knowledge for different methods of hyperfine interaction, very often needed in both theoretical calculations and experimental measurements.

Syllabus:

Theory

Hyperfine Hamiltonian equation and nuclear moments. Electric monopole. Quadrupole interaction and quadrupole moment of the nuclei. Magnetic interaction and magnetic moment of nuclei. Radiation and spin-orientation. Time evolution of perturbated oriented nuclei. Hyperfine structure of exotic nuclear states. Nuclear moments of high spin states. Hyperfine interaction in nuclear β decay. Experimental methods for measuring of magnetic dipole and electrical quadrupole interactions with special application in nuclear physics and condensed matter physics.

Practice

Calculus and individual term paper.

Required Reading:

1. Hyperfine Interactions of Radioactive Nuclei, Edited by J. Christiansen, Springer-Verlag Berlin Heidelberg New York Tokyo 1983.

2. "Nuclear magnetic and quadrupole moments for nuclear structure research on exotic nuclei" (chapters 3,4,5) G. Neyens, Reports on Progress in Physics 66, 633-689 (2003) and erratum p. 1251

3. "Nuclear Moments", R. Neugart and G. Neyens, Lecture Notes in Physics 700, 135-189 (2006)
4. Low-temperature nuclear orientation, Editors N.J.Stone, H.Postma, NH (1986).

Weekly Contact Hours:	**Lectures:** 3	**Practical work:** 2

Teaching Methods:

Lectures, seminars and practical work.

Knowledge Assessment (maximum of 100 points):

Pre-exam obligations	points	**Final exam**	points
Active class participation	5	written exam	25
Practical work	-	oral exam	50
Preliminary exam(s)	-	…….	
Seminar(s)	20		

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