Course Unit Descriptor

Study Programme: Physics

Course Unit Title: Basic physics of NMR

Course Unit Code: M18NMR

Name of Lecturer(s): Associate Professor Jovana Nikolov

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: -

Course Aims:

The technique of Nuclear Magnetic Resonance (NMR) is widely used in physics, chemistry and medicine. NMR is used in research of molecular and atomic structure, and the structure of the nucleus, for studies of interactions within the solids and liquids, as well as in medical diagnostic imaging as an NMR tomography. The aim of this course is for students to acquire the general theoretical principles on which the nuclear magnetic resonance is based, as well as to have access to specific applications of this technique, with particular emphasis on the use in medical diagnostics.

Learning Outcomes:

General Skills:

Within this course students will learn about connection between theoretical and experimental achievements of nuclear physics and everyday applications.

Specific Competencies:

Understanding of theoretical assumptions of NMR technique will help in better understanding of the practical application of this technique, as well as both its advantages and limitations. Particularly stressed is the application in medical diagnostics.

Syllabus:

Theory

Historical development of NMR techniques. Zeeman's effect. NMR relaxation. Spin and magnetic moment (high-frequency radiation, Bloch equation). Quantum-mechanical description of NMR. Features of the NMR signal. NMR experiments. The detection of NMR signals. Various applications of NMR technique (to solve the structure of organic molecules, NMR spectrometry and the application to the measurement of the basic parameters of the nuclei structure, the analysis of the experimental data by means of NMR experiments). NMR in medical diagnostics.

Practice

Calculus (1 time per week during the term), a review of NMR experiments and NMR techniques in the clinical setting, seminar papers.

Required Reading:

1. Low-temperature nuclear orientation, Editors N.J.Stone, H.Postma, NH (1986).

2. “Magnetic Resonance Imaging”, Perry Sprawls, Medical Physics Publishing, Madison 2000.

3. “Introduction to Magnetic Resonance – Principles and Applications”, Robert T. Schumacher Carnegie-Melon

University.			
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	20
Practical work	5	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.			