Level : MSc

Course title: Basic physics of NMR

Status: elective

ECTS: 8

Requirements: -

Learning objectives

The technique of Nuclear Magnetic Resonance (NMR) are 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

Theoretical instruction:

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.

Practical instruction:

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

Literature

1. Low-temperature nuclear orientation, Editors N.J.Stone, H.Postma, NH (1986).
2. “Magnetic Resonance Imaging”, Perry Sprawls, Medical Physics Publishing, Madison 2000.
1. “Introduction to Magnetic Resonance – Principles and Applications”, Robert T. Schumacher Carnegie-Melon University.

Weekly teaching load	**Lectures:** 3	**Exercises:** 2