

**UNIVERSITY OF PUERTO RICO
RÍO PIEDRAS CAMPUS
COLLEGE OF NATURAL SCIENCES
DEPARTMENT OF PHYSICS**

Title: Magnetic Resonance (EPR & NMR) Spectroscopy
Code: PHYS 8996-013
Credits: 3
Professor: Vladimir Makarov
Office CNL321
E-mail: vladimir.makarov@upr.edu
Time schedule: Tuesday, Thursday, 1:00 – 2:20 pm
Prerequisites: Permission of the Graduate Committee

Course Description

Magnetic Resonance Spectroscopy (MRS). Development of the basis statements including the various representations and 'pictures' of MRS. Detailed consideration of the MRS. Application of the MRS to research and industrial goals, Electronic Paramagnetic Resonance (EPR) and Nuclear Magnetic Resonance (NMR) spectroscopy. Pulsed EPR. NMR, NMR tomography and Electronic-Nuclear Double Resonance (ENDR) spectroscopy. Application of Fourier Transformation method in Magnetic Resonance Spectroscopy.

Objectives

Through this course, the students will:

- Acquire a basic understanding of the MRS meaning theory of MRS, basic statements of MR effects in different medias, application of MR theory in MRS, steady-state and pulsed (time resolved) MRS, technical realization of MRS application to research and industrial (technological) goals.
- Become proficient with the experimental and theoretical tools of the MRS.
- Develop problem-solving skills and strategies in basic MRS science.
- Communicate effectively a topic pertinent to basic of MRS.

Instructional Strategies: Online teaching process of magnetic resonance spectroscopy course is organized as follows: printed materials covering course lectures are sent to students two times per week and in online sessions organized two times per week with respect to academic class schedule, professor discuss with students respective printed materials. Online sessions are organized using Google Meet communication platform.

Minimum Required Facilities

Computer, access to internet and access to Google meet communication platform.

Evaluation Strategies. The course will be evaluated with three partial exams with a weight of 20% of the evaluation and the homeworks with a weight of 40% of the evaluation.

Grading. Standard A to F system.

Bibliography

A. Carington, A. nD. McLachlan,, *Introduction to Magnetic Resonance Spectroscopy.*, Happer & Row Publisher, New York – Evanston – London, 1967..

Online Resources:

- http://en.wikipedia.org/wiki/Nuclear_magnetic_resonance
- <http://www.webmd.com/a-to-z-guides/magnetic-resonance-imaging-mri>
- <http://magnetic-resonance.org/>

PROGRAM AND TIMETABLE.

<i>Week</i>	<i>Subjects</i>
1	Introduction
2	Magnetic resonance spectroscopy of H atom
3	Magnetic resonance spectroscopy of ^3He atom
4	Chemical shifts
5	Hyperfine structure of NMR spectra, AB system
6	First exam
7	EPR spectroscopy. Basis
8	Zeeman, hyperfine isotropic and anisotropic interactions
9	Spin-Hamiltonian and basis electron spin-nuclear spin-wavefunctions
10	Second exam
11	Energies of hyperfine spin states versus applied magnetic field
12	Magnetic field dependence of spin states of H atom
13	EPR of complex inorganic molecules
14	EPR spectra of organic radicals
15	EPR spectra of organic radicals containing conjugated π -system
16	Third exam

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ACOMODO RAZONABLE

La Universidad de Puerto Rico cumple con todas las leyes federales, estatales y reglamentos concernientes a discriminacion, incluyendo "The American Dissabilities Act" (Ley ADA) y la Ley 51 del Estado Libre Asociado de Puerto Rico. Los estudiantes que reciban servicios de rehabilitacin vocacional deben comunicarse con el (la)

profesor(a) al principio del semestre para planificar el acomodo razonable y equipo de apoyo necesario conforme a las recomendaciones de la Oficina de Asuntos para las Personas con Impedimento (OAPI) del Decanato de Estudiantes. Una solicitud de acomodo razonable no exime al estudiante de cumplir con los requisitos academicos del curso.

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