CHEM 7160 – Nuclear Magnetic Resonance Spectroscopy

TR 11.10 AM-12.30 PM
207 Denney Hall

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Course description Fundamental principles and concepts of modern NMR spectroscopy. Intended for graduate students (and advanced undergraduates) who seek expertise in NMR spectroscopy in the context of studies of molecular structure and dynamics. Lectures will cover the basic principles and theory of NMR, instrumentation and applications.

Useful reference texts (not required) M.H. Levitt, "Spin Dynamics: Basics of Nuclear Magnetic Resonance", Wiley
J. Keeler, "Understanding NMR Spectroscopy", Wiley
J. Cavanagh et al., "Protein NMR Spectroscopy: Principles and Practice", Academic Press
M. Duer, "Introduction to Solid State NMR Spectroscopy", Blackwell Publishing

Grading: Problem sets (20%), Midterm 1 (40%), Midterm 2 (40%)

Outline:

1. Classical Description of NMR Experiments
- Bloch equations for isolated spins, Relaxation times, Rotating frame, Fourier transforms, Simple NMR pulse sequences and spectra, Inhomogeneous broadening of NMR signals, Chemical shifts, Multiplet structure

2. Inside the NMR Spectrometer
- Magnet, Shims, Field-frequency lock, Transmitter and receiver, NMR probes

3. Acquisition and Processing of NMR Data
- One- and two-dimensional FT-NMR, Signal averaging, Time domain apodization functions, Phase corrections

4. Quantum Description of NMR I
- Spin operators, Density matrix, Interaction frame representation, Pulses and rotation operators, Quantum dynamics, Calculations of simple pulse sequences

5. Internal Spin Hamiltonians
- Chemical shift, J-coupling, Dipolar coupling, Quadrupolar coupling, Effects of motion

6. Quantum Description of NMR II
- Quantum description of multidimensional NMR experiments, Coherence transfer pathways, Phase cycling

7. Advanced Topics (as time permits)
- Solid-state NMR, Relaxation theory, Applications to biomolecular structure determination

Students with disabilities:

All students with documented disabilities, who need accommodations, should see me privately. We will work with the Office for Disability Services (098 Baker Hal, 113 W. 12th Ave, (614) 292-3307, http://slds.osu.edu) as needed to coordinate appropriate accommodations.

Academic integrity:

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understand the University's Code of Student Conduct, and that all students will complete all academic and scholarly assignments with fairness and honesty. If I suspect that a student has committed academic misconduct in this course, I am obligated by university rules to report this to COAM. COAM's sanctions for any violations of the university's code of student conduct could include a failing grade in this course and suspension or dismissal from the university. If you have any questions about the university's policies regarding academic misconduct please see the OSU COAM web page (http://oaa.osu.edu/coam.html).