

## Syllabus, CHEM/BCMB 4190/6190/8189

### Introductory NMR / Fundamentals of NMR

Nuclear Magnetic Resonance (NMR) is a form of spectroscopy that uses the magnetic properties of nuclei to probe molecular structure and dynamics. It has found applications in analysis of organic and inorganic compounds, in structure determination of biological macromolecules, and even in medical imaging. These introductory courses are intended to serve a broad audience seeking background in principles behind NMR methodology as well as a practical introduction to how data are acquired and analyzed. Material is presented partly in lecture and partly in laboratory formats. It is an ideal stepping-stone to more advanced courses offered in biomolecular NMR (CHEM/BCMB 8190) as well as other application-oriented courses.

The three courses share lecture and laboratory presentations. Grading is based on exams, a final exam, written laboratory reports, and an evaluation of classroom and laboratory participation (see page 3 of this syllabus). For 8189 completion of an additional independent study project is required.

**Instructor:** Professor Jeffrey Urbauer  
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**Office Hours:** - any time / by appointment

**Course Website:** - <http://www.bmb.uga.edu/bcmb4190>

**Class time:** - Tu,Th, 3:30-4:45

**Recommended text:** - Friebolin "Basic One and 2D NMR Spectroscopy" – VCH paperback  
- 2<sup>nd</sup>, 3<sup>rd</sup>, or 4<sup>th</sup> edition

#### Course Outline and Dates:

Month	Day	Date	Lecture / Exam / Lab	Readings
<b>August</b>				
	Tu	19	Introduction and basic principles	1.1 - 1.2
	R	21	Basic principles I	1.2 - 1.3
	Tu	26	Basic principles II	1.4 - 1.6
	R	28	<sup>1</sup> H and <sup>13</sup> C Chemical Shifts	2.1 - 2.4, 6.1 - 6.4
<b>September</b>				
	Tu	2	1D, <sup>1</sup> H NMR Lab #1	
	R	4	1D, <sup>1</sup> H NMR Lab #1	
	Tu	9	<sup>1</sup> H/ <sup>1</sup> H, <sup>13</sup> C/ <sup>1</sup> H, <sup>13</sup> C/ <sup>13</sup> C Couplings	3.1 - 3.5
	<b>R</b>	<b>11</b>	<b>EXAM 1</b>	
	Tu	16	Double resonance experiments	5.1 - 5.3
	R	18	Spin relaxation	7.1 - 7.3
	Tu	23	Intro to complex pulse sequences	8.1 - 8.2
	R	25	Spin-echo experiment	8.3 - 8.4
	Tu	30	1D double resonance NMR Lab #2	

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### October

	R	2	1D double resonance NMR Lab #2	
<b>EXAM</b>	<b>Tu</b>	<b>7</b>	<b>EXAM 2</b>	
	R	9	INEPT experiment	8.5
	Tu	14	DEPT experiment	8.6
	R	16	Intro to 2D NMR / COSY	9.1 - 9.3
	Tu	21	1D <sup>13</sup> C and DEPT NMR Lab #3	
	R	23	1D <sup>13</sup> C and DEPT NMR Lab #3	
***	R	23	***MIDPOINT WITHDRAWL DEADLINE***	
	Tu	28	2D COSY / HETCOR	9.4
<b>EXAM</b>	<b>R</b>	<b>30</b>	<b>EXAM 3</b>	

### November

	Tu	4	2D TOCSY / HSQC	9.4
	R	6	The Nuclear Overhauser Effect	10.1 - 10.2
	Tu	11	2D HSQC / COSY NMR Lab #4	
	R	13	2D HSQC / COSY NMR Lab #4	
	Tu	18	2D NOESY	10.2 - 10.4
	R	20	Special Topic	
	Tu	25	Thanksgiving Break – no class	
	R	27	Thanksgiving Break – no class	

### December

	Tu	2	NOESY / TOCSY NMR Lab #5	
	R	4	NOESY / TOCSY NMR Lab #5	
	Tu	9	Friday class schedule – no class	Last day of class
	Wed	10	Reading day	
<b>EXAM</b>	<b>Tu</b>	<b>16</b>	<b>EXAM 4 (3:30 - 6:30)</b>	

### ATTENDANCE:

The University of Georgia guidelines for attendance state:

*“Students are expected to attend classes regularly. A student who incurs an excessive number of absences may be withdrawn from a class at the discretion of the professor”*

(<http://bulletin.uga.edu/bulletin/ind/attendance.html>).

Attendance in this course will be monitored. For this course, five (5) absences from lectures will result in automatic withdrawal from the course. If the withdrawal is before the midpoint deadline, the grade will be “W”. After the deadline, the grade will be “F”. The five (5) absences include absences that may prove to be excused.

No absences from laboratory periods are permitted. A missed laboratory period will result in a score of zero (0) for that laboratory (see below).

No absences from exam periods are permitted. A missed exam will result in a score of zero (0) for that exam (see below).

Examinations missed in the case of emergencies, including personal/family crises, require a signed excuse from the Office of the Vice President of Instruction. No score for a makeup exam will be acknowledged/recorded without this signed excuse.

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Examinations missed in the case of personal illness require certification signed by the attending physician describing the illness and validating the absence. This will be presented to the instructor. Contact information for the attending physician will also be provided to the instructor.

In the event that a critical activity has been scheduled well in advance of a scheduled exam, the student can arrange with the instructor for a makeup exam. This must be done at least two weeks before the examination. In the event it is not, a signed excuse from the Office of the Vice President of Instruction must be provided.

Makeup exams will be given only within four (4) days of the normally scheduled exam. These will be scheduled at the earliest possible time.

The same guidelines for missed exams apply to missed laboratory sessions (see below).

Lectures begin at 3:30. Students who arrive between 3:30 and 3:40 will be considered late. Two (2) such instances of arriving late will constitute one (1) absence. Students who arrive after 3:40 will be considered absent.

### **ELECTRONIC DEVICES:**

No laptops, cell phones, ipods or other electronic devices are allowed to be in operation in the classroom. All such, or related, devices must be turned off before entering the classroom. The exception is, for exams, each student should bring a hand-held calculator to each exam. PDAs are not allowed.

### **GRADING:**

Grades will be based on exams and written laboratory reports. There are three (3) in-class exams and one (1) final exam, for a total of four (4) exams. There are five (5) laboratory sessions and a total of five (5) written laboratory reports. The grade in the course will be assigned based on the highest three (3) exam scores and the highest four (4) written laboratory report scores. The three (3) highest exam scores will count 75% toward the final grade, and the four (4) highest laboratory scores will count 25% toward the final grade.

Consideration for regrading of an exam requires that the student request the regrading no more than one (1) week after the graded exam is returned. A written statement detailing the justification for consideration of regrading must also be provided.

### **EXAMS:**

There are three (3) in class exams and one (1) final exam for a total of four (4) exams. All exams are comprehensive. The length of the final exam will be similar to the in class exams, but students will have the full examination time (approximately three hours) to answer the questions. The final exam does not count more towards the final grade than the in class exams. An absence from an exam will result in a score of zero (0) for that exam.

Exams will cover all material discussed in class, all material found in the lecture notes, and all material in the reading assignments.

### **LABORATORY / WRITTEN LABORATORY REPORTS:**

There are five (5) laboratory sessions and a total of five (5) written laboratory reports. A written report is required for each lab. These are generally due one (1) week after the scheduled laboratory period. An absence from a laboratory session will result in a score of zero (0) for that lab/report.