# BIOMOLECULAR NMR SPECTROSCOPY

## GRADUATE COURSE OFFERING IN NUCLEAR MAGNETIC RESONANCE

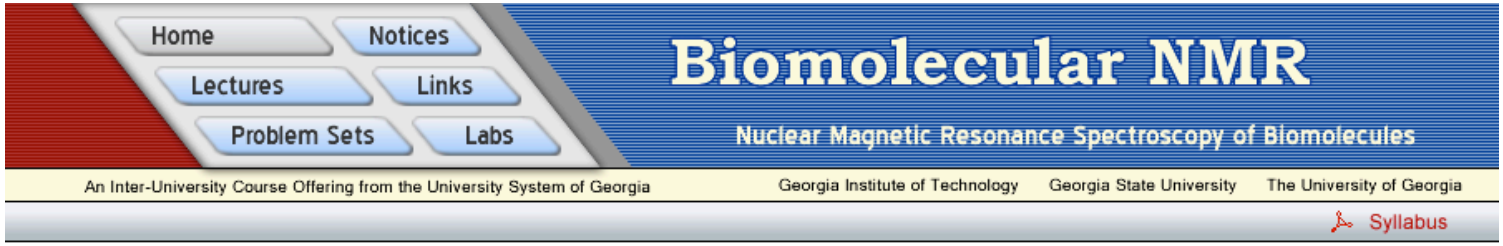
**Offered cooperatively by the Georgia State University,
the Georgia Institute of Technology, and the University of Georgia**

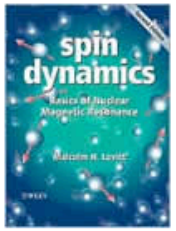
"Biomolecular Nuclear Magnetic Resonance" is a course intended for all graduate students with an interest in applications of nuclear magnetic resonance (NMR) to problems in structural and functional biology. It will begin with a treatment of the fundamentals that underlie magnetic resonance phenomena and develop this into a basis for experimental design, interpretation of data, and critical reading of the literature.

https://urbauerlab.uga.edu/8190

# COURSE WEBSITE: HOME PAGE

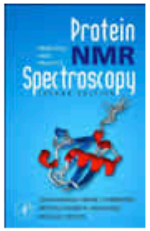
https://urbauerlab.uga.edu/8190



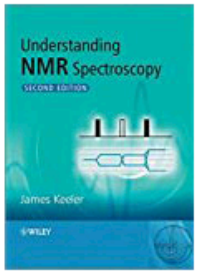

**Main Text**
Spin Dynamics – Basics of Nuclear Magnetic Resonance, 2nd Edition

Malcolm Levitt




**Supplementary Text:**
Protein NMR Spectroscopy, Principles and Practice, 2nd Edition

J. Cavanagh, W.J. Fairbrother, A.G. Palmer III, N.J. Skelton




**Supplementary Text:**
Understanding NMR Spectroscopy, 2nd Edition

James Keeler

The University of Georgia

**BCMB/CHEM 8190**
NMR Spectroscopy of Biomolecules

**Lectures:** M, W 10:05 - 10:55 (see instructor for location)

**Lab Sessions:** see instructor for time and location

**Instructor:**
Dr. Jeffrey Urbauer
urbauer@uga.edu

Georgia State University

**CHEM 8540**
Biomolecular Nuclear Magnetic Resonance

**Lectures:** M, W 10:05 - 10:55 (see instructors for location)

**Lab Sessions:** see instructor for time and location

**Instructors:**
Dr. Jenny Yang
Dr. Markus Germann

Georgia Tech

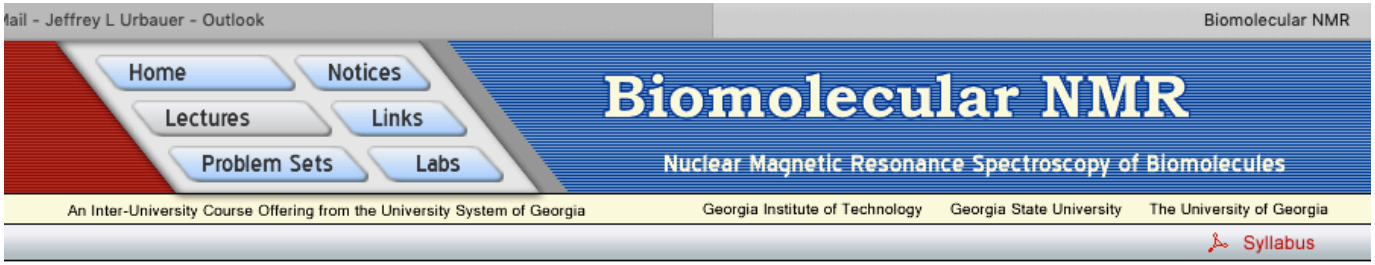
**CHEM 8853R**
Biomolecular NMR

**Lectures:** M, W 10:05 - 10:55 (see instructor for location)

**Lab Sessions:** see instructor for time and location

**Instructor:**
Dr. Les Gelbaum

# COURSE WEBSITE: LECTURES



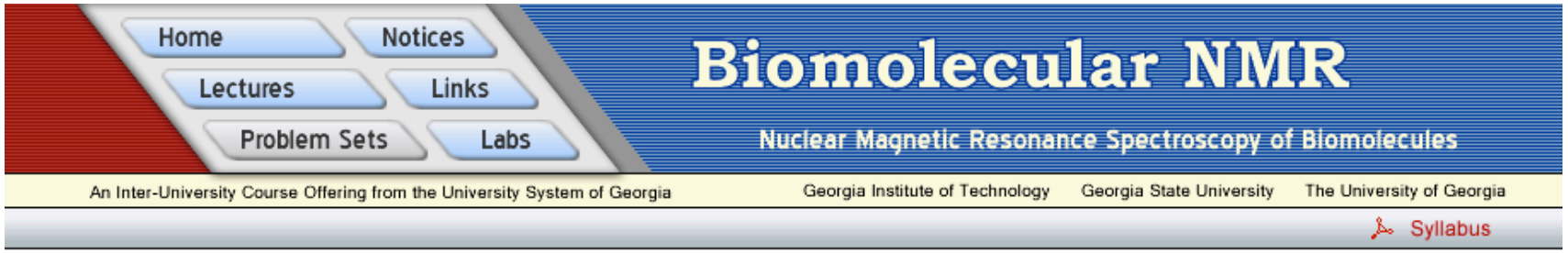

## Lecture Schedule

Blackboard Collaborate Ultra Classroom : Biomolecular NMR Spectroscopy - Spring 2020

Course Syllabus

| Week | Instructor | Topic | Suggested Reading |
|---|---|---|---|
| | | | L – Levitt C – Cavanagh K – Keeler |
| **I. Introduction** | | | |
| 1/6 | Urbauer | Course organization, website, syllabus [video] Brief history of biomolecular NMR [video] Review of spin properties [video] | 5 – 38 L |
| 1/13 | Urbauer | RF pulses and spin relaxation - Bloch equations (precession video) [video of lecture] | 39 – 50 L, 653 L |
| **II. Instrumentation** | | | |
| 1/13 | Urbauer | Instrumental considerations - a look at probes [video of lecture] | 65 – 76 L |
| 1/20 | Urbauer | Fourier transform methods and data processing [video of lecture not yet available] | 85 – 102 L, 78 – 101 K |
| **III. NMR Observables – Classical and Quantum Descriptions** | | | |
| 1/27 | Urbauer | Scalar Couplings [video of lecture not yet available] | 217 – 223 L |

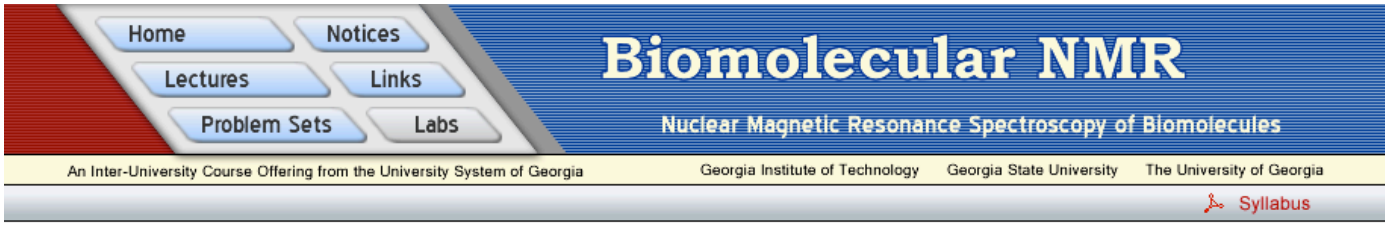
# COURSE WEBSITE: PROBLEM SETS




## Problem Sets & Exams

| | |
|---|---|
| Q. - Questions | A. - Answers |
| Q. Problem Set 1 | A. Problem Set 1 |
| Q. Problem Set 2 | A. Problem Set 2 |
| Q. Problem Set 3 | A. Problem Set 3 |
| Q. Problem Set 4 | A. Problem Set 4 |
| Midterm, no answers | Midterm with answers |
| Q. Problem Set 5 | A. Problem Set 5 |
| Q. Problem Set 6. | A. Problem Set 6 |
| Q. Problem Set 7. | A. Problem Set 7 |

# COURSE WEBSITE: LABS




## Laboratory Schedule

| Date | Instructor | Topic |
|---|---|---|
| F 1/10 | Urbauer | Computer Setup and Linux Tutorial (an older Linux Tutorial can be found here) |
| F 1/17 | Urbauer | Classical Simulations of NMR Experiments with PjNMR Tutorial (older tutorials can be found here and here) |
| F 1/24 | Urbauer | Intro to data processing, weighting functions - MNova [data] |
| F 1/31 | Urbauer | Advanced Data Processing - NMRPipe: Intro to Macros [lab exercise and data] |
| F 2/7 | Urbauer | Data Display using NMR Draw [lab exercise and data] |
| F 2/14 | Urbauer | Introduction to a general analysis tool: Maple [lab exercise and data] |
| F 2/21 | Urbauer | Product Operator Manipulations using Maple [lab exercise & data] |
| F 2/28 | | **----- midterm exam - no lab session -----** |

# COURSE ORGANIZATION

- *Previously*, live, online lectures Mon. and Wed., lab on Fri.
  - asking questions during lecture cumbersome, non-interactive
  - lecturers struggled to cover material in lecture with questions
  - opportunities to ask questions were stymied
  - result was no (little) interaction between instructors/lecturers and students

- *New format*, pre-recorded lectures, online discussions
  - students can view pre-recorded lectures any time
  - lectures can be viewed online or downloaded for offline viewing
  - an online discussion will be held each week so students can ask questions, get answers, review material/concepts, exchange ideas, get assistance with problems
  - students can also get help via email
  - the online discussion can be scheduled for any time

- *Lab*, the lab remains unchanged
  - the lab is run at the discretion of the instructor at each institution

# EXAMS and GRADING

- *Midterm exam*, Friday, February. 28
  - will cover all material covered up to and including the week of Feb. 24
  - students will have a normal class time (50 minutes) to answer the exam
- *Final exam*, scheduled during the institutional allotted time
  - comprehensive: will cover all material covered during the semester
  - students will have three hours to answer the exam
- *Grading*,
  - the midterm exam counts for 25% of the overall course grade
  - the final exam counts for 75% of the overall course grade
- *Exam Format*, open book, open notes

All exams are open-book, open-note. Students can bring whatever books or notes they wish to exams. Each student should also bring a hand-held calculator to the exam periods, as a calculator will be necessary for answering some of the questions. Otherwise, NO other electronic devices are allowed during the exam (no laptops, no phones, no iWatches or equivalent, no iPads or equivalent, etcetera). Students can bring hard copies of lecture notes but will NOT have access to electronic copies during the exam. Students will NOT have access to the internet during exams. Students will NOT be allowed to retrieve additional materials during the exam.