



# CHEM F620

## Applications of NMR Spectroscopy

### Fall 2018

CRN: 74891 Credits: 3 credits

Lecture: REIC 202, MWF 9:15 – 10:15 am

#### Instructors:



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**Course Description:** Application of nuclear magnetic resonance (NMR) spectroscopy in the chemical and biochemical sciences. The course will focus on the implementation and interpretation of NMR experiments for solving research problems. Topics include the basic theory of NMR and one- and two-dimensional techniques, solid and solution state methods and applications to various fields including environmental chemistry. Prerequisites: Graduate Standing or permission of instructor. Stacked with CHEM F420. (3+0)

#### Course Materials:

**Required Textbook:** *Basic One- and Two-Dimensional NMR Spectroscopy*, 5th Edition Horst Friebolin, 2011, Wiley-VCH;  
**ISBN-13: 978-3527327829 ISBN-10: 3527327827.**

**Recommended Text:** *NMR Spectroscopy: A Versatile Tool for Environmental Research*, Simpson and Simpson, eds., Wiley 2014  
**ISBN: 978-1-118-61647-5**



#### Important Dates:

Aug. 27<sup>th</sup>: First day of class

Sept. 7<sup>th</sup>: Deadline for adding classes, late registration, drops with no appearance on academic record

Nov. 2<sup>nd</sup>: Last day for withdrawal with W

Dec. 9<sup>th</sup>: Last day of instruction

**Dec. 10<sup>th</sup>: FINAL (Exam III) 8-10 am**

Dec. 19<sup>th</sup>: Grades Posted

**Course Goals:** The course is designed to teach the fundamentals and applications of NMR spectroscopy. We will focus on a primarily nonmathematical approach to describing pulsed NMR experiments. The interpretation of spectra, including 1-D and 2-D, will be emphasized through homework.

**Student-Learning Outcomes:** At the end of this course, students should be able to

1. Understand the fundamental concepts of nuclear behavior in an NMR experiment, including excitation and relaxation in a magnetic field.
2. Know the fundamental parameters associated with an acquisition of NMR data, and how parameter adjustment affects the resulting spectrum.

3. Know fundamental concepts of basic pulse sequences through the use of vector diagrams.
4. Be proficient in the interpretation of 1-D and 2-D NMR data of small molecules (< 2000 Daltons).
5. Be able to critically analyze scientific literature regarding NMR techniques.
6. Be able to understand and appropriately decide on NMR techniques best suited for specific applications.

**Course Structure.** The coursework will follow the Friebolin textbook (Green section) and the Simpson and Simpson textbook (Guerard section) in the order on the Tentative Lecture Schedule. The instructor Green will lecture on the theory, instrumental aspects, and interpretation of spectra. Problem solving sessions will be held every two weeks. The instructor Guerard will lecture on solid state methods and applications of NMR used in a variety of environmental applications. Instructors will use a combination of Power Point slides and Whiteboard, providing copies of notes and handouts to the students. Homework problems will be assigned.

**Point Breakdown.**

Exams (3)	= 300 pts
Homework (7)	= 105 pts
Paper Reviews	= 45 pts
Paper Presentation	= 50 pts
<u>Unknown Analysis</u>	<u>= 100 pts</u>
Total Course Points	= 700 pts

**Grading.**

A = $\geq 90\%$ ( $\geq 630$ pts)
B = 80-89% (560 – 629 pts)
C = 70-79% (490 – 559 pts)
D = 60-69% (420 – 489 pts)
F < 60% (< 420 pts)

**Homework (7).** Homework assignments are listed on the tentative course schedule in this syllabus and are due in class on the days shown. Late assignments are not accepted. Homework is a very important component of this class. The homework problems provide you with an opportunity to learn how to approach a problem and the mechanics of actually doing the problem. I encourage you to work in groups to solve the homework problems. However, your work must be your own - just copying someone else's solution violates the Honor Code (see below).

**Exams (3).** Exams are listed on the course schedule in this syllabus. No electronic devices are allowed during exams other than a non-programmable scientific calculator. You must turn in your exam before leaving the room. Use of cell phones or electronic devices other than a non-programmable scientific calculator during exams constitutes cheating and will result in an F in the course as per the policy of the Chemistry Department (see Honor code). Make-up exams are only allowed in the event of a legitimate excuse as determined by the instructor. If you anticipate an absence from an exam, bring it to the instructor's attention **before** the exam date, or in the case of unexpected absences, within one business day.

**Paper Review.** A partnered 1-page (single spaced 12 pt Times New Roman 1" margin) critical review and 10-minute presentation of that review of published journal articles of your choice relevant to the course material will be required during the term (see Tentative Schedule). Selected articles to review must be submitted to the instructor by October 12<sup>th</sup>. Details to Follow.

**Unknown Analysis.** Students will be given an "unknown" sample that they must analyze by a variety of NMR methods, and prepare a written report on their identification and spectral assignments. Students will present the analysis of their unknowns in class on Dec. 7<sup>th</sup>. Details to follow.

## Notes and Policies:

**Honor Code.** Chemistry Department policy states that any student caught cheating on graded work will be assigned a course grade of F. Course drop forms will not be signed in these cases.

**Instructor-Initiated Withdrawals.** Until Friday, Nov 2<sup>nd</sup> the instructor has the right to withdraw a student who has not participated substantially in the course. Any of the following constitute non-participation: 1) Exam I missed without an excused absence, 2) At least 2 incomplete homework assignments.

## Support & Accommodations:

**Disabilities Services.** The Office of Disability Services implements the Americans with Disabilities Act (ADA), and ensures that UAF students have equal access to the campus and course materials. Students with documented disabilities who may need reasonable academic accommodations should discuss these with me during the first two weeks of class. We will work with the Office of Disabilities Services (\*208 Whitaker, 474-5655) to provide reasonable accommodation to students with disabilities. You will need to provide documentation of your disability to Disability Services.

**Veteran Support Services.** Walter Crary (wecrary@alaska.edu) is the Veterans Service Officer at the Veterans Resource Center, 111 Eielson Building, 474-2475. Fairbanks Vet Center: 456-4238. VA Community Based Outpatient Clinic at Ft. Wainwright: 361-6370.

**Student Support Services.** The Student Support Services (SSS) program located in 512 Greuning (474- 6844), provides opportunities for academic development, assists students with college requirements, and serves to motivate students toward successful completion of their degree program.

**Diversity, Equal Opportunity, and Affirmative Action:** The University of Alaska Fairbanks is accredited by the Northwest Commission on Colleges and Universities. UAF is an affirmative action/equal opportunity employer and educational institution. University of Alaska Board of Regents have clearly stated in BOR Policy that discrimination, harassment and violence will not be tolerated on any campus of the University of Alaska

Student protections and services statement: Every qualified student is welcome in my classroom. As needed, I am happy to work with you, disability services, veterans' services, rural student services, etc to find reasonable accommodations. Students at this university are protected against sexual harassment and discrimination (Title IX), and minors have additional protections. For more information on your rights as a student and the resources available to you to resolve problems, please go the following site: [www.uaf.edu/handbook/](http://www.uaf.edu/handbook/)

**Amending this Syllabus:** Before the drop date, we may slightly revise the syllabus to correct for any errors. Revision at a later time would require majority vote by students present in class on day issue is decided. Any revisions will be distributed to all students via Blackboard and announced in class. Adjustments to the tentative lecture schedule, homework due dates and readings will be made throughout the course at the instructor's discretion and if so, communicated to students via Blackboard.

## CHEM 620 Tentative Lecture Schedule

Week	Date		Lecture Topic and Reading	Assignments
1	M	8/27	Ch 1 (Friebolin) 1.1, 1.2	HW 1 assigned
	W	8/29	Ch 1 (Friebolin) 1.3, 1.4	
	F	8/31	<b>Problem Solving</b>	
2	M	9/3	<i>Labor Day: NO CLASS</i>	
	W	9/5	Ch 1 (Friebolin) 1.5, 1.6	
	F	9/7	<b>Problem Solving</b>	<b>HW 1 Due</b>
3	M	9/10	Ch 2 (Friebolin) 2.1, 2.4	HW 2 assigned
	W	9/12	Ch 2 (Friebolin) 2.4	
	F	9/14	Ch 3 (Friebolin) 3.1,3.2	
4	M	9/17	Ch 3 (Friebolin) 3.3	
	W	9/19	<b>Problem Solving</b>	
	F	9/21	<b>EXAM I</b>	<b>HW 2 Due</b>
5	M	9/24	Ch 4 (Friebolin) 4.1, 4.2	HW 3 assigned
	W	9/26	Ch 4 (Friebolin) 4.6	
	F	9/28	Ch 5 (Friebolin) 5.1, 5.3	
6	M	10/1	Ch 7 (Friebolin) 7.1, 7.2	
	W	10/3	Ch 7 (Friebolin) 7.3	
	F	10/5	<b>Problem Solving</b>	<b>HW 3 Due</b>
7	M	10/8	Ch 1 (Simpson)	HW 4 assigned
	W	10/10	Ch 5 (Simpson)	
	F	10/12	Ch 11 (Simpson)	<b>Paper Rev Topic Due</b>
8	M	10/15	Ch 8 (Friebolin) 8.1. - 8.3	
	W	10/17	Ch 8 (Friebolin) 8.5.1, 8.5.2, 8.6	
	F	10/19	<b>EXAM II</b>	<b>HW 4 Due</b>
9	M	10/22	Ch 9 (Friebolin) 9.1-9.3	HW 5 assigned
	W	10/24	Ch 9 (Friebolin) 9.4.1,9.4.2, 9.4.5	
	F	10/26	<b>Problem Solving</b>	
10	M	10/29	Ch 2-3 (Simpson)	
	W	10/31	Ch 14 (Simpson)	
	F	11/2	Ch 22-24 (Simpson)	<b>HW 5 Due</b>
11	M	11/5	Ch 4 (Simpson)	HW 6 assigned
	W	11/7	Ch 13 (Simpson)	
	F	11/9	Special Topics	
12	M	11/12	Ch 10 (Friebolin) 10.1, 10.2	
	W	11/14	Ch 10 (Friebolin) 10.4	
	F	11/16	<b>Problem Solving</b>	<b>HW 6 Due</b>
13	M	11/19	Guest Lecture: Dr. Murphy	HW 7 assigned
	W	11/21	<i>THANKSGIVING: NO CLASS</i>	
	F	11/23	<i>THANKSGIVING: NO CLASS</i>	
14	M	11/28	Ch 12 (Simpson)	
	W	11/30	Ch 19 (Simpson)	
	F	12/2	Ch 6 (Simpson)	<b>HW 7 Due</b>
15	M	12/3	<b>Problem Solving</b>	
	W	12/5	Paper Review Presentations	<b>Paper Review Due</b>
	F	12/7	Graduate Presentations	
16	W	12/10	<b>8:00 – 10:00 FINAL EXAM (Exam III)</b>	