BIOCHEM 729 section 012

Advanced Topics

COURSE INFORMATION

Advanced Topics

BIOCHEM 729 012 (2 Credits)
2022 Spring [1224]

Description
Specialized subjects of current interest. Enroll Info: None

Prerequisite(s)
Graduate/professional standing

Instruction Mode
Classroom Instruction

Section Level Com B
False

Department: Biochemistry
College: Agricultural and Life Sciences

2022 Spring [1224]

Term Start Date: Tuesday, 23-Nov-2021 **Term End Date:** Wednesday, 15-Jun-2022

ADD TO CALENDAR

Location and Schedule: Babcock Hall 119 TR 11:00 AM-11:50 AM
CRN: 865511224

How Credit Hours are Met :

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This class meets for two 75-minute class periods each week over the semester and carries the expectation that students will work on course learning activities (reading, writing, problem sets, studying, etc.) for about 3

hours out of classroom for every class period. The syllabus includes more information about meeting times and expectations for student work. Students are expected to read the assigned sections from the textbook and primary literature, participate in discussion in class sections, and work on assigned homework problems. Homework problems will not be graded but will be discussed in class and all students are expected to participate actively. There will be an end-of-semester project customized for each student enrolled in the class according to their research interests; this project could involve NMR data collection, theoretical spin physics calculations, processing or NMR data, and/or calculation of molecular structures and dynamics parameters.

Regular and Substantive Student-Instructor Interaction :

This course meets the regular and substantive student-instructor interaction requirement in several ways:
1. Direct instruction occurs in person twice a week at the scheduled class periods.
2. Instructor is available before and after these class periods for informal discussion for at least 15 minutes.
3. Instructor is available for office hours that will be scheduled according to student preferences the first week of class.
4. Online discussion is encouraged through Canvas and the instructor reviews the discussion threads on a daily basis.
5. Private meetings may be scheduled by students with the instructor.

Other Course Information :

This course will offer opportunities for individualized training in NMR spectroscopy data collection and analysis according to the individual needs of each student, with support of staff from the National Magnetic Resonance Facility at Madison (NMRFAM). Students are encouraged to discuss their individual training needs with the instructor and relevant NMRFAM staff early in the semester.

INSTRUCTORS AND TEACHING ASSISTANTS (TAs)

Instructors

SAMUEL BUTCHER
SEBUTCHER@WISC.EDU

KATHERINE HENZLER-WILDMAN
HENZLERWILDM@WISC.EDU

CHAD RIENSTRA
CRIENSTRA@WISC.EDU

Instructor Availability and Preferred Contact :

Prof. Rienstra is the primary instructor for this course and is available by email (crienstra@wisc.edu) to answer questions, will establish a regular office hour according to student preferences during the first week of class, and can be scheduled for individual meetings (by Zoom or in person) by emailing him and/or his assistant Lai Bergeman (lai.bergeman@wisc.edu).

Profs. Henzler-Wildman and Butcher are also available to address questions in their areas of expertise and can also be reached by email and scheduled via Lai Bergeman.

TA Availability and Preferred Contact :

There is no formal TA assigned for this course, but several NMRFAM staff are available to answer questions about NMR practice and theory. Please see https://nmrfam.wisc.edu/people/ for a full list of NMRFAM staff and please inquire by email to Prof. Rienstra if you need further guidance regarding which staff member has the best expertise to support your educational needs.

COURSE OUTCOMES, GRADING, and OTHER COURSE MATERIALS

Course Learning Outcomes (CLOs) :

- Understand foundational principles of nuclear magnetic resonance spectroscopy.
- Use spin physics theory (product operators and average Hamiltonians) to calculate expected results from specific types of NMR pulse sequences
- Design experiments to measure specific structural and dynamic parameters in biological macromolecules
- Calculate protein and nucleic acid structures using NMR data
- Determine timescales of molecular motions from NMR data

Grading :

The class is graded with A-F scale; F is not being used because C is a failing grade. This is advanced undergraduate and graduate level course with assignments throughout the semester that will require active participation in the class. 75% of the grade will be based on participation and effort as evidenced in the class. 25% of the grade will be based on the final project. Following is the translation of percentage of points achieved in the course and how that corresponds to a letter grade. Note that IPiB students must achieve a minimum grade of BC in order for this program requirement to be fulfilled:

C	<73 (Must retake class)
BC	73-77
B	78-83
AB	83-88
A	88-100

Course Website, Learning Management System and Digital Instructional Tools :

Course website is on Canvas.
Zoom will be used if it becomes necessary to meet online.
However, the plan is to meet in person throughout the semester.

Required Textbook, Software, & Other Course Materials :

Required textbook: Protein NMR spectroscopy, Principles and Practice, 2nd edition. Arthur G. Palmer III (Author), Wayne J. Fairbrother (Author), John Cavanagh (Author), Nicholas J. Skelton (Author), Mark Rance (Author). ISBN-13: 978-0121644918

We would prefer for all students to obtain their own copy of this excellent book. In addition, some copies are available through the NMRFAM library for short-term use.

Homework & Other Assignments :

Each lecture will include specific problems to be worked out by the students in advance of the next lecture. These will be provided in the lecture notes. At the start of the subsequent class, the instructor will ask students to volunteer to present their solutions to the problems and/or difficulties encountered in attempting to solve the problems. Credit will be given for each time a student volunteers to contribute to this discussion. First opportunity to volunteer will be given to students who did not volunteer in the previous session.

EXAMS, QUIZZES, PAPERS & OTHER MAJOR GRADED WORK

Exams, Quizzes, Papers & Other Major Graded Work :

No exams or quizzes. There will be a final project.

ADDITIONAL COURSE INFORMATION AND ACADEMIC POLICIES

Teaching & Learning Data Transparency Statement

The privacy and security of faculty, staff and students' personal information is a top priority for UW-Madison. The university carefully reviews and vets all campus-supported digital tools used to support teaching and learning, to help support success through learning analytics, and to enable proctoring capabilities. View the university's full teaching and learning data transparency statement.

Privacy of Student Records & the Use of Audio Recorded Lectures Statement

View more information about FERPA.

Lecture materials and recordings for this course are protected intellectual property at UW-Madison. Students in this course may use the materials and recordings for their personal use related to participation in this class. Students may also take notes solely for their personal use. If a lecture is not already recorded, you are not authorized to record my lectures without my permission unless you are considered by the university to be a qualified student with a disability requiring accommodation. [Regent Policy Document 4-1] Students may not copy or have lecture materials and recordings outside of class, including posting on internet sites or selling to commercial entities. Students are also prohibited from providing or selling their personal notes to anyone else or being paid for taking notes by any person or commercial firm without the instructor's express written permission. Unauthorized use of these copyrighted lecture materials and recordings constitutes copyright infringement and may be addressed under the university's policies, UWS Chapters 14 and 17, governing student academic and non-academic misconduct.

How to Succeed in This Course

Resource links to other campus services:

- University Health Services
- Undergraduate Academic Advising and Career Services
- Office of the Registrar
- Office of Student Financial Aid
- Dean of Students Office

Course Evaluations

Students will be provided with an opportunity to evaluate this course and your learning experience. Student participation is an integral component of this course, and your confidential feedback is important to me. I strongly encourage you to participate in the course evaluation.

Digital Course Evaluation (AEFIS)

UW-Madison uses a digital course evaluation survey tool called AEFIS. In most instances, you will receive an official email two weeks prior to the end of the semester, notifying you that your course evaluation is available. In the email you will receive a link to log into the course evaluation with your NetID. Evaluations are anonymous. Your participation is an integral component of this course, and your feedback is important to me. I strongly encourage you to participate in the course evaluation.

Students' Rules, Rights & Responsibilities

Rights & Responsibilities

For fall 2021, instructors and students should consult the following website for current campus health and safety guidance: covidresponse.wisc.edu.

Diversity & Inclusion Statement

Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals. The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world.

Academic Integrity Statement

By virtue of enrollment, each student agrees to uphold the high academic standards of the University of Wisconsin-Madison; academic misconduct is behavior that negatively impacts the integrity of the institution. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these previously listed acts are examples of misconduct which may result in disciplinary action. Examples of disciplinary action include, but is not limited to, failure on the assignment/course, written reprimand, disciplinary probation, suspension, or expulsion.

Accommodations for Students with Disabilities

The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA. (See: McBurney Disability Resource Center)

Academic Calendar & Religious Observances

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BIOCHEM729: Biochemical Applications of NMR

Chapter 1: Classical NMR Spectroscopy

1/25 Magnetism, Bloch Equations and One Pulse NMR Experiment
1/27 Chemical Shifts and Couplings

Software: Mathematica notebooks

Chapter 3: Experimental Aspects of NMR Spectroscopy

2/1 Introduction to NMR Instruments and Probes
2/3 Data Acquisition and Processing of 1D Spectra

Software: Mnova

Chapter 2: Theoretical Description of NMR Spectroscopy

2/8 Essential Quantum Mechanics: Density Matrix and Time Evolution
2/10 Matrices as Operators
2/15 Product Operator Formalism
2/17 Examples: Spin Echo, INEPT, Decoupling

Software: Mathematica product operator notebooks

Chapter 4: Multidimensional NMR

2/22 Basics of 2Ds; COSY, HSQC, TOCSY
2/24 Phase Cycling and Hypercomplex Frequency Discrimination

Software: NMRPipe

Detour from Palmer: Introduction to Solid-State NMR

3/1 Dipolar couplings and magic-angle spinning
3/3 Recoupling theory
3/8 Homonuclear recoupling
3/10 Heteronuclear recoupling and decoupling

Software: SIMPSON, Spinach

3/15 Spring break
3/17 Spring break

Chapter 6: Homonuclear Methods (^{1}H in Solution, ^{13}C in Solids)

3/22 COSY/SPC5; TOCSY/DARR; NOESY/PAR
3/24 3D Homonuclear Experiments and Non-Uniform Sampling

Software: SMILE

Chapter 7: Heteronuclear Methods

3/29 Foundational Elements: HSQC, HMQC, TROSY, SPECIFIC CP, TEDOR
3/31 Concatenation: HNCA, HNCO, HNCACB, NCACX, NCOCX, CANCO
4/5 Combination of Homo/Heteronuclear Experiments
4/7 Considerations for Larger Proteins (including some of Chapter 9)

Software: Sparky; PINE

Chapters 5 and 8: Relaxation, Dynamic Processes, and Experimental Methods
(Prof. Katherine Henzler-Wildman)

4/12 Fundamentals of Relaxation Theory
4/14 Fast Motions: Picoseconds to Nanoseconds
4/19 Slower Motions: Microseconds to Milliseconds
4/21 Intermediate Motions: Measuring the Invisible

Software: ModelFree, Ring

Structure Calculations (Examples from Primary Literature)

4/26 Distance Geometry and Simulated Annealing
4/28 Structure Refinement and Joint Computations

Software: XPLOR-NIH, PASD

Student Project Presentations

5/3 4 x 15 min. presentations
5/5 Remaining presentations*
*Schedule additional time during finals week if necessary