

Analytical Methods for Heterogeneous Catalysts and other Solid Materials

ECH 6937 (3 credits)

Class Periods: M Periods 8,9, F Period 8, and corresponding time of day

Location: CHE 316

Academic Term: Fall 2023

Instructor:

Helena Hagelin Weaver

Email Address: hweaver@che.ufl.edu

Office Phone Number: 352-392-6585

Office Hours: Fridays, 3;50-4:55 PM, CHE 323

Teaching Assistant/Peer Mentor/Supervised Teaching Student:

N/A

Course Description

Various spectroscopic and analytical techniques for characterizing catalytic properties of solid materials will be covered. Topics include identification and quantification of different species, temperature programmed reaction methods, X-ray diffraction for structural evaluation, electron microscopy, infrared and Raman spectroscopy, X-ray photoelectron spectroscopy, nuclear magnetic resonance spectroscopy as well as other commonly used and state-of-the-art characterization methods. The information that can be obtained, as well as the strengths and weaknesses of each method will be discussed.

Course Pre-Requisites / Co-Requisites

N/A

Course Objectives

This course will introduce students to analytical techniques that are used in heterogeneous catalysis and related fields. Emphasis is placed on acquiring a fundamental understanding of each method, knowledge about the information that can be obtained, as well as the strengths and weaknesses of each method. By the end of this course, the students will be able to determine the best analytical method to use to obtain the desired information in their research and understand the limitations of the techniques as well as how the measurements may affect the results.

Materials and Supply Fees

N/A

Required Textbooks and Software

N/A

Recommended Materials

Book:

- Title: Spectroscopy in Catalysis: An Introduction
- Author: J. W. Niemantsverdriet
- Publication date and edition: Wiley, 3rd edition, 2007
- ISBN number: 978-3-527-61135-5

Course Notes: Personal notes from lectures and documentation uploaded on Canvas (such as PowerPoint presentations and other information files).

Additional Literature: Articles from search engines such as Web of Science (<https://www.webofscience.com/wos/woscc/basic-search>).

Tentative Course Schedule

- Week 1: Overview of Analytical Methods for Heterogeneous Catalysts
- Week 2: Surface Properties, Pore Volume, Particle Size
- Week 3: Elemental Analysis (AAS, ICP, EDS, EMPA)
- Week 4: General Methods for Measuring Reactivity (Catalytic Activity and Selectivity)
- Week 5: Temperature Programmed Techniques (Oxidation, Reduction and Reaction)
- Week 6: Crystal Structure and X-Ray Diffraction
- Week 7: X-ray absorption Methods (XANES and EXAFS)
- Week 8: X-ray Photoelectron Spectroscopy
- Week 9: Transmission and Scanning Electron Microscopy
- Week 10: Vibrational Spectroscopy (Infrared and Raman)
- Week 11: Nuclear Magnetic Resonance
- Week 12: Limitations of Analytical Techniques
- Week 13: State-of-the-Art Analytical Methods
- Week 14: Project Presentations
- Week 15: Project Presentations

Attendance Policy, Class Expectations, and Make-Up Policy

- Attendance is required and will be recorded at each class meeting.
- Excused absences must be consistent with university policies in the Graduate Catalog (<https://catalog.ufl.edu/graduate/regulations>) and require appropriate documentation. Additional information can be found here: <https://gradcatalog.ufl.edu/graduate/regulations/>. Make-up work for excused absences will be considered on a case-by-case basis in a manner that is fair for you and your classmates. Unexcused absences will significantly impact the class participation grade (see below).
- Reading assignments will be given each week and should be completed prior to next week's class meeting.
- Students are expected to participate in class discussions and prepare one question or conclusion (summary) about each reading assignment.
- Students must maintain a journal with notes about the reading assignments and each lecture. The journal should summarize material covered in the textbook and notes about each lecture. The instructor will periodically collect the journals for review.

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Attendance and Participation	100	25%
Assignments (includes journal summary)	100 each	25%
Presentation	100	25%
Term Paper	100	25%
	Total:	100%

Grading Policy

Detailed Explanation of Grading:

Class participation grade (0-100 points): 100 points will be assigned if a student never missed class (or made up an excused absence) and also participated in class discussions. Each hour of class is ~2.5 pts (total class hours ~40). If students do not participate in class discussions 0.5 points will be deducted from the 2.5 pts assigned to each class period.

Assignments (0-100 points each): This includes reading assignments, which will require submission of short summaries and/or questions to ask during discussions. Expected total assignments = 10.

Presentation and Term Paper (0-100 points each): The presentation and term paper are each worth a maximum of 100 points and will be graded based on effort and adherence to instructions.

The following is an approximate but typical grading scale:

Percent	Grade	Grade Points
93.4 - 100	A	4.00
90.0 - 93.3	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.7 - 79.9	C+	2.33
73.4 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:

[UF Graduate Catalog](#)
[Grades and Grading Policies](#)

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.ua.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.ua.ufl.edu/public-results/>.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript

of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University’s core values, including the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information, and veteran status.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- HWC OE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

For campus resources see next page.

Campus Resources:
Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <https://counseling.ufl.edu>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Connections Center, Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.edu>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

On-Line Students Complaints: <https://distance.ufl.edu/getting-help/>; <https://distance.ufl.edu/state-authorization-status/#student-complaint>.