

ENMA 312: Experimental Methods in Materials Science

Department of Materials Science and Engineering

University of Maryland

Spring 2020

Course Description: Introduction to experimental and instrumental methods in measurements of properties of materials. Discussions and laboratory experiments involve activities such as synthesis and characterization of nanoparticles, construction and characterization of devices. Emphasis on structure-processing-properties relationship.

Pre-requisite: ENMA 300

Co-requisite: ENMA 460

Instructor:

Dr. Aldo Ponce
Office: 1103 Chemical and Nuclear Engineering Building
Email: aldop@umd.edu
Office hours: By appointment.

Preferred contact method: The instructor prefer to be contacted by email. Messaging via ELMS is also acceptable and may be used any time email communication is specified in the syllabus.

Teaching Assistant:

Mr. Richmond Wang
Office: 1142 Chemical and Nuclear Engineering Building
Email: rwang247@umd.edu
Office hours: By appointment.

Course Objectives: 1) To provide an understanding of the influence of bonding, nano- and micro-structure, composition and processing on the properties of materials. 2) to provide students with an understanding of various types of materials, their ranges of properties, and how their properties can be tailored for engineering purposes. 3) To enhance students' familiarity with materials characterization methods and data analysis techniques, through a combination of hands-on experience, measurement demonstration, and data analysis.

At the end of this course, the student should be able to:

1. Describe a variety of experimental methods and identify when they should be applied
2. Identify what materials' properties a particular method probes
3. Identify the most appropriate method(s) to probe specific materials characteristics. Be able to design experiments based on this knowledge
4. Understand how different characterization methods complement each other
5. Become familiar with modern methods of materials characterization, similar to those encountered in industrial and testing facilities and government laboratory
6. Communicate effectively their results and findings through reports and orally

Course website and communication:

The course website is on ELMS: <https://myelms.umd.edu/login>. The course website will be used for posting course materials, announcements, and grades, as well as for submitting assignments. The primary means for communicating information with students, including time-sensitive information, will be through ELMS, though email may also be used. Make sure the email you have associated with ELMS is current and that your notification settings ensure you to receive information in a timely manner. Unless announced (in class, by email, or on ELMS), all assignments will be submitted online with the exception of the notebook.

All questions regarding course assignments should be posted to the appropriate discussion board on ELMS, so all students can benefit from the response.

Textbook: No textbook is required for this course. However, you may find the following references helpful:

- Notes supplied by instructors.
- Callister and Rethwisch's *Fundamentals of Materials Science and Engineering*, Wiley.
- Yang Leng's *Materials Characterization: Introduction to Microscopic and Spectroscopic Methods*, Wiley-VCH, Second Edition, 2013.
- M. De Podesta's *Understanding the Properties of Matter*, Taylor and Francis, second edition, 2002.

Laboratory Exercises (tentative topics to be covered):

Computational modeling of materials
Polymer dispersed liquid crystals
Nanoparticle synthesis
Dynamic light Scattering (DLS)
X-ray diffraction (XRD)
Electrical measurements
Polarizing microscopy
Thermal analysis
Thermal conductivity and expansion
Ellipsometry
Spin coating/Thin film
Atomic force Microscopy (AFM)

Class Schedule: Please see the accompanying document for a detailed schedule.

<u>Section</u>	<u>Lecture/location</u>	<u>Lab time/location</u>
101	Tuesday 8:00 – 9:15 pm in KEB 1135	Wednesday 9 am–11:50 am in KEB 1135

The discussion, lab, and assignment schedule will be followed as closely as possible. Changes will be announced in class, via ELMS, or by email and will be posted on the course website.

Course materials: All course materials provided in class or in the course website (e.g., lectures, handouts, slides, laboratory manuals, homework assignments, quizzes, etc.) are copyright protected. Students may not copy and/or distribute these materials without the instructors' permission.

Grading: Final grades will be determined based on the following weighting system:

50%	Lab reports
20%	Laboratory notebook
10%	Online assignments
10%	Oral presentations
10%	Exam

Attendance to class (both laboratory and lecture) is compulsory. Unjustified absence(s) and tardiness (see attendance section below) will affect your grade at the discretion of the instructor.

Lab reports shall convey all experimental steps and processes, provide a description of the results, and provide a conclusion of the experiment. By the end of the semester, students will give an oral presentation on one of the experiments performed. Details on the format and content of the lab reports, presentation, and notebooks are provided in separate documents.

Questions regarding grading should be addressed to the instructor or TA who graded the assignment in question. Requests for regrading must be brought up within one week of the grade being posted. These requests should be made by email to the person responsible for grading, and Dr. Ponce must be copied on these emails. Requests that do not conform to these policies will not be considered.

Final grades will be calculated at the end of the semester. The final course letter grade will be determined based on the final distribution of all grades in the class, and the plus/minus grading system will be used. Grades will be assigned based on the following guidelines:

- A Work was outstanding and at a level well above requirements of the course
- B Work was at a level above the basic requirements of the course
- C Work was at a level that met the requirements of the course
- D Work was at a level that did not fully meet the basic requirements of the course
- F Work failed to satisfy the basic requirements of the course

There are *no curves* thrown in this class.

The final letter grade will be posted either after the deadline for the Course Evaluations submissions or before, if all the Course Evaluation have been submitted ahead of the deadline.

Late work: Pay close attention to the due dates and times for each assignment, along with the required format and content. Each student is responsible for checking that uploaded file(s) are in the requested format and appear as intended. Deadlines are based on the dates/time reported on ELMS, in the case a deadline is changes, students will be notified in advance.

Late work will be accepted past the deadline (unless stated otherwise), but will receive a deduction of 20% of the total points possible on the assignment per day and it will not be accepted five days after the deadline.

Note: you have a five-minute grace period to submit your assignment, after that time it will be consider a day late.

Safety: Maintaining a safe work environment for yourself, your classmates, the teaching assistants, and the instructors is critical. The following procedures and requirements must be followed:

1. Before entering the laboratory, be aware of the safe operation of your experimental equipment and understand any chemistry relevant to your system.
2. Do not eat or drink in the lab. Food/beverages must be kept away from any working surfaces.
3. Find, read, and understand material safety data sheets (MSDS) for all chemicals used in your experiments.
4. Know where all safety equipment is located in and near the lab (e.g., first aid kit, eye wash, fire extinguishers).
5. Turn off cell phones or set them to vibration mode. If you have to answer a call please inform the TA or the instructor, and step out, and be brief. Your colleagues are waiting for you.
6. **When asked by the instructor**, wear appropriate attire in the lab. Long pants (or the equivalent), a lab coat, and closed-toe shoes. Tie long hair back; neckties and jewelry must, if worn, must be secured or removed to prevent interference with equipment or chemicals. Students not dressed appropriately will not be allowed in the lab. This will be considered an unexcused absence.
7. Wear safety goggles at all times in the lab when any group is working with their equipment. Contacts are strongly discouraged.
8. Use gloves when handling corrosive, reactive, or poisonous chemicals. Do not touch doorknobs, computers, monitors, keyboards, mice, or cell phones when wearing gloves.
9. Report all injuries, however slight, to a teaching assistant or instructor. For emergencies, call 911 from a campus phone or #3333 from your cell phone. (Calling 911 from your cell phone is also acceptable, but #3333 is preferable.)

10. Dispose of all chemical waste appropriately. Ask an instructor or a teaching assistant, if you are unsure of the proper disposal method.
11. Stay focused on your experiment; lab time is not for the internet, email, or social media.
12. Pick up all trash and dispose of it properly.
13. Do not leave the lab without permission, so the instructors and teaching assistant know your location.

Housekeeping:

At the end of each lecture and lab period, each group must make sure their equipment and work area are returned to a condition as good as or better than they were at the beginning of the lab period. All glassware must be cleaned, and all tools and materials must be returned to their proper locations.

At the end of each lecture and lab period, place all chairs back under the table.

Academic integrity: The University of Maryland Code of Academic Integrity can be found in full at <https://president.umd.edu/administration/policies/section-iii-academic-affairs/iii-100a>. Instances of suspected academic dishonesty will be reported to the Honor Council for adjudication. The code states that “any of the following acts, when committed by a student, shall constitute academic dishonesty:

- a) Cheating: intentionally using or attempting to use unauthorized materials, information, or study aids in any academic exercise.
- b) Fabrication: intentional and unauthorized falsification or invention of any information or citation in an academic exercise.
- c) Facilitating academic dishonesty: intentionally or knowingly helping or attempting to help another to violate any provision of this code.
- d) Plagiarism: intentionally or knowingly representing the words or ideas of another as one’s own in any academic exercise.”

Additional information regarding expectations for this course will be provided during discussion and posted on ELMS.

Attendance: Students are expected to be present at and participate in each lecture and lab period for the entire scheduled time. Arriving more than 5 minutes late will be treated as an absence after the first infraction. Any non-medical absences (even for part of the class period) and requests for accommodations must be approved prior to class by email, and the request should be sent to Dr. Ponce. The instructors may request documentation to support your absence, which can typically be supplied by email. Only university-approved absences will be accepted (with the exception of job interviews that cannot be scheduled outside of class time).

In the event that a class must be missed due to illness, the policy in this class follows university and department policies. Documentation required for medically necessary absences should be provided by email, though the instructors may also request to review the original documentation.

Students with unapproved absences from lecture will not be allowed to make up missed work from the lecture section, and the student will receive a deduction of 25% of the total grade for the corresponding notebook report. Students with unapproved absences from a laboratory period will receive a deduction of the total points possible on the assignment corresponding to the missed work in the lab at the discretion of the instructor. Students who miss a presentation without approval will not be allowed to make up the missed work and will receive no credit for the presentation.

University closures or delays: The student is responsible for staying informed regarding university closures or delays. Sources of information are available at the university website, or signing up for alerts at <https://alert.umd.edu/> to find out if classes have been cancelled or classes will start at a later time. The information is generally made public by 6AM.

University closures or delays may require adjustments to the course schedule. When possible, lectures will be posted to ELMS for viewing when the university is closed for the lecture period. Students will be informed that the lecture is available and are responsible for viewing the lecture in a timely manner. For lab periods, if the time that classes will resume is 10 am, CLASS WILL BEGIN AT 10:00 am, EXCEPT WHERE NOTED.

When changes to the course schedule are required, students will be informed of these changes within one week of the university returning to normal operation. Any concerns students have about the schedule changes must be brought up within one week of receiving the changes.

Religious observances: The University of Maryland's policy states that students should not be penalized for participation in religious observance. Within the first two weeks of the semester, students are responsible for notifying the instructor by email of any anticipated absences for religious reasons.

Students with disabilities: Students with disabilities documented by the Disability Support Service Office (DSS; 301-314-7682) will be provided with appropriate accommodations. Students are responsible for presenting their accommodation letter to the instructor by the end of the drop/add period for this semester. Students may email the instructor to set up a meeting or may visit during office hours.

Additional information on university policies for undergraduate courses: Students and instructors have a shared responsibility to know and abide by the University of Maryland's policies that relate to all courses. Further information regarding policies relevant to undergraduate courses can be found at <http://ugst.umd.edu/courserelatedpolicies.html>. Topics that are addressed in these various policies include academic integrity, student and instructor conduct, accessibility and accommodations, attendance and excused absences, grades and appeals, copyright and intellectual property.

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