

## **Course Syllabus**

### **MTEN 305. Materials Characterization Methods**

**Fall 2025**

#### **Course details:**

4 credits

Course code: MTEN 305

Course title: Materials Characterization Methods

Course location: TIER 411B (class)/TIER 007A (lab)

Course time: Wednesday: 11:30 AM - 2:20 PM; Friday 1 – 3:05 PM

Pre-requisite: MATH 211 or MATH 213, MTEN 201

#### **Course Instructor and Office Hours:**

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Instructor: Dr. Edward L. Dreizin, York 120

Email address: [dreizin@njit.edu](mailto:dreizin@njit.edu)

Office number: 973-596-5751

Office hours: by appointment (in person or virtual)

Laboratory Instructor: Dr. Irina Molodetsky, Tiernan Hall 350

Email address: [irina.molodetsky@njit.edu](mailto:irina.molodetsky@njit.edu)

Office number: 973-596-3599

#### **Course Description:**

This course gives an introduction to instrumentation for characterization of material structures and compositions and methods for measuring a wide range of material properties including optical, morphological, structural, compositional, and thermal. Principles of microscopic imaging and the major branches of microscopy: optical, electron, and scanning probe will be discussed. Certain methods of image analysis will be discussed. Principles of X-ray diffraction and X-ray, IR, UV, and electron spectroscopies will be introduced by considering interaction of materials with electromagnetic radiation and electrons. Principles of thermal analysis in which the properties of materials are studied as

they change with temperature will be introduced. Students will learn hands-on operation of analytical instrumentation, organization and interpretation of experimental data.

### **Course organization:**

The course includes 3 hours of lecture time weekly, with in-class discussion and problem solving, and laboratory work 2 hours per week. Lecture notes will be available in CANVAS. The lecture notes are set up as problems, engaging students to interact with the material and actively test the concepts covered in the course.

The laboratory portion of the class will not be directly correlated with the lectures. The students are encouraged to begin all laboratory experiments as soon as possible. The theoretical guidance can be obtained from the course materials, reading, and consultations with the instructors and the TA. Each experiment is expected to include multiple measurements (at different conditions or to establish reproducibility and to analyze errors). Outside the regular class hours, please schedule your access to the equipment [here](#)

[Links to an external site.](#)

### **Required software:**

Microsoft Word, Excel and PowerPoint.

### **Recommended text**

Yang Leng. Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, 2nd Edition ISBN: 978-3-527-33463-6

### **Suggested resources:**

[NSF Virtual Lab](#)

[Links to an external site.](#)

[Myscope microscopy training](#)

[Links to an external site.](#)

[Nanoscience technique pages](#)

[Links to an external site.](#)

[Profex: open source XRD and Rietveld refinement](#)

[Links to an external site.](#)

## Topics

1. [Introduction and basic concepts](#) (week 1; Sept. 3 -5); teams formed
2. [Optical microscopy](#) (week 2, 3; Sept. 8 - 19)
3. [X-ray fluorescence](#) (week 3, 4; Sept. 22 - Oct. 3)
4. [X-ray diffraction](#) (week 4 – 6; Oct. 6 - 24)
5. [Transmission electron microscopy](#) (week 7; Oct. 27 - 31)
6. [Scanning electron microscopy](#) (week 8, 9; Nov. 3 - 14)
7. [Thermal analysis](#) (week 10 - 12; Nov. 17 - 26)
8. [Scanning probe and atomic force microscopy](#) (week 13; Dec. 1 - 5)
9. [Optical spectroscopy](#) (week 14; Dec. 8 - 10)

## Grading

In-class assignments (submitted in Canvas, individually): 18%

[Laboratory project reports and presentations](#) (teams): 82%

Presentations will be made by the teams in class on the same date when the report is due.

Lab 1: Optical imaging: Due September 26, 2025

Lab 2: X-ray diffraction analysis: Due October 31, 2025

Lab 3: Electron microscopy: Due November 21, 2025

Lab 4: Thermal analysis: Due December 3, 2025

**Final report:** characterization of the provided material: Due December 14, 2025. Oral presentations will be made and graded during the scheduled final exam time.

Student leaders will be assigned for Labs 2, 3, and 4. The leaders will receive the same grade as the rest of the team, but that will be worth double points for the lab reports they supervise. Each student will serve as a lab lead for one of the labs.

For the laboratory reports, the grades will be split as follows:

1. Results of experiments: 30%
2. Interpretation of results: 25%
3. Writing style: 25 %

4. Oral presentation of the report: 20 %

The report grades will be assigned to teams of 2-3 students

For labs 2, 3, and 4, one team member will be assigned as a lead. The lead group member will receive the same grade as the rest of the team; however, the total number of points earned by the lead will be doubled. Each student must serve as a leader for one lab.