SYLLABUS
MTSE-3020: Microstructure and Characterization of Materials
Department of Materials Science and Engineering *Fall 2020*

Introduce the principal methods for characterizing materials at all scales (from nano to micro) in terms of atomic composition, atomic structure and chemical bonding. During this course, Students are presented with the basic operation and capabilities of the principal characterization methods used in materials science. This course applies basic science concepts to develop a fundamental understanding of materials characterization methods that are fundamental for graduate research and employment in the area of materials design.

Professor: El Bouanani
Office: E-111 Research Park Phone: 940-369-8109 E-Mail: bouanani@unt.edu
Office Hours: Wednesday 11:00 AM – 1:00 PM and via Appointment
Class Hours: T/Th 2:30-3:50 PM Class Location: Remote

Textbook: The Instructor will supply handouts and references.
Course notes for each class (PPT files) will be posted on Canvas

Suggested text books:

- Materials Characterization, Y. Leng, Wiley (2010) ISBN 978-0-470-82298-2
- Microstructural Characterization of Materials, David Brandon and Wayne Kaplan, Wiley
- J.B. Wachtman, Characterization of Materials, Butterworth-Heinemann, ISBN 0-7506-9215-4 (1992).
- C.R. Brundle, C. A. Evans, Jr., and S. Wilson, Encyclopedia of Materials Characterization, Butterworth-Heinemann, ISBN 0-7506-9168-9 (1992).

Homework: Five homework sets will be assigned and graded. The purpose of the homework is to aid in learning the material. Although some collaboration among students in preparing the homework is acceptable, the main work should be primarily yours.
Late homework will not be accepted.

Exams: There will be tree examinations and one student project:
Midterm-I: October 8th
Midterm-II: November 10th
Comprehensive final Exam: December 8th, 1:30 PM - 3:30 PM
Student's projects are assigned on November 12th and are due on November 26th. Project presentations are scheduled to start on November 26th.

Grading:

(1) Homework (~ 5 total)	20%
(2) Quizzes	10%
(3) Student project	10%
(4) Midterm Exam-I + Midterm Exam-II	30%
(5) Comprehensive Final Exam	30%

If your grade in the comprehensive Final Exam is higher than the above grading plan, it will be used as your final course grade on the condition that you attend all classes, turn in all your Homeworks and take all mid-term Exams.

1. Quizzes are closed-book. Pop-up quizzes will not be announced.
2. Final exam will cover all chapters
3. Attendance of the class is required. Any student missing 5 classes without acceptable justification will be dropped from class.
4. Unethical conduct in quizzes or exams will automatically lead to failure of the course.

Course Topics (*Subject to Change*)

- Syllabus overview/General Introduction to Characterization
- Brief overview of Materials depositions and vacuum Technology

- Overview of X-ray, electron and ion sources

- **Spectroscopies Using Photon and Ion Probes**
  - Photon interactions with matter
  - X-Ray Fluorescence
    - X-ray absorption in materials
    - Instrumentation
    - Elemental identification and quantification
    - Basic principles
    - Instrumentations
    - Chemical identification and quantification
    - Examples and applications

  - X-ray Photoelectron Spectroscopy/UV Photoelectron Spectroscopy
    - Basic principles
    - Instrumentations
    - Chemical identification and quantification
    - Examples and applications

  - Fourier Transform Infra-Red and Raman
    - Basic principles
    - Examples and applications

  - Ion interactions with matter
  - Rutherford Backscattering Spectroscopy
    - Basic principles
    - Instrumentations
    - Atomic Collisions and Backscattering
    - Energy Loss and Backscattering Profiles
    - Examples and applications

- Secondary Ion Mass Spectroscopy
  - Basic principles
  - Instrumentations
  - Sputtering processes
  - Examples and applications

- *Examples and comparison of various spectroscopies in applications*

- **Topics on Optical microscopy**

  Metallographic Preparation Techniques
  Resolution (Rayleigh criterion, pixel counts)
  Contrast Formation
  Digital Imaging
  Image Quantification – Stereology
  Examples of optical microscopy in applications

- **Topics on Electron microscopy**

  Basics of electron sources and vacuum
  Signal types (SE, BSE)
  Energy Dispersive Spectroscopy (EDS)
  How TEM fundamentally differs
  Examples of electron microscopy in applications

- **Topics on X-ray diffraction**

  Bragg's Law
  Structure Factor
  Powder diffraction
  Textured diffraction
  Examples of X-Ray diffraction in applications

Course Goal:
The emphasis of this course will be on techniques utilizing X-ray, electron and ion probes.

Relationship to program Objectives:
(a) An ability to apply knowledge of mathematics, science, and engineering.
(e) An ability to identify, formulate, and solve engineering problems.
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Prepared by: El Bouanani Date: August 25, 2020

COVID-19: UNT

Face Coverings:

Face coverings are required in all UNT facilities. Students are expected to wear face coverings during this class. If you are unable to wear a face covering due to a disability, please contact the Office of Disability Access to request an accommodation. UNT face covering requirements are subject to change due to community health guidelines. Any changes will be communicated via the instructor.

Attendance Policy: Attendance is mandatory.

While attendance is expected as outlined above, it is important for all of us to be mindful of the health and safety of everyone in our community, especially given concerns about COVID-19. Please contact me if you are unable to attend class because you are ill, or unable to attend class due to COVID-19 including symptoms, potential exposure, pending or positive test results, or if you have been given specific instructions to isolate or quarantine from a health care provider or a local authority. It is important that you communicate with me prior to being absent so I may make a decision about accommodating your request to be excused from class.

If you are experiencing any symptoms of COVID-19 please seek medical attention from the Student Health and Wellness Center (940-565-2333 or askSHWC@unt.edu) or your health care provider PRIOR to coming to campus. UNT also requires you to contact the UNT COVID Hotline at 844-366-5892 or COVID@unt.edu for guidance on actions to take due to symptoms, pending or positive test results, or potential exposure. While attendance is an important part of succeeding in this class, your own health, and those of others in the community, is more important.

The UNT fall schedule requires this course to have fully remote instruction beginning November 28th. Additional remote instruction may be necessary if community health conditions change or you need to self-isolate or quarantine due to COVID-19. Students will need access to a webcam and microphone to participate in fully remote portions of the class.

Synchronous (live) sessions in this course will be recorded for students enrolled in this class section to refer to throughout the semester. Class recordings are the intellectual property of the university or instructor and are reserved for use only by students in this class and only for educational purposes. Students may not post or otherwise share the recordings outside the class, or outside the Canvas Learning Management System, in any form. Failing to follow this restriction is a violation of the UNT Code of Student Conduct and could lead to disciplinary action.
