

**Department of Materials Science and Engineering  
University of Maryland, College Park, Maryland**

1. **ENMA 475 – Fundamentals of Diffraction Techniques in Materials Science**
2. **Credits and contact hours – 3 credits.** The University of Maryland follows the Maryland Higher Education Commission's policies on "contact hours;" specifically, one semester hour of credit will be awarded for a minimum of 15 hours, of 50 minutes each of actual class time, exclusive of registration, study days, and holidays.  
  
**Schedule:** meets two 75 minutes periods per week
3. **Instructor's or course coordinator's name: Prof. Luz Martinez-Miranda**
4. **Text book, title, author and year:** Elements of Modern X-ray Physics, Jens Als-Nielsen and Des McMorrow, 2nd. Edition, Wiley and Sons, 2011.
  - a. **Other supplemental materials:** X-ray diffraction, B. E. Warren, Dover, republication of the work published by Addison-Wesley, 1969.
5. **Specific course information**
  - a. **Brief description of the content of the course (catalog description):** This course looks at the advanced methods of x-ray scattering/diffraction available thanks to the more powerful sources available to us. The availability of these sources enables us to study liquid crystals, polymers, nanomaterials, quasiorganized materials (including nano) and disordered materials.
  - b. **Pre-requisites or co-requisites:** MATH246, PHYS270, and PHYS271.  
Restriction: Permission of ENGR-Materials Science & Engineering department
  - c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** ENMA 475 is an elective course for Materials Science and Engineering majors.
6. **Specific goals for the course:**
  - a. **Specific outcomes of instruction:** The main objectives of this course:
    1. What are the basic physical principles that govern diffraction and scattering changed in going from a fixed x-ray source to a synchrotron source?
    2. What is the advantage that synchrotron radiation has on the following techniques?
      - a. Reflectivity
      - b. Grazing Incidence Scattering
      - c. Small Angle X-ray Scattering
      - c. Speckle diffraction

d. Absorption: Resonant scattering

3. How does synchrotron radiation help in the study of:
- organics (biomaterials, new mono- and polymeric materials)
  - nanoparticles
  - thin films

**b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed in this course.**

ABET A: Ability to apply mathematics, science and engineering principles to design

ABET K: Ability to use the techniques, skills and modern engineering tools necessary for engineering practice

**7. Brief list of topics to be covered:**

1. Introduction
2. How do X-rays interact with matter?
3. Brilliance, Divergence (resolution)
4. Reflection and Refraction of X-rays
5. Kinematical diffraction
6. X-ray absorption
7. Resonant scattering