

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

1. **ENMA 422 – Radiation Effects of Materials**

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 minute periods per week

3. **Instructor’s or course coordinator’s name:** **Prof. Mohamad Al-Sheikhly**

4. **Text book, title, author and year:** Robert J. Woods and Alexei K. Pikaev, “Applied Radiation chemistry Radiation Processing”, John Wiley and Sons, Inc., 1994 and Frank Herbert Attix, “Introduction to Radiological Physics and Radiation dosimetry”, Willey-VCH
 - a. **Other supplemental materials:** Manual for Radiation Engineering provided on Canvas.

5. **Specific course information**
 - a. **Brief description of the content of the course (catalog description):** Ionizing radiation, radiation dosimetry and sensors, radiation processing, radiation effects on: polymers, metals, semiconductors, liquids, and gases. Radiation in advanced manufacturing, radiation-physical technology.
 - b. **Pre-requisites or co-requisites:** ENMA 300 and permission of the department.
 - c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** ENMA 422 is an elective course for Materials Science and Engineering majors.

6. **Specific goals for the course:**
 - a. **Specific outcomes of instruction:** This course provides an in-depth knowledge on the use of ionizing radiation in advanced manufacturing of polymeric materials and composites, lithography, environmental remediation of toxic materials, sterilization, medicine, and radiation effects on materials and electronics.

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 C: Ability to design a system, component, or process to meet desired needs

ABET E: Ability to identify, formulate and solve engineering problems

ABET H: The broad education necessary to understand the impact of engineering solutions in a global and societal context

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. Interactions of high energy photons and Electrons with matter- Calculation of stopping power and mass stopping power; dose depth plot; absorbed dose at the interfaces
2. High-dose dosimetry-Bragg-cavity theory; calculation of absorbed dose at complicated geometry at the interfaces; neutron dosimetry
3. Bremsstrahlung- Theory and applications
4. Radiation processing – Radiation yields; G-values calculations; radiation sources power and energy; production through-put calculation, processing cost calculation and radiation; processing efficiency
5. Radiation in advanced manufacturing – Radiation-induced polymerization; composite materials and polymer; degradation methods and calculations
6. Chemical dosimetry systems- Fricke dosimeter; dichromate dosimeter system; radiochromic dosimeters; EPR-alanine dosimetry systems
7. Radiation sterilization of medical products- Design of electron beam and gamma radiation processing facilities, and x-rays facilities; types of electron beam machines and sources
8. Environmental applications of ionizing radiation in the remediation of toxic materials; radiation processing of flue glasses: Radiolysis of gases, purification of flue gasses, containing SO₂ and NO_x
9. Radiation-physical technology (Part 1): Ion implantation, doping of semiconductors, Radiation- physical technology (Part 2): lithography and polymers in micro-electronic
10. Radiation effect on solid-state devices: Single-event phenomena, transient; photocurrent in p-n junction, degradation
11. Radiation-induced corrosion: Mechanisms of radiation-induced corrosion and prevention.