

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

1. **ENMA 301 – Materials for Emerging Technologies**

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. Oded Rabin/Marina Leite**

4. **Text book, title, author and year:** Callister, William D., Jr., Rethwisch, D.G., Fundamentals of Materials Science and Engineering: An Integrated Approach, 5th Ed., John Wiley and Sons, 2016. ISBN # 9781119325987.
 - a. **Other supplemental materials** – Textbook segments and journal articles assigned at the University of Maryland library.

5. **Specific course information**
 - a. **Brief description of the content of the course (catalog description):** Five topical areas will be presented, each leading up to specific applications that have recently come to market or are currently experiencing heavy research and development. The goal of each module will be to introduce the basic materials science principles necessary to understand these new areas.
 - 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 301 is a required course for Materials Science and Engineering majors.

6. **Specific goals for the course:**
 - a. **Specific outcomes of instruction:** The outcomes for the course are the following:
 1. Identify structure-property relationships in engineering materials and how these apply to materials selection in specific engineering problems.
 2. Understand the challenges associated with the development and application of materials in emerging technologies, including financial and environmental aspects.
 3. Understand the operation principle of devices and their limitations.

4. Understand the basic terminology and engineering principles related to biomaterials

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

ABET F: Understanding of professional and ethical responsibility

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

ABET I: Recognition of the need for and an ability to engage in life-long learning

ABET J: Knowledge of contemporary issues

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. Electrical and Optical Properties--Organic Photovoltaics

Conductivity, energy band structures in solids, electrons and holes in semi-, reflection, electrical properties of semi-conductor devices, transistors, Junctions conductors, electromagnetic radiation, light interaction with solids, absorption, transmission and interfaces, Solar cell characterization; Electrical properties: materials for solar cells; Emerging optical materials

2. Thermal properties: heat capacity, thermal expansion, thermal conductivity; Materials for thermoelectrics;

3. Magnetic properties: magnetic field and magnetic moment Magnetic properties: diamagnetism and paramagnetism; ferromagnetism and antiferromagnetism Applications of magnetic materials; Materials for batteries

4. Composite materials at the macroscale, microscale, and nanoscale Applications in aerospace, construction, sporting equipment

5. Biomaterials