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

1. **ENMA 462 – Smart 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. Manfred Wuttig**

4. **Text book, title, author and year:** Magnetic Materials: Fundamentals and Device Applications by Nicola A. Spaldin (Paperback)
   a. **Other supplemental materials:** Principles and Applications of Ferroelectrics and Related Materials (Oxford Classic Text in the Physical Sciences) by M. E. Lines and A. M. Glass (Paperback), optional. Notes on Shape Memory Alloys.
   Notes on Magnetoelectrics. Shape Memory Materials, K. Otsuka and C.M. Wayman, eds. Cambridge University Press 1998/2002, optional
   Physics of Ferroelectrics, K. Rabe, ed., Springer, 2007, optional

5 .**Specific course information**
   a. **Brief description of the content of the course (catalog description):** A fundamental understanding will be provided as it relates to the following topics: ferroic materials, ferromagnets, ferroelectric materials, shape memory alloys and multiferroic materials that are simultaneously ferromagnetic and ferroelectric. The ferroic properties will be discussed on an atomic, nano- and micro-scales so that actual and potential applications on those scales become clear. Examples of those applications will be presented.
   b. **Pre-requisites or co-requisites:** Permission of the Department.
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** ENMA 462 is an elective course for Materials Science and Engineering majors.

6. **Specific goals for the course:**
   a. **Specific outcomes of instruction**: At the end of this course, the student should be able to:
      1. Understand the common functionality of all "smart" materials
      2. estimate the operating ranges of smart materials

3. estimate the energy transfer in smart materials
4. analyze the interdependence of intrinsic and extrinsic actuation variables

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 B: Ability to design and conduct experiments, analyze and interpret data.
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 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. Ferromagnetism
2. Shape Memory Alloys
3. Ferroelectricity
4. Magnetoelectric Materials