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

1. **ENMA 414 – Introduction to Solid State Ionics**

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. Eric Wachsman**

4. **Text book, title, author and year:** no text book required
   a. **Other supplemental materials:** "The CRC Handbook of Solid State Electrochemistry," Edited by P.J. Gellings and H.J.M. Bouwmeester; "Electrochemistry of Solids," by H. Rickert, Springer - Verlag. This is a classic in this field. However, it is out of print but may be available on amazon.com.

5. **Specific course information**
   a. **Brief description of the content of the course (catalog description):** The objective of the course is to develop a fundamental understanding of defect equilibria and transport in ion conducting solids, with emphasis on crystalline and particularly ceramic materials. Furthermore, to understand how these materials can be applied to energy production (fuel cells) and storage (batteries), chemical conversion (membranes), and pollution control (sensors).

   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 489W is an elective course for Materials Science and Engineering majors.

6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:** The main objective of this course is to:
   1. Students develop fundamental understanding of defect equilibria and transport in ion conducting solids

   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.

7. <u>Brief list of topics to be covered:</u>

1. Introduction
2. Disorder in Solids
3. Thermodynamics of Point Defects
4. Structural Disorder
5. Electron Occupancy
6. Defect Equilibrium Diagrams
7. Role of Point Defects in Physical Properties
8. Electrochemical Principals and Potentials
9. Transport in Solids
10. Solid Electrolytes
11. Electronic and Mixed Conductors
12. Ion Transport Membranes
13. Fuel Cells
14. Batteries
15. Solid State Reactions and Kinetic Investigations
16. Sensors
17. Other Solid-State Electrochemical Cells