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

1. **ENMA 466 – Advanced Materials Fabrication Laboratory**

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: One 90 minute lecture and one three hour lab per week

3. **Instructor's or course coordinator's name: Prof. Gary Rubloff**

4. **Text book, title, author and year:** None required.
   - **a.** Other supplemental materials: provided by faculty

5. **Specific course information**
   - **a. Brief description of the content of the course (catalog description):** This course allows students an opportunity to study advanced materials systems in depth through a combination of lectures and hands-on laboratory experiments. Students will be trained in materials processing and characterization techniques. Each student will fabricate materials and devices in our state-of-the-art nanofabrication clean room facility (Fablab), as well as evaluate them using a variety of characterization techniques.
   - **b. Pre-requisites or co-requisites:** ENMA465 and 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 466 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. Provide a meaningful experience in thin film micro/nano processing through hands-on experimental and design projects centered on process combinations and sequences, mask/layout design for lithographic creation of desired structures, and design for functionality of the structures.

   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 F: Understanding of professional and ethical responsibility
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. Course introduction; an overview of informed designed electrode materials for battery studies. Applied and fundamental studies
2. FabLab orientation & safety; intro to photolithography tools.
3. Discuss electrochemical measurements; describe electrode response electrochemically and physically
4. Sputter Si for electrochemical characterization; samples prep for Raman and XPS
5. Anneal Sputtered Si, measure Raman XPS and XRD
6. Continue/finish Raman/XRD. Electrochemical tesing of the Sputtered Si and ALD V2O5 in coin-cells
7. SEM, XPS Raman- Postmortem analysis of the Si and V2O5
8. Discuss/reconcile electrochemical measurements of the Si, and discussion on design projects