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

1. **ENMA 443 – Photonic Materials, Devices and Reliability**

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. Aris Christou**

4. **Text book, title, author and year:** Franz Kaertner, "Fundamentals of Photonics", (pdf)
   Aris Christou, "Photonic Materials, Devices and Reliability," (pdf)

5 .Specific course information

   a. **Brief description of the content of the course (catalog description):** The course focuses on the understanding of the basic optical processes in semiconductors, dielectrics and organic materials. The application of such materials in systems composed of waveguides, light emitting diodes and lasers, as well as modulators is developed.
   b. **Pre-requisites or co-requisites:** Permission of the department and junior standing or higher
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** ENMA 443 is an elective course for Materials Science and Engineering majors.

6. Specific goals for the course:

   a. **Specific outcomes of instruction**: Students understand propagation of waves through lenses and materials and how this can be used to develop devices

   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 E: Ability to identify, formulate and solve engineering problems

7. Brief list of topics to be covered:

1. Introduction to Photonics

2. Energy in a Magnetic Field: Gauge Transformation, Poynting's Theorem, Conservation of Energy, Electromagnetic Waves, Linear and Circular Polarization
3. Electromagnetic
4. Mirrors, Interferometers and Thin-Film Structures
5. Gaussian Beams and the Wave Equation Waves and Interfaces
6. Ray Optics and Optical Systems
7. Optical Fibers and Resonators
8. Integrated Optics: Optical Fibers
9. Integrated Optics: Coupled Mode Theory
10. Optical Resonators
11. Anisotropic Media: Crystal Optics and Polarization
12. Quantum Nature of Light and Matter
13. Schrödinger Equation and Stationary States
14, Lasers
15. Non-Linear Optics and Non-Linear Optics Materials
16. Physical Processes for Optical Detection
17. Characteristics of Photodetectors
18. Modulation of Laser Beams
19. Semiconductor Lasers and Light Emitting Diodes
20. Optical Amplifiers and Lasers
21. Double Heterojunction and Vertical Channel Surface Laser
22. Vertical Channel Emitting Laser
23. Failure Mechanisms of Optoelectronic Devices and Components