

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

**1. ENMA 426 – Reliability of 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. Aris Christou**

- 4. Text book, title, author and year:** "Reliability Physics and Engineering" by J.W. McPherson, Published by Springer. ISBN 978-1-4419-6347 (2010). Edition 1 or 2
- a. Other supplemental materials:** "Reliability and Quality in Microelectronic Die Manufacturing" by Aris Christou and Willie M. Webb, Published by Reliability Information Analysis Center, 2006. ISBN-10 1-933904-15-1 (reference). Failure Mechanisms in Semiconductor Devices", Second Edition by A. A. Amerasekera and F. N. Najm, published by Wiley. Failure of Materials in Mechanical Design" Jack A. Collins, second edition, 1993, published by Wiley. Course Notes in Failure mechanisms are provided by the instructor to supplement the required text books.

**5. Specific course information**

- a. Brief description of the content of the course (catalog description):** Students are taught the basic degradation mechanisms of materials, through the understanding of the physics, chemistry, mechanics of such mechanisms. Mechanical failure mechanisms concentrate on fatigue, and creep. Chemical failure mechanisms emphasize corrosion and oxidation. Physical mechanisms such as diffusion, electromigration, defects and defect migration, surface trapping mechanisms, charge creation and migration are also included.
- 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 426 is an elective course for Materials Science and Engineering majors.

**6. Specific goals for the course:**

**a. Specific outcomes of instruction:** This course provides knowledge in the following areas: 1. Students learn about probability density functions in order to calculate mean time to failure: 2. Students learn how to assess fatigue and creep failures: 3. Students learn about the ethical issues of reliability and failure of equipment in critical applications.; 4. Students learn about the critical reliability problems of microelectronics.: and 5.Students learn how to research reliability problems in a team environment and to write reliability reports and give reliability presentations.

**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 D: Ability to function on multidisciplinary teams.

ABET E: Ability to identify, formulate and solve engineering problems

ABET F: Understanding of professional and ethical responsibility

ABET G: Ability to communicate effectively

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. Engineering Approach to Reliability vs. Statistical Approach to Reliability
2. Quality and Reliability, Design of Experiments
3. Theories and Models of Basic Materials Failure
4. Time to Failure Models, Failure Rate Models
5. Mechanical Failure Mechanisms
6. Environmental and Chemical Failure Mechanisms
7. Electrical Failure Mechanisms
8. Mechanisms of Failure in Systems
9. Engineering-Based Reliability Modeling and Testing