# ENME 476
# BIOMATERIALS
# Fall 2016

Instructor: L.D.T. (Dr. T) Topoleski, ECS 225K, x5/3302, topoleski@umbc.edu

Class Meeting Times: Monday/Wednesday 4:00PM – 5:15PM, ITE 238

Office Hours: Monday after class (5:15-6PM), Thursday 11AM-12PM

Teaching Assistant: "Blackboard"

Text: none required; suggested reading

1) JC Anderson, KD Leaver, RD Rawlings & JM Alexander, *Materials Science* (4th ed), Chapman and Hall
2) RE Reed-Hill, R Ababschian, *Physical Metallurgy Principals* (3rd ed), PWS-Kent
3) PW Atkins, *Physical Chemistry* (4th ed), Freeman
4) JB Park and RS Lakes, *Biomaterials, An Introduction*, 2nd ed., Plenum
4) Previous text(s) in Materials Science, e.g. Askeland.

***COURSE OBJECTIVES:*** The structure and components (atoms) determine a material's properties. In this course, we will study how the structure/composition of a material influences a material's properties, and how the structure/composition of a material can be changed to engineer or design a material's properties. The course will focus on building upon the materials science concepts first introduced in ENME 301, and applying those principals to engineering biomaterials - materials used to augment, enhance, or replace natural human biological functions. We will consider what we would like materials to accomplish in the human body, and examine how the structure/property relationships can be designed or exploited for the benefit of people. Although the examples we discuss in class will be focussed on biological or medical applications of materials, the materials science fundamentals are equally applicable to any engineering discipline (for example, manufacturing, electronics, solid mechanics, etc.). In addition, because the field of biomaterials is intimately connected to creating devices and treatments for medical conditions, product development is an integral part of the field of biomaterials. Bringing a useful medical product to market often requires entrepreneurial process. In this class, we will also study the aspects of entrepreneurship relevant to biomaterial products.

***COURSE STRUCTURE:*** There are two lecture periods each week (Monday/Wednesday 4:00PM – 5:15PM). The lecture periods will be a combination of instructor's lectures and class discussion. Homework will be assigned in the form of reading material, written reviews, and problem solving. Undergraduates will perform a semester design project, designing an implantable device using the materials principals learned in class and through outside reading, and graduate students will write a term research paper. Those students taking the course for graduate level credit will earn their graduate experience from additions/amendments to the assignments, different assignments, different readings, and different expectations in their assigned work, and a separate discussion section.

***COURSE SUBJECTS:*** The Course will cover several topics of importance in biomaterials. Those topics may include: Introduction: what is a biomaterial, and where are they used?, Tissue Engineering, Orthopaedic Biomaterials, Surfaces, including methods of analysis (e.g., Auger electron spectroscopy, Scanning electron microscopy), Mechanical behavior, i.e. failure, of biomaterials, Biocompatibility, and Mechanics of Materials in Biological tissue. We may change these topics as time and/or student interests indicate. Advanced topics in materials science will be introduced on an "as needed" or "just in time" basis. Examples include: Phase thermodynamics and equilibrium, Fracture Mechanics, Surface Physics and Chemistry, Advanced Mechanics of Materials. In addition, we will explore the entrepreneurial side of biomaterials, and we will invite guest lecturers with entrepreneurial experience.

Grading:

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| Homework | 20% |
| Project | 30% |
| Oral Presentation | 10% |
| Midterm | 20% |
| Final | 20% |
| Total | 100% |

A Note of Caution on Written Reports: I expect all Written Reports (including Homework) to be submitted professionally and written in clear concise English. My experience indicates that this will require working on a report in considerable advance of the due date. If I deem any paper or project report unreadable or unacceptable from a writing stand point, I will return such project without grade. Students will then have an opportunity to rewrite the paper, and if it then becomes acceptable, it will be graded (less a late penalty).

NOTE on ACADEMIC INTEGRITY: By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community, in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty and they are wrong. Academic misconduct could result in disciplinary action that may include suspension or dismissal. To read the full policy on academic integrity, consult the UMBC Student Handbook.