

## MSE 474 Biomaterials

### Learning Objectives:

This course develops the understanding of the interaction between materials and human biological environment. The course introduces students to the principles of materials science and engineering involved in the selection, design, and assurance of long and short-term function of materials for medical applications. The students will learn the fundamental principles involved in the interaction of biomedical materials (metals, polymers and ceramics) with cells, tissue and blood. Students will be introduced to the requirements for implantable materials. A discussion on soft tissue (cardiovascular, ophthalmic, and wound closure) and hard tissue (orthopedic and dental) medical implant devices will be presented. Students will conduct a meaningful design project utilizing the acquired knowledge. This course directly supports overall MSE program educational outcomes 1, 2, 3, 4, 5, 8, 9, and 10.

### Catalog Description:

**474 Biomaterials (3)** Metals, polymers and ceramics utilized in orthopaedic, cardiovascular, and dental surgical implant devices; corrosion and degradation problems; materials properties of primary importance; tissue response to synthetic materials. Prereq: 201. Recommended for engineering science and mechanics majors.

**Textbook:** Biomaterials Science: An Introduction to Materials in Medicine, B. D. Ratner, A. S. Hoffman, F. J. Schoen and J. E. Lemons (eds.), Academic Press, 1996.

**Reference:** J. Black, Biological Performance of Materials: Fundamentals of Biocompatibility, 2nd ed. Marcel Dekker, Inc. New York 1992  
Polymers: Biomaterials and Medical Applications, J. I. Kroschwitz (ed.), John Wiley & Sons, New York 1989  
Extensive references in the biomaterials literature.

**Coordinator:** R. S. Benson, Professor  
R. A. Buchanan, Professor

### Topics:

1. Tissue response to implants: wound-healing process, complement activation, cellular response to implants, systemic effects of implants. (4 classes)
2. Blood compatibility. (2 classes)
3. Metallic implant materials: stainless steels, Co-base alloys, Ti and Ti-base alloys, other metals, mechanical properties, microstructures, corrosion fundamentals, corrosion of metallic implant materials. (8 classes)
4. Ceramic implants. (2 classes)
5. Hard tissue replacement implants: fracture fixation devices, joint replacements, dental implants, design and function. (5 classes)
6. Polymeric implant materials: Polymerization, structure and properties, biodegradation of polymers. (7 classes)
7. Wound closure: Sutures and adhesives. (2 classes)
8. Soft tissue replacement implants: synthetic skin; maxillofacial, ear and eye implants. (3 classes)
9. Vascular and heart implants. (3 classes)
10. Artificial Kidney. (2 classes)
11. Blood Oxygenators (2 classes)

**Estimated Content:** 3 Credits Engineering Topics

**Prepared by R. S. Benson Date: January 2005**