University of Central Florida

Mechanical, Materials & Aerospace Engineering Department

EMA 5937 (Special topic)
Biocompatibility of Materials
Spring Semester 2005

INSTRUCTOR:

Dr. Samar Jyoti Kalita ("Dr. Samar")
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Office Hours: Tuesday, Wednesday; 11:00-11:50 A.M.
Other times by appointment

COURSE WEBSITE:

http://webct.ucf.edu/webct/public/home.pl

COURSE CREDIT AND ORGANIZATION:

3 credit hours. The class meets twice a week for 1 hr 15 min each on Tuesday and Thursday; 6:30 – 7:45 P.M. in ENG I, Room 388.

PREREQUISITES:

EGN 3365 Structure and Properties of Materials or equivalent

TEXTBOOK AND REFERENCES:

Currently, there is no textbook available with any publisher that covers all sections of this course. However, the following handbook will be extensively used to teach most parts of this interdisciplinary course. Students interested in pursuing a career related to Biomaterials/ Biomedical Engineering are encouraged to acquire a copy of this handbook.

- The Biomedical Engineering Handbook, Second Edition, Volume I, edited by by Joseph D. Bronzino. Publisher: CRC Press; 2nd edition (December 28, 1999) ISBN: 0849385946.

Other useful references:

- Introduction to Biomedical Engineering (Academic Press Series in Biomedical Engineering) by John D. Enderle, Susan M. Blanchard, Joseph D. Bronzino. (September 17, 1999) ISBN: 0122386604
- Biomaterials Science: An introduction to Materials in Medicine, edited by B.D. Rutner, A.S. Hoffman, F. J. Schoen and J.E. Lemenons, Academic Press 2nd edition (July 29, 2004) ISBN: 0-12-582460-2.

COURSE OBJECTIVES:

1. To realize the importance of biomedical materials and devices used in treating various diseased and/ damaged tissue in the biomedical industry.
2. To learn, appreciate and understand the importance of engineering in broad and materials science in specific in tissue engineering.
3. To gain interdisciplinary knowledge on cell-biomaterials interaction, issues related to biocompatibility and bioactivity of materials, and to use these understanding to correlate materials property (composition, structure, anisotropy) with biological properties.
4. To learn about the recent trend and development in prostheses design, biomedical imaging and nanotechnology (materials aspects).
5. To be able to use the knowledge gained for materials design and selection in biomedical engineering.

COURSE DESCRIPTION:

This course will provide in-depth understanding on issues related to biocompatibility of materials and prostheses used in the biomedical industry. The course will discuss the design and selection of biomaterials for various clinical usages such as total hip replacements (THR), artificial heart valve, knee prostheses and components used in spinal fusion and correlate the properties of materials with the biological properties. Engineering students trained in these interdisciplinary concepts will be able to appreciate biology and gain interest in biomedical materials research while learning fundamental materials issues related to processing and characterization of biomaterials. The class will meet twice a week for 1hr and 15 min each. The lectures will cover topics including historical development of prostheses and artificial organs, introduction to cell-biomaterials interactions, basics of tissue engineering, issues related to biocompatibility and bioactivity of materials, soft tissue replacements, hard tissue replacements, Total Hip Replacement (THR), biomedical imaging techniques and preservation techniques for biomaterials.

At the completion of the course, the students are expected to be familiar with broad spectrum of issues related to biocompatibility of materials used in clinics. Students will also learn about the emerging materials and recent developments in biomedical materials engineering. The students with this broad based interdisciplinary knowledge will be able to design and select biomaterials and characterization techniques for a given specific application.

GRADUATE CATALOG DESCRIPTION:

3(3,0). PR: EGN 3365. Fundamentals of cell-biomaterials interactions, biocompatibility and bioactivity. Materials selection for soft and hard tissue replacements. Preservation techniques. Introduction to prosthetic devices and biomedical imaging materials.
ECS-Mechanical/Matrls/Aerosp

GRADING:

Homework	20%
Special Report/ Project	10%
Midterm Exam I	20%
Midterm Exam II	20%
Final Exam	30% (**Comprehensive**)

The final grade assigned will include +/- modifiers.

ASSIGNMENTS:

***Reading*:** Students are advised to read the assigned topics before the class in which they will be discussed. This will make the lecture more understandable and will enable them to be prepared to ask questions.

***Written*:** Homework problems will be assigned and collected on weekly basis.

GENERAL POLICIES:

1. There will be no make-up exam given. In case of emergency/ illness, special arrangement will be made on one-to-one basis.
2. Homework problems will be posted the web http://webct.ucf.edu. Solutions will be discussed in class on the day of submission. No homework will be accepted after the solutions are posted.
3. Feedback and suggestions are always welcome.
4. Class participation is strongly encouraged and attendance is important.
5. To enhance learning and for your convenience, some class notes will be made available to you through http://webct.ucf.edu/. To access the class web page, students are required to log on to the website using personal PID and password. For web support and help, students are advised to contact WebCT Specialist Ms. Kim Okamato in Room 289 ENG I; Telephone: 407-823-5248.

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EMA 5937 ST: Biocompatibility of Materials

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Course Contents

Section A

1. Historical Development of Prostheses and Artificial Organs
2. Introduction to Tissue Engineering
3. Basics of Biomaterials Science, Cell Biology & Biocompatibility Testing

Section B

4. Protein-surface interactions on Biomaterials
5. Tissue engineering of Bone and Skeletal Muscle
6. Biomaterials and Device Design Criteria

Section C

7. Artificial Heart Valves Circulatory Assist Devices
8. Artificial Kidney
9. Artificial Skin and Dermal Equivalents
10. Emerging Materials in Soft Tissue Replacements

Section D

11. Total Hip Replacements (THR): current challenges
12. Knee and Ankle joint prostheses
13. Preservation Techniques for prostheses and artificial organs
14. Biomedical Imaging Techniques