EMAT 575
BIOMATERIALS

Instructor: **Sudhakar Vadiraja, Ph.D., P.E.**
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Catalogue Description:
Various classes of biomaterials are introduced and their processing, characteristics and properties are discussed to evaluate their similarities and differences. Surface modification and processing of nano-biomaterials are also explored. The basic principles of tissue engineering are discussed and their influence on the degradation/corrosion, wear and failure of synthetic implants are discussed.

Credits: 3.0 Credit Hours (Lectures)

Designation: Elective

Prerequisites: EMAT 251 *or* EGEN 213 *or* consent of the instructor.

Lab: There is no lab allotted to this course.

Textbook: Qizhi Chen, George Thouas, ***Biomaterials-A basic introduction***, December 2014, CRC Press, ISBN: 9781482227697 - CAT# K22550

Additional References:

- Seeram Ramakrishna, Murugan Ramalingam, T .S. Sampath Kumar, Winston O. Soboyejo, *Biomaterials-A nano approach*, June 2010, CRC Press, ISBN-13: 9781420047813.
- C. M. Agrawal, J. L. Ong, Mark R. Appleford, Gopinath Mani, Introduction to Biomaterials-Basic Theory with Engineering Applications, Dec 2013, Cambridge University Press, ISBN: 9780521116909
- J.S. Tremenoff, A.G. Mikos, Biomaterials: The Intersection of Biology and Materials Science, Prentice Hall, 2008, ISBN-10: 0130097101
- J. Park**,** R. S. Lakes, Biomaterials- An Introduction, 3rd ed., 2007, Springer, ISBN: 9780387378794

Relationship of Course to Metallurgical and Materials Engineering Program Outcomes:
This course introduces various advanced materials in biomedical applications/engineering and addresses various processing and testing methods, structure and property relationship in them.

Objectives: The objective of this course is to provide the student with:
- Classification of biomaterials and their varieties of applications inside human body
- Properties/characteristics of each type of biomaterial and methods of evaluating them
- Basic principles of tissue engineering and applications of nano-biomaterials
- Interactions between synthetic implants and biological environments

Learning Outcomes: Undergraduates/Graduates of the course will be able to
- Identify the similarities and differences between various classes of biomaterials in their biomedical device applications
- Select an appropriate biomaterial for a given biomedical application.
- Describe the surface modification, processing of Bio/Nano-biomaterials
- Evaluate processing methods and structure-property correlations in biomaterials
- Recognize the basics of tissue engineering and their influence on corrosion, wear and failures of biomaterials
- Recognize various fracture modes/micro-mechanisms of fracture in biomaterials
- Recognize various corrosion and wear mechanisms including failure analysis procedures for biomaterials
- Identify areas of biomaterials research opportunities based on review papers from journals
- Demonstrate higher level of oral and written communications
- Identify new methods/techniques used to improve synthetic biomaterials' performance
- Fulfill **ABET outcomes 1 & 9** (*please see below for descriptions*)

	Tentative course plan	Forecast lectures
1	Introduction to biomaterials & Basics of human biology	2
2	Toxicity and corrosion tendency of biomaterials	2
3	Natural materials for biomedical applications	1
4	Metallic biomaterials	2
5	Ceramic biomaterials	2
6	Polymeric biomaterials	2
7	Composite biomaterials	2
8	Surface modification of biomaterials	2
9	Nano-biomaterials for tissue engineering & their processing	1
10	Characterization of biomaterials	2
11	Specific corrosion types and wear of biomaterials	2
12	Failure of biomaterials	2
	Term Paper Presentations	4
	Tests & Review	4
	Total	**30**

Assessment:

Test (2) -*25 pts. each*	50%
Term Paper -*(Oral presentation-10 pts.+ written report 10 pts.)*	20%
Finals	30%
Total	100 %

Grading:

A = (92-100), A− = (90-91.9), B+ = (88-89.9), B = (82-87.9), B− = (80-81.9), C+ = (78-79.9), C = (72-77.9), C− = (70-71.9), D+ = (68-69.9), D = (62-67.9), D− = (60-61.9), F = (0-59.9)

Academic Integrity:

Academic dishonesty or cheating will not be tolerated. Acts of academic dishonesty include (but are not limited to):

- Plagiarism
- Copying from another student's paper while taking a quiz or examination
- Using unlawful aids (books, notes, cell phones or other electronic devices, etc.) to pass an examination (*unless the instructor has clearly stated that it is an open notes or open book exam*)
- Assisting another student in an act of academic dishonesty

If it is determined that a student has deliberately cheated on a quiz, examination, or assignment, he or she will be dropped from the course with an "F" grade. In compliance with Montana Tech policy, cases of academic dishonesty will be reported to the Office of the Vice Chancellor for Academic Affairs.

Contribution to Professional Component:

Engineering Topics - Yes
Engineering Design - Yes (Introductory)
Computer Usage - Yes (limited use)
Ethics - No
Statistics - No
Safety - No

ABET outcomes covered: 1 & 9

1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
9. Integrate the understanding of the scientific and engineering principles underlying the four major elements of the field: structure, properties, processing and performance related to metallurgical and materials systems appropriate to the field

Prepared by**: Sudhakar Vadiraja, Ph.D., P.E.**