1. General Information

1a. Submitted by the College of: ENGINEERING

Date Submitted: 5/3/2013

1b. Department/Division: Ctr For Biomedical Engineering

1c. Contact Person

Name: David Puleo

Email: puleo@uky.edu

Phone: 859-257-2405

Responsible Faculty ID (if different from Contact)

Name:

Email:

Phone:

1d. Requested Effective Date: Semester following approval

1e. Should this course be a UK Core Course? No

2. Designation and Description of Proposed Course

2a. Will this course also be offered through Distance Learning?: No

2b. Prefix and Number: BME 488G

2c. Full Title: Introduction to Biomaterials

2d. Transcript Title:

2e. Cross-listing:

2f. Meeting Patterns

LECTURE: 3/wk

2g. Grading System: Letter (A, B, C, etc.)

2h. Number of credit hours: 3

2i. Is this course repeatable for additional credit? No

If Yes: Maximum number of credit hours:

If Yes: Will this course allow multiple registrations during the same semester?

2j. Course Description for Bulletin: Study of biological and man-made materials that perform, improve, or restore natural functions. Structure and properties of connective tissue and commonly implanted metals, ceramics, and polymers; biocompatibility of materials used in orthopedic, soft tissue, and cardiovascular applications.

2k. Prerequisites, if any: Engineering standing, MSE 201, and MSE 301; or consent of instructor.

2l. Supplementary Teaching Component:

3. Will this course taught off campus? No

If YES, enter the off campus address:

4. Frequency of Course Offering: Fall,

Will the course be offered every year?: Yes

If No, explain:

5. Are facilities and personnel necessary for the proposed new course available?: Yes

If No, explain:

6. What enrollment (per section per semester) may reasonably be expected?: 10

7. Anticipated Student Demand

Will this course serve students primarily within the degree program?: Yes

Will it be of interest to a significant number of students outside the degree pgm?: Yes

If Yes, explain: [var7InterestExplain]

8. Check the category most applicable to this course: Traditional – Offered in Corresponding Departments at Universities Elsewhere,

If No, explain:

9. Course Relationship to Program(s).

a. Is this course part of a proposed new program?: Yes

If YES, name the proposed new program: Biomaterials certificate in MSE

b. Will this course be a new requirement for ANY program?: Yes

If YES, list affected programs: Biomaterials certificate in MSE

10. Information to be Placed on Syllabus.

a. Is the course 400G or 500?: Yes

b. The syllabus, including course description, student learning outcomes, and grading policies (and 400G-/500-level grading differentiation if applicable, from **10.a** above) are attached: Yes

Distance Learning Form

Instructor Name:

Instructor Email:

Internet/Web-based: No

Interactive Video: No

Hybrid: No

1.How does this course provide for timely and appropriate interaction between students and faculty and among students? Does the course syllabus conform to University Senate Syllabus Guidelines, specifically the Distance Learning Considerations?

2.How do you ensure that the experience for a DL student is comparable to that of a classroom-based student's experience? Aspects to explore: textbooks, course goals, assessment of student learning outcomes, etc.

3.How is the integrity of student work ensured? Please speak to aspects such as password-protected course portals, proctors for exams at interactive video sites; academic offense policy; etc.

4.Will offering this course via DL result in at least 25% or at least 50% (based on total credit hours required for completion) of a degree program being offered via any form of DL, as defined above?

If yes, which percentage, and which program(s)?

5.How are students taking the course via DL assured of equivalent access to student services, similar to that of a student taking the class in a traditional classroom setting?

6.How do course requirements ensure that students make appropriate use of learning resources?

7.Please explain specifically how access is provided to laboratories, facilities, and equipment appropriate to the course or program.

8.How are students informed of procedures for resolving technical complaints? Does the syllabus list the entities available to offer technical help with the delivery and/or receipt of the course, such as the Information Technology Customer Service Center (http://www.uky.edu/UKIT/)?

9.Will the course be delivered via services available through the Distance Learning Program (DLP) and the Academic Technology Group (ATL)? NO

If no, explain how student enrolled in DL courses are able to use the technology employed, as well as how students will be provided with assistance in using said technology.

10.Does the syllabus contain all the required components? NO

11.I, the instructor of record, have read and understood all of the university-level statements regarding DL.

Instructor Name:

SIGNATURE|BJSTOK0|Barbara J Brandenburg|College approval for ZCOURSE_NEW BME 488G|20121017

SIGNATURE|ZNNIKO0|Roshan N Nikou|Graduate Council approval for ZCOURSE_NEW BME 488G|20121126

SIGNATURE|BJSTOK0|Barbara J Brandenburg|Approval resent to college for ZCOURSE_NEW BME 488G|20130109

SIGNATURE|ZNNIKO0|Roshan N Nikou|Graduate Council approval for ZCOURSE_NEW BME 488G|20130131

SIGNATURE|JMETT2|Joanie Ett-Mims|Undergrad Council approval for ZCOURSE_NEW BME 488G|20130305

SIGNATURE|WF-BATCH|Batch User|Reminder for minor course work item|20130425

BME 488G

Introduction to Biomaterials

Fall 2012

Class Meetings:	Tuesdays and Thursdays, 9:30 - 10:45 a.m. 19 Wenner-Gren Laboratory
Instructor:	David Puleo, Ph.D.
Office:	209 Wenner-Gren Lab
Telephone:	257-2405
E-mail:	puleo@uky.edu
Office Hours:	Tuesdays from 11:05 a.m. - 12:30 p.m. or by appointment

---

Course Description

Study of biological and man-made materials that perform, improve, or restore natural functions. Structure and properties of connective tissues and commonly implanted metals, ceramics, and polymers; biocompatibility of materials used in orthopedic, soft tissue, and cardiovascular applications.

Prerequisites

Engineering standing, MSE 201, and MSE 301; or consent of instructor.

Learning Outcomes

After completing this course successfully, a student should be able to:

1) Describe and explain the structure, properties, and function of important hard and soft connective tissues, including bone, tendons, ligaments, and cartilage.
2) Apply engineering modeling and analysis to relate structure and properties of natural and synthetic biomaterials.
3) Describe and explain the structure, properties, and function of important metallic, ceramic, and polymeric biomaterials.
4) Describe and explain cellular responses involved in hemostasis, wound healing, and inflammation in relation to biological performance of implanted materials ("biocompatibility").
5) Apply all of the items above in engineering design of orthopedic, soft tissue, and cardiovascular implants.
6) Critically review biomaterials research studies and new technology.

Course Grade

Undergraduate students		Graduate students	
exams (3)	20% each	exams (3)	20% each
device analysis		design project	
final report	10%	final report	10%
oral presentation	5%	oral presentation	5%
assignments	10%	assignments	10%
quizzes	10%	quizzes	10%
class participation	5%	class participation	5%

Points in each category will be totaled and weighted as described above to arrive at a final grade using the following grading scales:

Undergraduate – A = 90-100%; B = 80-89%; C = 70-79%; D = 60-69%; E = 50-59%
Graduate – A = 92-100%; B = 84-91%; C = 77-83%; E = 70-76%

If warranted, a curve based on the distribution of final scores may be applied to adjust final grades. If used, the curve will make only small adjustments based on the statistical distribution of overall scores. Scores grouped near the top will get As, the next major grouping gets Bs, etc.

Examinations

Exams are tentatively scheduled for September 29, November 1, and December 1. There will not be a final examination. The exams will be closed book, and no crib sheets will be allowed.

Device Analysis/Design Project

Undergraduate students. Individual students will select a topic from the attached list for a Medical Device Analysis. Each topic may be assigned to only one student, and selections are available first come, first served. Sections to be included are: (a) A Common Use, (b) History, (c) Materials Used, (d) FDA Classification, (e) Current Problems, (f) Speculation on Future Use, (g) Current Experimental Studies, and (h) References. The final report will consist of no more than a single page of 12 pt. text with 1.5 line spacing and 1" margins. Papers are due by 8:00 a.m. on December 5; both electronic and paper submissions are needed. Late papers will be penalized 10% per day.

Graduate students. Individual students will select a currently used biomedical device from the attached list. Each topic may be assigned to only one student, and selections are available first come, first served. A proposal of research aimed at improving performance of the selected device will be developed. More specifically, the document will describe a strategy for improving performance of the device along with an experimental program determining whether it overcomes current deficiencies. The proposal must include: (a) Abstract and Specific Aims (1 page); (b) Background (2-3 pages), including an economic assessment and discussion of societal impact of the proposed system; (c) Design and Methods (2-5 Pages); and (d) Literature citations (no limit). Proposals are due by 8:00 a.m.

on December 5; both electronic and paper submissions are needed. Late papers will be penalized 10% per day.

At the end of the semester, each undergraduate and graduate student will orally present his/her analysis to the class. Presentations should be approximately 5 minutes, followed by 2 minutes for questions. They will take place on December 6 and 8, and if needed, the final exam time (Monday, Dec. 12, at 10:30 a.m.) will be used to finish the presentations.

Quizzes

Short "pop" quizzes will be given every one to two weeks during the semester.

Homework Assignments

A limited number of homework assignments will be used to supplement content covered during our meetings. They are an opportunity for students to assess their understanding of basic concepts at relatively little risk to their final grade. Although discussion of homework questions is permissible, students are required to independently write their solutions. Assignments are due at the beginning of class. Late assignments will be penalized 10% per day.

Textbook

Biomaterials Science: An Introduction to Materials in Medicine, Ratner, B.D., Hoffman, A.S., Schoen, F.J., and Lemons, J.E. (eds.), 2nd Ed., Academic Press, San Diego, 2003.

Selected sections from books and journals will be made available as needed.

Mid-term Grade

Mid-term grades will be posted in myUK by the deadline established in the Academic Calendar (http://www.uky.edu/Registrar/AcademicCalendar.htm).

Attendance Policy

Attendance is recommended and will be considered when deciding borderline final grades.

Make-up Policy

If needed, one comprehensive make-up exam will be given to students with excused absences. The instructor must be notified of anticipated absences in advance. The make-up exam time will be scheduled as needed. Missed quizzes and other assignments will also be accepted with an excused absence.

Excused Absences

Students need to notify the professor of absences prior to class when possible. S.R. 5.2.4.2 defines the following as acceptable reasons for excused absences: (a) serious illness, (b) illness or death of family member, (c) University-related trips, (d) major religious holidays, and (e) other circumstances found to fit "reasonable cause for nonattendance" by the professor.

Students anticipating an absence for a major religious holiday are responsible for notifying the instructor in writing of anticipated absences due to their observance of such holidays no later than the last day in the semester to add a class.

Students are expected to withdraw from the class if more than 20% of the classes scheduled for the semester are missed (excused or unexcused) per university policy.

Verification of Absences

Students may be asked to verify their absences in order for them to be considered excused. Senate Rule 5.2.4.2 states that faculty have the right to request "appropriate verification" when students claim an excused absence because of illness or death in the family. Appropriate notification of absences due to university-related trips is required prior to the absence.

Academic Integrity

Per university policy, students shall not plagiarize, cheat, or falsify or misuse academic records. Students are expected to adhere to University policy on cheating and plagiarism in all courses. The minimum penalty for a first offense is a zero on the assignment on which the offense occurred. If the offense is considered severe or the student has other academic offenses on their record, more serious penalties, up to suspension from the university may be imposed.

Plagiarism and cheating are serious breaches of academic conduct. Each student is advised to become familiar with the various forms of academic dishonesty as explained in the Code of Student Rights and Responsibilities. Complete information can be found at the following website: http://www.uky.edu/Ombud. A plea of ignorance is not acceptable as a defense against the charge of academic dishonesty. It is important that you review this information as all ideas borrowed from others need to be properly credited.

Part II of Student Rights and Responsibilities (http://www.uky.edu/StudentAffairs/Code/part2.html) states that all academic work, written or otherwise, submitted by students to their instructors or other academic supervisors, is expected to be the result of their own thought, research, or self-expression. In cases where students feel unsure about the question of plagiarism involving their own work, they are obliged to consult their instructors on the matter before submission.

When students submit work purporting to be their own, but which in any way borrows ideas, organization, wording or anything else from another source without appropriate acknowledgement of the fact, the students are guilty of plagiarism. Plagiarism includes reproducing someone else's work, whether it be a published article, chapter of a book, a paper from a friend or some file, or something similar to this. Plagiarism also includes the practice of employing or allowing another person to alter or revise the work which a student submits as his/her own, whoever that other person may be.

Students may discuss assignments among themselves or with an instructor or tutor, but when the actual work is done, it must be done by the student, and the student alone. When a

student's assignment involves research in outside sources of information, the student must carefully acknowledge exactly what, where and how he/she employed them. If the words of someone else are used, the student must put quotation marks around the passage in question and add an appropriate indication of its origin. Making simple changes while leaving the organization, content and phraseology intact is plagiarism.

Written assignments you turn in may be submitted to TurnItIn for comparison with a collection of other previously submitted works and those available on public web sites.

Accommodations Due to Disability

If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center (Room 2, Alumni Gym, 257-2754, email address: jkarnes@email.uky.edu) for coordination of campus disability services available to students with disabilities.

Classroom Behavior

Please assist in creating a good learning environment free of distractions. Use of cell phones, including text messaging, is not permitted during class.

BME 488G

Introduction to Biomaterials

Fall 2012

Lecture Schedule

Week of	Tuesday	Thursday
August 22		Introduction
August 29	Proteins - Collagen (begin)	Collagen (finish) - Mechanical Functions of Tissue Components
September 5	Tendons – Preconditioning	Strain Rate Dependence - Cartilage (begin)
September 12	Cartilage (finish) - Bone (classifications)	Bone (anatomy - different structures)
September 19	Bone (mechanical properties)	Bone (remodeling) - Blood Vessels
September 26	Exam 1	Materials Review (begin)
October 3	Materials Review (finish) - Co-Cr-Mo (begin)	Co-Cr-Mo (finish) - Ti and Ti-6Al-4V
October 10	Alumina - Calcium Phosphates (begin)	No Class
October 17	Calcium Phosphates (finish) - Bioactive Glasses	Polymers (structure - nylons)
October 24	Polymers (PMMA - biodegradables)	Porous Coatings (begin)
October 31	Exam 2	Hemostasis - Wound Healing (begin)
November 7	Wound Healing (finish) - Thromboresistant Materials (begin)	Thromboresistant Materials (finish)
November 14	Soft Tissue-Biomaterial Interactions	Fracture Healing - Bone-Biomaterial Interactions (begin)
November 21	Bone-Biomaterial Interactions (finish) – Systemic Effects (begin)	No Class
November 28	Systemic Effects (finish) - Conclusion	Exam 3
December 5	Presentations	Presentations
December 12	Presentations (if needed) on **Monday, Dec. 12, at 10:30 a.m.**	

BME 488G

Introduction to Biomaterials

Fall 2012

Reading in *Biomaterials Science: An Introduction to Materials in Medicine* (2nd Edition)

Topic	Pages
Introduction	1-19
Biological Materials	
Connective tissue molecules	127-137
Synthetic Materials	
Sterilization	754-760
Metals	137-153, 430-439
Ceramics	153-170
Polymers	67-86, 100-106, 115-126, 411-430
Responses to Injury or Invasion	
Hemostasis	332-338
Wound healing	260-265, 272-274, 293-304
Immune response	304-318
Tissue-implant interactions	
Biocompatibility	11-12, 355-367
Cardiovascular applications	367-379, 456-506
Soft tissue applications	583-627
Orthopedic applications	526-555
Drug delivery	628-648
Tissue engineering	709-728
Dental applications	555-572
Tumorigenesis	338-345
Infection	345-354
Failure	760-765

BME 488G

Introduction to Biomaterials

Fall 2012

Reading in *Biomaterials Science and Engineering*
(in CBME library)

Topic	Pages
Biological Materials	
Tissue components	119-129
Soft tissues	113-118, 147-166
Mineralized tissues	129-146

Reading in *Basic Histology*
(in CBME library)

Topic	Pages
Biological Materials	
Connective tissue molecules	91-104
Connective tissues	113-118
Cartilage	127-135
Bone	137-159
Blood vessels	214-228

BME 488G

Introduction to Biomaterials

Fall 2012

Device Analysis / Design Project Topics

1. Artificial blood
2. Biodegradable bone fixation plate
3. Biodegradable interference screw
4. Caps (dental restorations)
5. Cardiac catheter (balloon angioplasty)
6. Contact lens
7. Coronary stent
8. Craniofacial reconstruction plates
9. Dialysis tubing
10. Dynamic compression plate
11. Ear drainage tubes (myringotomy tubes)
12. Elbow replacement
13. Extra corporeal membrane oxygenator (ECMO) membranes
14. Fillings (dental restorations)
15. Finger joint
16. Foley (urinary) catheter
17. Guided tissue regeneration barrier
18. Heart valves (natural)
19. Heart valves (synthetic)
20. Hernia repair mesh
21. Hip replacement
22. Hydrocephalic shunt (drain)
23. Implantable defibrillator electrodes
24. Intraocular lens
25. Knee replacement
26. Ligament replacements
27. Pacemaker electrodes
28. Peripheral vessel stent
29. Shoulder replacement
30. Stent graft for aneurysm
31. Tissue engineering scaffolds
32. Transdermal drug delivery patches
33. Tympanic membrane (ear)
34. Ureteral stent