DEGREE/PROGRAM CHANGE
FORM C
Form Number: C1406

Fields marked with * are required

Name of Initiator: Heather Canavan **Email:** canavan@unm.edu **Phone Number:** 505 277-8026 **Date:** 07-24-2014

Associated Forms exist? Yes

Initiator's Title Associate Professor: Chemical Biological Eng

Faculty Contact Heather Canavan

Administrative Contact Annette Torres

Department Biomedical Engineering Graduate Program

Admin Email anntorr@unm.edu

Branch

Admin Phone 277-7959

Proposed effective term

Semester Fall Year 2015

Course Information

Select Appropriate Program Graduate Degree Program

Name of New or Existing Program MS & PhD Biomedical Engineering

Select Category Emphasis Degree Type MS and PhD

Select Action New

Exact Title and Requirements as they should appear in the catalog. If there is a change, upload current and proposed requirements.
See current catalog for format within the respective college (upload a doc/pdf file)

Form C for BME August 2014.docx

☑ **Does this change affect other departmental program/branch campuses? If yes, indicate below.**

Reason(s) for Request (enter text below or upload a doc/pdf file)
See attachment.

Upload a document that inlcudes justification for the program, impact on long-range planning, detailed budget analysis and faculty workload implications.(upload a doc/pdf file)

☐ **Are you proposing a new undergraduate degree or new undergraduate certificate? If yes, upload the following documents.**

Upload a two-page Executive Summary authorized by Associate Provost. (upload a doc/pdf file)

Upload memo from Associate Provost authorizing go-ahead to full proposal. (upload a doc/pdf file)

Degree/Program Change
Form C
Form Number C1406

Form initiated by Prof. Heather Canavan

Exact Title and Requirements as they should appear in the catalog. If there is a change, upload current and proposed requirements.
See current catalog for format within the respective college (upload a doc/pdf file)

Changes to the Catalog's entry:

Biomedical Engineering Graduate Program
Heather E. Canavan, Director
Centennial Engineering Center 2059
MSC01 1141
1 University of New Mexico
Albuquerque, NM 87131-0001
(505) 277-8026

Affiliated Faculty
Kateryna Artyushkova, Chemical and Biological Engineering
Plamen Atanassov, Chemical and Biological Engineering
C. Jeffrey Brinker, Chemical and Biological Engineering
Vince Calhoun, Electrical and Computer Engineering
Heather Canavan, Chemical and Biological Engineering
Thomas Caudell, Electrical and Computer Engineering
Eva Chi, Chemical and Biological Engineering
Vittorio Cristini, Pathology
Elizabeth L. Dirk, Chemical and Biological Engineering
Jeremy Edwards, Chemistry, and Chemical and Biological Engineering
James P. Freyer, Chemical and Biological Engineering
Julia Fulghum, Chemical and Biological Engineering
Steven W. Graves, Chemical and Biological Engineering
David Grow, Mechanical Engineering, New Mexico Institute of Mining and Technology
Sang Han, Chemical and Biological Engineering
Kerry Howe, Civil Engineering
Linnea Ista, Chemical and Biological Engineering
Ravi Jain, Electrical Engineering
Zayd C. Leseman, Mechanical Engineering, and Electrical and Computer Engineering
Gabriel P. Lopez, Biomedical Engineering, Duke University
Chad Melancon, Chemistry
Diana Mercer, Orthopaedics
Meeko Oishi, Electrical and Computer Engineering
Marek Osinski, Electrical and Computer Engineering
Marios Pattichis, Electrical and Computer Engineering
Dimiter Petsev, Chemical and Biological Engineering
Christina Salas, Orthopaedics
Andrew Schuler, Civil Engineering
Andrew Shreve, Chemical and Biological Engineering
Scott S. Sibbett, Chemical and Biological Engineering
Darko Stefanovic, Computer Science
Mahmoud Reda Taha, Civil Engineering
Michaelann Tartis, Chemical Engineering, New Mexico Institute of Mining and Technology
Margaret Werner-Washburne, Biology
David Whitten, Chemical and Biological Engineering
John E. Wood, Mechanical Engineering
Steve A. Young, Pathology

Biomedical Engineering Concentration for the Ph.D. in Engineering

M.S. and Ph.D. Admission Requirements

Prospective candidates can apply directly for admission to the Ph.D. program. The Admissions Committee will make admission decisions on a case-by-case basis.

Degree Completion Requirements
The general requirements for this degree are identical to those specified in the Graduate Program section of this catalog. (Please see the Graduate Program section for detailed requirements and procedures common to all UNM graduate programs.) In addition to the general requirement specified in the Graduate Program, graduates must complete the core and elective BME curriculum specified below. BME 567 (Biomedical Engineering Seminar) should be taken every semester.

Degrees Offered
M.S. in Biomedical Engineering
Ph.D. in Engineering with a Concentration in Biomedical Engineering

Ph.D. and M.S. in Biomedical Engineering
The M.S. and Ph.D. programs in Biomedical Engineering prepare students for careers in solving engineering problems in health care, biomedical research, and biotechnology. Areas of current faculty research include biomaterials, nanobiotechnology, bioanalytical microsystems, patient-care devices, tissue engineering, flow cytometry, disease processes, clinical translation, and molecular and cellular systems. Instruction includes 5 core courses, a seminar and numerous electives taught by Affiliated Faculty and others within the School of Engineering, School of Medicine, College of Arts and Sciences, and College of Pharmacy.

Ph.D. and M.S. Admission Requirements
Prospective candidates may apply directly for admission to the Ph.D. program. Successful applicants to the program usually have a bachelor's degree in the physical sciences or engineering. The Admissions Committee makes admissions decisions on a case-by-case basis, with special consideration of scholastic proficiency in one or more of the following subject areas:

- Molecular and Cellular Biology
- Chemistry and Organic Chemistry
- Calculus and Ordinary Differential Equations
- Thermodynamics
- Physics
- Biochemistry or Biomolecular Engineering

Students who have not passed courses in one or more of these subject areas may be admitted to the program, but required to take undergraduate courses to address deficiencies in their background. General admission requirements described in the Graduate Program in the Catalog also apply.

Ph.D. and M.S. Application Process
Details of applying to the Ph.D. and M.S. programs are found on-line at http://bme.unm.edu. Applications to the degree program are submitted electronically at www.unm.edu/apply.

Ph.D. Degree Completion Requirements
The general requirements for the Ph.D. degree include those specified in the Graduate Program section of this catalog. In addition to these general requirements, students must also complete the BME core, Emphasis Area core, and elective BME curricula described below. BME 567 (Biomedical Engineering Seminar) must be taken every semester, up to a maximum of 8 credit hours total. Students must pass the Qualifying Examination before applying for Candidacy or proceeding to the Comprehensive Exam. Upon successfully passing the Doctoral Comprehensive Exam and successful review of their application by program faculty and the Dean of Graduate Studies, students are admitted to Candidacy for the doctoral degree. For successful completion of the program requirements, all candidates must pass a Final Examination (Defense of Dissertation).

M.S. Degree Completion Requirements
Completion requirements of a thesis-based M.S. degree (Plan I)
The minimum requirements for the thesis-based M.S. include 6 hours of thesis credit (BME 599) and 24 hours of course work that must include 18 hours of mandatory courses, as approved by the Committee on Studies, and at least 3 hours from the electives such as those listed below. Plan I automatically meets the

requirement of at least 12 hours of course work at the 500 level or higher, exclusive of thesis credit, as stipulated by the UNM Catalog for this plan.

Completion requirements of a course-based M.S. degree (Plan II)

The minimum requirements of the Plan II Course-Based M.S. degree program include 32 hours of course work for credit, with at least 24 hours drawn from the list of BME required and elective courses and 3 hours of research seminar/problems course. At most, 6 hours of *400 level School of Engineering courses are allowed. Also, at least 12 hours of course work should be at a 500 level or higher, as stipulated by the Catalog for this Plan.

Curriculum for Students Pursuing the BME Concentration for the Ph.D. in Engineering

For all students pursuing degrees in BME, the following BME core courses are offered once per academic year:

BME 547	Biomedical Engineering Research Practices
BME 558	Methods of Analysis in Bioengineering
BME 567	Biomedical Engineering Seminar

For students pursuing degrees in the emphasis area of Molecular and Cellular Systems, the following Emphasis Area Core courses are offered every other year:

BME 517	Applied Biology for Biomedical Engineers
BME 544	Mechanics and Thermodynamics of Molecular Components in Cells
BME 556	Protein and Nucleic Acid Engineering

For students pursuing degrees in the emphasis area of Biomaterials, Biomechanics and Tissue Engineering, the following Emphasis Area Core courses are offered every other year:

BME 572	Biomaterials Engineering
BME 579	Tissue Engineering
BME 598	Biomechanics

Comment [HC1]: Note, we have also submitted a Form B to add a course # for this course (it's currently a Special Topics course). (Form #B0)

Equivalent graduate-level courses taken at other institutions may be used to satisfy one or more of the above core requirements, as approved by the student's Graduate Advisor or Curriculum Committee.

Elective Courses

For completion of the Ph.D. degree, the student must complete a minimum of 18 credit hours of elective courses from the list below. At least 9 of these must be from courses offered in the School of Engineering. Ph.D. candidates may substitute electives other than those listed below, as approved by the student's Graduate Advisor or Curriculum Committee.

M.S. degree candidates must complete a minimum of 6 credit hours of elective courses from the lists below. M.S. candidates may substitute electives other than those listed below, as approved by the student's Graduate Advisor or Curriculum Committee.

Biomedical Engineering Electives	
BME 517	Applied Biology for Biomedical Engineers
BME 544	Mechanics and Thermodynamics of Molecular Components in Cells

BME 556	Protein and Nucleic Acid Engineering
BME 570	Physical Bioanalytical Methods
BME 572	Biomaterials Engineering
BME 579	Tissue Engineering
BME 598	Biomechanics
BME 598	Special Topics

Comment [HC2]: See previous comment.

Engineering Electives	
BIOL **351	General Microbiology
BIOL 547	Advanced Techniques in Light Microscopy
BIOM 507/BIOL 581	Advanced Molecular Biology
BIOM 508/BIOL 582	Advanced Cell Biology
BIOM 509	Principles of Neurobiology
BIOM 510	Physiology
BIOM 514	Immunobiology
BIOM 515	Cancer Biology
BIOM 516	Molecular Genetics and Genomics
CHNE/NSMS 522L	Fundamentals of Nanofluidics
CHNE/NSMS 530	Surface and Interfacial Phenomena
CHNE/NSMS 538/438	Biosensors Fundamentals and Applications
CHNE 504	Nanomaterials
CHNE 521	Advanced Transport Phenomena I
CS 529	Introduction to Machine Learning
CS 530	Geometric and Probabilistic Methods in CS
CS 561	Algorithms and Data Structures
CS 590	Topics: Complex Adaptive Systems
ECE 500	Theory of Linear Systems
ECE 510	Medical Imaging
ECE 533	Digital Image Processing
ECE 537	Foundations of Computing
ECE 539	Digital Signal Processing I
ME 501	Advanced Mechanics of Materials
ME 504	Computational Mechanics
ME 512	Introduction to Continuum Mechanics

ME 530	Theoretical Fluid Mechanics I
ME 571	Advanced Materials Science

Impact on Other Departmental Programs. The impact on other department programs will be positive. There are three faculty members (Profs. Shreve, Chi, and Ista) currently teaching courses that are currently considered to be BME Core courses (Mechanics and Thermodynamics of Molecular Components in Cells, Protein and Nucleic Acid Engineering, and Applied Biology for Biomedical Engineers), that will no longer be considered core courses with the inclusion of this second emphasis area. As the courses will henceforth be considered electives, they will be offered every other year (instead of every year). This will reduce the teaching load experienced by these faculty, and allow them to teach courses in their home departments if need be.

The majority of the courses in the additional emphasis area are already offered as electives in the BME program (and in the home departments of the instructors). Therefore, no additional teaching load will be experienced with their inclusion.

Upload a document that inlcudes justification for the program, impact on long-range planning, detailed budget analysis and faculty workload implications.*

Justification for the Change to the Program. The BME Graduate Program is an interdisciplinary degree program, housed within the School of Engineering rather than a single department. From its inception, the degree program was intended to have multiple emphasis areas that tailored the educational needs of students within the program, as well as the faculty participating in it. The first emphasis area (Molecular and Cellular Systems) introduced reflected the faculty originally participating in the graduate program, including their research areas and funding.

In the subsequent four years, a number of new faculty have begun participating in the BME Graduate Program through the advising of students, participation on committees, and addition of new courses in BME. These faculty have research and educational interests that are complementary to our existing courses and core. The addition of new emphasis areas will reflect the inclusion of these faculty into the BME graduate program, and will enhance our collaborations across the Schools of Engineering and Medicine, as well as the College of Arts & Sciences.

This proposed new emphasis area (in "Biomaterials, Biomechanics and Tissue Engineering") reflects the interests in faculty from the Departments of Chemical and Biological Engineering (Profs. Canavan and Dirk), Civil Engineering (Prof. Reda Taha), Mechanical Engineering (Prof. Wood), and Orthopaedics (Prof. Salas). It is important to note that the new emphasis area includes courses that are already available as BME electives (e.g., BME 572: Biomaterials, BME 572: Tissue Engineering; BME 598: Biomechanics will be offered in 2014 for the first time).

The proposed emphasis area was voted on and unanimously approved by the participating BME faculty in April 2014. It was presented by Associate Dean Fleddermann at the SOE Academic Council in April 2014 and then at the School of Engineering faculty meeting in May 2014, where it was also unanimously approved.

Impact on Long-range Planning. Inclusion of Profs. Salas, Reda Taha and Wood as instructors of core courses—rather than instructors of electives—will demonstrate the BME Graduate Program's commitment to interdisciplinary education and research. It will position our program to recruit blue chip students to the program, enhancing our program's reputation within the University and State. Furthermore, the increasingly vibrant educational and research environment will help the School of Engineering to recruit new faculty members to our six departments.

Detailed budget analysis. The BME Graduate Program does not have a budget associated with it. All of the graduate program's courses are cross-listed with the home department of the instructor, and are therefore counted toward the faculty member's teaching in his or her home department (e.g., Prof. Canavan's home department of Chemical and Biological Engineering counts her courses in Biomaterials and Research Practices as courses in Chemical and Biological Engineering, as well). Therefore, the proposed change will not impact the budget of our program in any way.

Faculty workload implications. The addition of this emphasis area will actually improve faculty workload. The inclusion of a second emphasis area means that we have decreased the number of core BME courses from five to three. These remaining three courses will be taught each year as core courses. The emphasis area electives will be offered on off-set years (every other year). Therefore, although all students will be able to take their core courses in 18 months, two courses will be taught every other year, rather than every year (reduction of 2 x 0.5 course teaching load per year).