DEC 21 2005

PROCESS C

CURRICULUM PROPOSAL SCC #04-05- 964

NEW Programs - MAJOR Program Revisions - PROGRAM Name Changes

Deadlines: October 6, 2004 to be implemented Fall 2005 ~ February 1, 2005 to be implemented Spring 2006

PROPOSAL TITLE: Concentration in Bioengineering

Sponsor: Jennifer Kadlowec Email: kadlowec@rowan Ext: 5344

co-sponsors - see Attached

DEPARTMENT:

COLLEGE: Engineering

If Liberal Arts & Sciences CHECK: ___ History/Humar

___ UNDERGRADU

THE ATTACHED NEW PROGRAM – MAJOR PROGRA VA

DESCRIBED BY THE ITEM(S) CHECKED

___ New Degree Program ___ Majo ents/m

___ New Major ___ Changes in ___ ool, Dep

___ New Minor ___ Other Curriculum C

✓ New Concentration, Specialization, or Track

___ New Certificate of Graduate Study Program: GCSS & GCSI

THE FOLLOWING SIGNATURES REPRESENT APPROVAL

Department Chair: see attached Date

Department Curriculum Chair: see attached Date

Academic Dean: Deanne Worley Date 2.11.05

COLLEGE CURRICULUM COMMITTEE

CLOSED-FILING Date ___ Received ___ Not Approved ___

COLLEGE CURRICULUM CHAIR

UNIVERSITY CURRICULUM COMMITTEE

OPEN-FILING Date 3/4/05 Approved ✓ Not Received ___

Senate Curriculum Chair Signature: [signature] Date Senate Announcement Date: 11/28/05

Comments:

EXECUTIVE VICE PRESIDENT/PROVOST Signature: [signature] Date 1/24/06

✓ Approved ___ Not Approved

REGISTRAR

Date 1/31/06 Official Copy & Agenda Sheet Rec'd

Date ___ Course Description Received & Added ~ Reg's Taxonomy & Courses =

Course Deletions Received & Approved ~ Reg's Taxonomy & Courses =

Registrar Signature:

NOTIFICATION FORWARD

✓ SCC Chair ✓ Academic Dean ✓ Department Chair ✓ Registrar ✓ R ✓ Chair ✓ Faculty Assembly

✓ Faculty Affairs ✓ Others

Transmittal - 2/9/06

Additional Sponsors and Signatories

Co-sponsors
Jess Everett, Civil and Environmental Engineering, everett@rowan.edu, ext. 5326
Rich Frazee, Chemistry and Biochemistry, frezee@rowan.edu, ext. 5461
Cristina Iftode, Biological Sciences, iftode@rowan.edu, ext. 3586
Brian Lefebvre, Chemical Engineering, lefebrve@rowan.edu, ext. 5338
Robi Polikar, Electrical and Computer Engineering, polikar@rowan.edu, ext. 5372

Department Chairs:

ChE Robert P. Hesketh Date 2/11/05

CEE _____ Date 2/10/05

ECE _____ Date 2/11/05

ME _____ Date 2/11/05

Department Curriculum Chairs:

ChE _____ Date 2/11/05

CEE _____ Date 2/10/05

ECE _____ Date 2/11/05

ME _____ Date 2/10/05

Abstract
Proposed Concentration in Bioengineering

Sponsors

Jennifer Kadlowec, Mechanical Engineering
Jess Everett, Civil and Environmental Engineering
Rich Frazee, Chemistry and Biochemistry
Cristina Iftode, Biological Sciences
Brian Lefebvre, Chemical Engineering
Robi Polikar, Electrical and Computer Engineering

Need for the Program

Bioengineering is a very broad and inherently interdisciplinary study where skills attained through training in one discipline are generally insufficient to address outstanding questions, which relate to areas of established and emerging biotechnologies and biosciences. With the increasing demand for health industry professionals in clinical, industrial and government settings, there is a need for well trained engineers who can design and develop ways of improving quality of life.

Relationship to Departments and School

The proposing departments in the College of Engineering all have a different definition of bioengineering, but use this umbrella terminology for technology and science to improve life and our surroundings. The concentration will be coordinated by and housed in the College of Engineering. Courses in the College of Engineering and the College of Liberal Arts and Sciences will make up possible curriculum for the proposed concentration.

Summary of the Curriculum

The Bioengineering Concentration requires at least 18 semester hours of approved coursework, with a minimum of 3 semester hours above and beyond the required coursework for the major degree. At least one of the courses must be outside of the student's major and at least one must be in the chemical or biological sciences.

Implementation Time Frame

The Bioengineering Concentration can be implemented immediately as the coursework already exists. New coursework may be developed to augment current course offerings through collaborations between the College of Engineering and the College of Liberal Arts and Sciences.

Resources Required

A faculty member from each department will need to advise students from within that department.

Concentration in Bioengineering and Sciences

Sponsors - Jennifer Kadlowec, Mechanical Engineering, Jess Everett, Civil and Environmental Engineering, Rich Frazee, Chemistry and Biochemistry, Cristina Iftode, Biological Sciences, Brian Lefebvre, Chemical Engineering, Robi Polikar, Electrical and Computer Engineering

Program Size - This program is designed for, but not limited to, students from Mechanical, Electrical and Computer, Chemical, and Civil and Environmental Engineering. We expect at least 25 students each year to enroll in the Bioengineering Concentration.

Relationship to Curriculum - There are no changes to the general education or to the core area curriculum requirements. Undergraduate engineering students may experience an increase of 3-7 required credit hours for their B.S. depending on their major and choice of electives.

Prerequisites and Eligibility - The concentration requires at least 18 semester hours of approved coursework, with a minimum of 3 semester hours above and beyond the required coursework for the major degree. At least one of the courses must be outside of the student's major and at least one must be in the chemical or biological sciences. Eligible students must have Junior standing.

Implementation - The coursework exists and implementation can be carried out immediately. We expect at least 25 students each year to enroll in the concentration.

Resource Requirements

Equipment - Much necessary equipment to implement the concentration exists. Proposals will be written to seek funds for additional resources.

Library Resources - While current library resources are adequate (see form), an expanded number of journals will greatly augment the success of the program.

Staff Staffing is adequate, yet the as the College of Engineering plans a small growth, new faculty will be hired in bioengineering areas. The current staff will advise students who enroll in the concentration.

Space Current space allotments are sufficient yet increases will be necessary as additional faculty is added.

Costs To date there will be no additional costs, but equipment for new areas may need to be purchased.

Recommended Library Resources

The following books and journals are recommended for additional library resources:
Bioinstrumentation, Webster, Wiley, 2004
Introduction to Biomedical Engineering, Enderle, Elsevier, to be published 2005
Principles of Magnetic Resonance Imaging, Liang abd Lauterbur, IEEE press 2000
The Biomedical Engineering Handbook, Bronzino (ed.), Vol I and II, CRC press 1999
Introduction to Biomedical Engineering - Domach, Prentice Hall 2003
Introduction to Biomedical Imaging - Webb, Wiley - IEEE Press, 2002
Medical Physics and Biomedical Engineering, Brown, Smallwood et al, Institute of Physics
Std. Handbook of Biomedical Engineering & Design, Kutz, Mc Graw Hill, 2004
Design of Medical Electronic Devices, Perez, Academic Press, 2002
Biomedical Signal Processing and Signal Modeling, Eugene, Wiley, Interscience 2000
System Theory and Practical Applications of Biomedical Systems, Baura, Wiley - IEEE Press, 2002
Environmental Biotechnology: Principles and Applications by Bruce E. Rittmann, Perry L. McCarty Publisher: McGraw-Hill Science/Engineering/Math; 1 edition (July 25, 2000) ISBN: 0072345535
Environmental Biotechnology by Alan H. Scragg, Oxford University Press; 2nd Ed edition (January 31, 2005) ISBN: 0199268673
Environmental Biotechnology : Theory and Application by Gareth M. Evans, Judith C. Furlong, John Wiley & Sons (December 6, 2002) ISBN: 0470843721
Engineering Physiology, by Kroemer, John Wiley & Sons (December 6, 2002) ISBN: 0471287989
Basic Biomechanics of the Musculoskeletal System, by Nordin, Lippincott, Williams and Wilkins, ISBN 0683302477
Journal of Biomechanics, published by Elsevier
Proc. National Academy Science

While the program would be greatly enhanced if the library acquired the annual packages, the actual functionality of the Bioengineering Concentration will not be impaired if these are not provided. Perhaps a cost sharing approach between the sponsoring departments and the library can be explored.

Rationale

Bioengineering is a very broad and inherently interdisciplinary study, where a background resulting from training in one area is generally insufficient to address outstanding questions in this ever change field of study. The need for bioengineering or biomedical engineering graduates is on the rise. By 2010, there is a projected increase of 31.4% in positions for biomedical engineers, (compared to 9.4% for all engineers) [1]. The Department of Labor states that "the employment of biomedical engineers is expected to increase faster than the average for all occupations through 2010. The aging population and the focus on health issues will increase the demand for better medical devices and systems designed by biomedical engineers [2]." Many jobs in the "Fast Company 25 Top Jobs for 2005" list are bio-related.[3] The proposed concentration will further department and college goals in preparing students to enter the workforce with

interdisciplinary backgrounds demanded by biotechnology and bioengineering research and industry employers. Additionally, the proposed concentration will provide a broad knowledge of bioengineering research, development, and use as related to the student's major.

1. U.S. Department of Labor, Bureau of Labor Statistics, *Employment Outlook: 2000 2010, Monthly Labor Review*, Author, Daniel E. Hecker (Washington, DC 2001).
2. U.S. Department of Labor, Bureau of Labor Statistics website, http://www.bls.gov/oco/ocos262.htm, accessed on Jan. 3, 2002.
3. http://biz.yahoo.com/special/bestjobs05.html

Essence of the Concentration

Major Program Goals

Bioengineering research and development is a field of employment with increasing employment opportunities as mentioned above. The proposed concentration will not only afford students the opportunity to explore potential careers, but it will also foster greater interdepartmental and intercollegiate student and faculty interaction. This concentration will prepare our students for expected employment situations where employees are expected to work in a team environment with experts from various backgrounds.

Specific Objectives of Program -

- Introduce students to several disciplines with aspects of bioengineering
- Enhance understanding of interdisciplinary work of scientists and engineers in research and development
- Realize the different approaches taken by biologists, chemists, and engineers in solving problems
- Develop an understanding about the problems involved for product design
- Collect and integrate information from various sources
- Interact with students of different majors and backgrounds in project groups

Structure of the Organization

Following is an identification of each course, course descriptions, HEGIS number, and assigned credits. It should be noted that not all electives are offered every semester.

Accepted Coursework

Chemical Engineering

Bioprocess Engineering (3 s.h.) 0906.462

This course reviews the fundamentals and engineering of bioprocess engineering with emphasis on applying biotechnology to industrial processes. Essential aspects of biochemistry, microbiology and kinetics are presented. This course discusses bioreactor engineering, and recovery and purification processes. Processing applications of engineering kinetics and enzyme technology are included. Laboratory experiments and demonstrations will be integrated throughout the course. prerequisites 1906.100 or 1906.105, 1701.130

Principles of Biomedical Engineering (3 s.h.) 0906.472

This course introduces students to chemical engineering fundamentals applied to biomedical systems. Students analyze and design biomedical processes. The basic biochemistry and physiology required for understanding of biomedical systems is presented. Basic principles of mass transfer, heat transfer, fluid flow, and chemical reaction are used to analyze or design drug delivery systems, pharmacokinetic models, the circulatory system, transport across cell membranes, and human and artificial organs. Laboratory experiments and demonstrations will be integrated throughout the course. prerequisites – 1906.100 or 1906.105, 1701.131

Principles of Bioseparation Processes (3 s.h.) 0906.476

This course will focus on the fundamental principles of bioseparation processes. The characteristics of bioseparations will be presented as applied to downstream processing in the pharmaceutical biotechnology and related industries. Theory and design of filtration, microfiltration, centrifugation, cell disruption, extraction, adsorption, chromatography, precipitation, ultrafiltration, crystallization, and drying will be presented as applied to biosystems. Commercial design considerations, such as sanitary design/sterilization, water quality, solvent recovery, waste disposal and biosafety will be reviewed. prerequisite – 0906.314

Principles of Food Engineering (3 s.h.) 0906.482

This course introduces students to chemical engineering fundamentals applied to food processing systems. Students analyze and design food engineering processes. The basic chemistry required for understanding of food systems is presented. Basic principles of mass transfer, heat transfer, fluid flow, chemical reaction, process control, and mixing are used to analyze or design food production systems. Computer simulations will be used for the design of food processing systems. Laboratory experiments and demonstrations will be integrated throughout the course. prerequisites – 1906.100 or 1906.105, 1701.131

Principles of Engineering Exercise Physiology (4 s.h.) 0906.483

This course introduces students to chemical engineering fundamentals applied to physiologic systems, primarily during exercise. The basic biochemistry and physiology required for understanding these systems is presented. Basic principles of mass transfer, heat transfer, fluid flow, thermodynamics, and chemical reaction are used to analyze the human metabolic system, respiratory system, cardiovascular system, and thermal system. The interrelationships of these systems will be investigated, and their dynamic response to exercise will be studied. Laboratory experiments will be conducted throughout the course. This course is jointly taught with the Department of Health and Exercise Science. prerequisites – 1906.100 or 1906.105, 1701.236

Fundamentals of Controlled Release (3 s.h.) 0906.484

Controlled release systems are designed to provide delivery of an agent at a pre-determined rate for an extended period of item. Controlled release offers several advantages over traditional methods of formulation and administration: maintenance of effective concentrations for a sustained period, less total agent required, cost effectiveness, convenience and compliance. This course introduces students to chemical engineering fundamentals applied to controlled release systems. Basic principles of materials, mass transfer, heat transfer, fluid flow and chemical reactions are used to analyze and design controlled release systems. Applications to pharmaceutical, agricultural, and food industries will be explored. Laboratory experiments and demonstrations will be integrated throughout the course. Prerequisites: Chemistry I (Lecture and Lab) – 1906.100 or Advanced College Chemistry I – 1906.105 and Calculus II 1701.131.

Membrane Processes (3 s.h.) 0906.486

Principles of membrane processes: reverse osmosis, ultrafiltration, microfiltration, electrodialysis, prevaporation, gas permeation, and their application to traditional and emerging fields. Membrane materials and structure. Mass transfer and design aspects for both liquid and gas separation systems. (Implementation Fall 2004). Prerequisites: Chemistry I (Lecture and Lab) – 1906.100 or Advanced College Chemistry I 1906.105 and Calculus II – 1701.131.

Civil Engineering

Environmental Engineering I (0908.311) 3 s.h.

Topics in principles of environmental engineering, including ecosystems, water and wastewater treatment and design, and sludge residuals management. (Prerequisites: 1907.300, must be taken with Corequisite 0901.341)

Environmental Engineering II (0908.312) 3 s.h.

Topics in solid and hazardous waste and air pollution engineering, including regulations, fundamentals, evaluation, management, prevention, treatment and disposal. *(Prerequisites: 0908.311 or permission of instructor)*

Site Remediation Engineering Principles (0908.422) 3 s.h.

Topics in site remediation engineering, including site characterization, site safety, modeling site conditions, conducting feasibility studies, and designing remediation systems, such as pump and treat, stabilization, containment, treatment walls, natural attenuation, enhanced bioremediation, phytoremediation, oxidation, soil flushing, and soil vapor extraction. *(Prerequisites: Senior standing or permission of instructor)*

Pollutant Fate and Transport Principles (0908.432) 3 s.h.

Topics include Characteristics and Properties of Organic Pollutants, Aquatic Chemistry, Transport Mechanisms for Pollutants (Absorption, Retardation, Attenuation, Volatilization, Biodegradation), Groundwater (Properties, Flow Equations, Transport in Porous Media) and Mathematical Modeling. *(Prerequisites: Senior standing or permission of instructor)*

Principles of Integrated Solid Waste Management (0908.433) 3 s.h.

The course deals with the theories and principles of integrated solid waste management as applied to real-world analysis and design problems. The course covers the design of facilities and programs, such as landfills, composting facilities, transfer stations, collection programs, and drop-off centers, and planning of integrated systems for municipalities and counties. Computer applications are included. *(Prerequisites: Senior standing or permission of instructor)*

Electrical Engineering

Principles of Biomedical Systems and Devices (0909.404) 3 s.h.

As a survey of biomedical engineering, this class will introduce various systems of the human physiology from an engineering perspective. In particular, students will be introduced to signals of biological origin obtained from these systems; biosensors, transducers and bioelectrodes used to acquire such signals, along with medical quality amplifiers for measuring biopotentials. Electrical safety of medical devices; measurements of the blood pressure, blood flow, and respiratory system will also be discussed. Along with a carefully designed set of experiments, this course will provide the fundamental principles of biomedical engineering from an electrical and mechanical engineering perspective. *(Prerequisite: 0909.311, 0909.321)*

Mechanical Engineering

Introduction to Biomechanics (0910.470) 3 s.h.

This course presents an introduction to biomechanics of human motion. The course will encompass the use of engineering principles to describe, analyze and assess human movement. Topics will include kinematics, kinetics, anthropometry applied to the synthesis of human movement and muscle mechanics. Prerequisite: Dynamics (0901.291)

Introduction to Biofluids (0910.471) 3 s.h.

The goal of this course is to present an introduction to fundamental concepts of fluid mechanics and mass transport that are involved in mammalian cell function. Special attention is given to the vascular circulation system and problems that commonly occur therein. This course will include a small laboratory component and will involve independent learning about the state-of-the-art in biofluids research. Prerequisite: Fluid Mechanics I (0901.341).

Introduction to Biomaterials (0910.472) 3 s.h.

The goal of this course is to present an introduction to the numerous issues that factor into the choice of material selection for biomedical devices. Issues to be examined include mechanical properties, biocompatibility, production costs, and ease of manufacture. This course will familiarize students with relevant material issues and highlight the process for matching material performance with the desired design characteristics and functionality. Prerequisite: Materials Science (0901.281).

Introduction to Crash Safety Engineering (0910.475) 3 s.h.

This course presents an introduction to the design and analysis of crashworthy cars and light trucks. The course will encompass three major focus areas: the crash response of (1) the vehicle structure, (2) the occupant, and (3) the occupant restraints. Topics will include the analysis of crash tests, vehicle crash kinematics, vehicle modeling, the biomechanics of impact injury, occupant modeling, and airbag design. (Prerequisite: 0901.291)

Biological Sciences

Biological Systems & Applications (0401.210)

Fundamental concepts and applications of biochemistry, cellular biology, microbial physiology, and environmental microbiology will be presented during this course. Emphasis will be placed on the theme that all biological systems (from the molecular level to the community level) are dynamic and interactive Laboratory sessions will expose students to a variety of standard biological techniques from areas such as biotechnology, microbiology, and environmental biology. No credit towards biology major. Pre-requisites: Advanced Chemistry I

Work Physiology (0410.350)

This course studies the effect of short term and long term work stress on the human organism. This course may not be offered annually. Prerequisites: Bio I (0401.100) and Bio II (0401.101)

Environmental Toxicology (0420.425)

This course covers topics related to the fate and impact of pollutants in the environment. This course deals with the laws and regulations of pollutant discharge, the kinds of chemical pollutants, the transport and distribution of such chemicals into the environment, and their effect in populations and communities as well as individual organisms. The acute and chronic effect of these pollutants, the principles of environmental monitoring and assessment, and special examples and case studies will be analyzed. Prerequisites: 0401.100, 0410.101, 1906.100, 1906.101, 1907.200, 0420.310, Junior or Senior class standing; or permission from the instructor

Microbiology (0411.330)

This course deals with the morphology and physiology of unicellular organisms, with emphasis upon bacteria. It studies culture methods, growth parameters, isolation, identification and characterization, and metabolism of microorganisms in the laboratory.
Pre-requisites: Bio I & II

Cell Biology (0401.430)

This laboratory course addresses the fundamental properties of cell biology from an experimental perspective by exploring modern and classic experimental approaches to understanding cellular function.

The course will focus on experimental design, current technology and techniques, and data interpretation. Pre-requisites: BioI and BioII

Developmental Biology- it will be offered beginning Fall 2006

Developmental biology is a dynamic field that addresses the development of organisms from fertilization through embryonic and post-embryonic stages. The field of developmental biology has both a rich history and an exciting future. Current research uses the tools of cell biology, genetics, biochemistry and molecular biology to address the basic questions of how an organism is formed. By studying both classical and current research, students will explore the fundamental processes of embryology as well as the cellular and molecular signaling involved in complex developmental mechanisms. The course will include lecture, discussion, student presentation, and independent laboratory projects. Pre-requisites: Biology I (0401.100), Biology II (0401.101), and any one of the following Genetics (0422.335), Introduction to Biochemistry (0414.348), Introduction to Biochemistry-Lecture only (0414.440), Embryology of Animals (0427.401), Cell Biology (0401.430) or permission of instructor

Concepts in Human Genetics: (undergraduate-0422.410 and graduate-0422.598)

This is an advanced course for senior undergraduate (Human Genetics-0422.410) and graduate level (Concepts in Human Genetics: 0422.598). This course will discuss the application of genetics principles to the human species. All major areas of genetics such as transmission genetics, cytogenetics, biochemical genetics, molecular genetics and population genetics will be covered. However, the course is not a traditional human genetics course, but rather emphasizes fundamental concepts and technological advances in the study of human genetics as they pertain to medical practice. Therefore, various case studies related to different genetic disorders will be used to exemplify the concepts discussed. The general objective of the course is to extend the principles of human genetics by applying them to counseling, screening, ethics, law, and evaluating their social implications. Lectures will alternate with laboratory sessions, allowing students to experimentally test various human genetics concepts.
Prerequisites: This is a course designed for senior undergraduate students as well as for graduate students. Genetics (0422.335) is required or permission from the instructor. In the later case, students must have a reasonable understanding of the molecular processes in both eukaryotic and prokaryotic cells, and be able to supplement their basic genetics knowledge by individual study. The course will briefly review, not cover in depth, basic genetics principles.

Human Anatomy and Physiology I (0410.210)

This course offers a molecular, cellular and systematic approach to the structure and function of the component units and organizational systems of humans. Emphasis is placed on membrane physiology and the skeletal, molecular, digestive and circulatory systems. Pre-requisites: Bio I and Bio II

Human Anatomy and Physiology II (0410.212)

This laboratory course focuses on the gross and microscopic structure of the body. The course is the second semester of a two-semester sequence that covers all of the functional systems of the human organism. In this course, the systems of the body to be studied in detail include the endocrine, cardiovascular, respiratory, excretory, digestive, and reproductive systems. Whole body metabolism and fluid balance will also be studied. Pre-requisites: Bio I and Bio II

Chemistry

Biochemistry (1907.348) 4 s.h.

This course deals with chemical compounds and reactions important to the functioning of biological systems and includes a discussion of the metabolic pathways for energy production and biosynthesis. Prerequisite: Organic Chemistry II 1907.201.

Advanced Biochemistry (1907.408) 4 s.h.

This course provides an in-depth study of the principles involved in biological processes. It emphasizes the significance of biochemical reactions and regulations as well as mechanisms. A thorough elucidation of the

structure, function and mechanism will be presented. The overall strategy of living systems will be illustrated. The laboratory experiments will provide exposure to representative procedures and some important modern techniques. Prerequisite: Biochemistry.

Biophysical Chemistry (1908.305) 4 s.h.

This course covers the topics of physical chemistry and their applications in biochemistry. Topics include thermodynamics, kinetics and spectroscopy. This course also provides laboratory experience in physical methods that apply to biological systems. Prerequisites: Organic Chemistry II – 1907.201; Calculus II – 1701.131; Physics II (for scientists and engineers) – 1902.201; Quantitative Analysis – 1909.250; and Biology II – 0401.101.

Medicinal Chemistry (1907.410) 3 s.h.

A study of the biochemical principles and metabolic pathways with particular emphasis on pharmaceutical applications and biotechnology. This course will focus on the molecular mechanisms of drug action and chemical basis of drug therapy. Current methods used to study medicinal chemistry including recombinant DNA, combinatorial chemistry and bioinformatics will be reviewed. A 3-D molecular modeling of drug targets and drug design will be integrated throughout the course. Clinical trials of drug case study are included. *(Prerequisite: 1907.201)*

Below is a set of possible options for completing the concentration for various majors with the course prerequisites already satisfied by major requirements.

B.S. Chemical Engineering

Biological Systems & Applications or Biology 1 (4 s.h.) – fall soph. yr.
Advanced Chemistry Elective (3 s.h.) – spring sr. yr.
Junior/Senior Engineering Clinic (2 s.h.) – 1 bioengineering related project in jr. or sr. yr.
Chemical Engineering Electives (6 s.h.) – 2 of the following in fall and spring of sr. yr.

Bioprocess engineering, Principles of Biomedical Processes, Principles of Bioseparation Processes, Principles of Food Engineering, Principles of Engineering Exercise Physiology, Fundamentals of Controlled Release, and Membrane Processes

Biology, Chemistry or Engineering Elective (3-4 s.h.)

Any coursework listed in this proposal, student is responsible to see that prerequisites are satisfied.

Approved list of electives will be reviewed on a yearly basis depending on the courses offered on campus.

B.S. Civil Engineering

Major Requirements
Advanced Chemistry I (4 s.h.)
Advanced Chemistry II (4 s.h.)
Environmental Engineering I (3 s.h.)
Environmental Engineering II (3 s.h.)
Engineering Clinic or Elective (2-7 s.h.)
CEE Elective (3 s.h.)
Options (prereq. satisfied): Site Remediation Engineering Principles, Pollutant Fate and Transport Principles, Principles of Integrated Solid Waste Management, Introduction to Biomechanics, Introduction to Biomaterials

Approved list of electives will be reviewed on a yearly basis depending on the courses offered on campus.

B.S. Electrical Engineering

Major Requirements
Biological Systems & Applications or Bio I (4 s.h.)
Junior / Senior Clinic (4-8 credits may be applied to BioX concentration if the projects are approved by the ECE Bio Concentration coordinator.
Options (prereq. satisfied): Minimum of 8 credits from an approved list of Biological or other Science electives (may include the bio-related courses taken as science electives taken towards ECE major)
Minimum of 3 credits from an approved list of Bio-related ECE electives (such as Principles of Biomedical Systems and Devices).
Minimum of 3 credits from an approved list of Bio-related non-ECE engineering electives.
Approved list of electives will be reviewed on a yearly basis depending on the

courses offered on campus. Students should consult with the ECE Bio Concentration coordinator.

B.S. Mechanical Engineering

Mechanical Engineering Electives (9 s.h.) - 3 of the following in jr. and sr. yrs.

Introduction to Biomechanics, Introduction to Biofluids, Introduction to Biomaterials, Introduction to Crash Safety Engineering

Junior/Senior Engineering Clinic – (2 s.h.) 1 bioengineering related project in yr. or sr. yr.

Engineering Elective – (3 s.h.) 1 of the bio related engineering electives listed in this proposal in fall or spring of sr. yr.

Possible options include - Bioprocess Engineering, Principles of Bioseparation Processes, Principles of Biomedical Engineering, Principles of Engineering Exercise Physiology, Principles of Biomedical Systems and Devices, Waste Water Treatment

Science Elective (4 s.h.) 1 of the following in spring of soph. yr. or fall of jr. yr.

Most relevant options – Biological Systems and Applications, Human Anatomy and Physiology 1, Human Anatomy and Physiology 2

One additional Engineering or Science Elective - (3-4 s.h.) sr. yr.

one additional course out of the engineering elective or science elective banks

Approved list of electives will be reviewed on a yearly basis depending on the courses offered on campus. Students should consult with the ME Bio Concentration coordinator.

Administration

Faculty members from each department will advise participants whose major lies with their departments. Faculty members will meet annually to discuss curriculum issues. A semi-annual review committee will also be organized. The committee will consist of one member from each of the participatory departments, one of whom will serve as a director. The director appointment will alternate between departments. The review committee findings and recommendations will be reported to each college dean semi-annually. Annual meetings will be held with faculty, chairpersons of each department, and the deans of Engineering and Liberal Arts and Sciences to review program progress.

Results of Consultation

Evidence of consultation with each sponsoring engineering department chairperson and curriculum chairperson is provided on the consolidated signature sheet attached to the Process C form. These persons are

ChE – Chair, Robert Hesketh and Curriculum, Jim Newell

CEE – Chair, Ralph Dusseau and Curriculum, Yusef Mehta

ECE – Chair, John Schmalzel and Curriculum,

ME – Chair, John Chen and Curriculum, Hong Zhang

Letters of consultation are attached from the department chairmen of Chemistry and Biochemistry and Biological Sciences.

February 10, 2005

ROWAN UNIVERSITY

Department of Chemistry and Biochemistry

Curriculum Committee
Rowan University

Dear Colleagues:

The Chair of Chemistry (Dr. Robert Newland), our Biochemistry coordinator (Dr. Cathy Yang), and myself support the proposed concentration in Bioengineering and Sciences put forth by the College of Engineering. My colleagues and I look forward to working with you in advisory/consulting capacities to implement the concentration as proposed as well as to modify it in the future to suit the changing needs of majors in this field.

Sincerely,

Richard W. Frazee, Ph.D.
Assistant Professor of Chemistry & Biochemistry

201 Mullica Hill Road • Glassboro, New Jersey • 08028-1701 • Phone (856) 256-4505 • Fax (856) 256-4478

Kadlowec, Jennifer A.

From: Iftode, Cristina
Sent: Wednesday, February 09, 2005 3:44 PM
To: Kadlowec, Jennifer A.
Subject: FW: Letters of consult

Hi Jennifer,

Here is the letter.

Cristina

------ Forwarded Message
From: Gregory Hecht <hecht@rowan.edu>
Date: Wed, 09 Feb 2005 15:41:48 -0500
To: Cristina Iftode <iftode@rowan.edu>
Cc: Gregory Hecht <hecht@rowan.edu>
Subject: Re: Letters of consult

9 Feb 2005

MEMO TO: College of Engineering Curriculum Committee

From: Gregory Hecht, Interim Chair Biological Sciences

Re: Proposed Bioengineering Concentration

The Biological Sciences Department is pleased to support this curricular proposal. This proposal was developed in consultation with the Biological Sciences Department and one of our faculty, Dr. Cristina Iftode, is in fact one of the co-sponsors. Our Department currently enjoys numerous academic and scholarly collaborations with the College of Engineering, particularly with the Chemical Engineering and the Civil & Environmental Engineering Departments. We look forward to further such collaborations with all four of the Engineering departments if this proposal is approved.

If I or the Biological Sciences Department can be of additional assistance, please feel free to get in touch.

------ End of Forwarded Message

MEMORANDUM

To: Dr. Jennifer S. Kay, Chair, Department of Computer Science
From: Dr. Jennifer Kadlowec, Mechanical Engineering
Date: March 8, 2005
Subject: Curriculum Proposal: Concentration in Bioengineering

Upon receipt of the memorandum regarding the Concentration in Bioengineering from Dr. Jennifer Kay, Chair, Department of Computer Science, I appreciate that support of the initiative and would like to address the concerns that were raised.

- The Concentration in Bioengineering would in no way prevent the Department of Computer Science from establishing a program in Bioinformatics.

- In the coming years as engineering grows, the plan would not be to duplicate, but rather complement existing areas in hiring of new faculty. At the current time of this curriculum proposal there is no request for the hiring of new faculty. The courses that are offered by the Department of Computer Science would be worthwhile to list as possible options for students in the bioengineering concentration to take, particularly students in the Department of Electrical and Computer Engineering. As new courses are developed, we may collaborate with Computer Science.

- In developing the curriculum proposal, it did no occur to the members in the group to consult with the Department of Computer Science. As the lead on the proposal, please accept my apology. The group was focused on the integration of biology and biochemistry with engineering at the time, not on software and algorithms. As stated above, I see future collaborations with Computer Science and the Bioengineering Concentration and some existing courses already fit well.

Cc: Dr. Eric Milou, Chair, University Curriculum Committee
Dr. Jay Harper, Dean, College of Liberal Arts & Sciences
Dr. Dianne Dorland, Dean, College of Engineering
Dr. Patricia Mosto, Associate Provost
Dr. Christy Faison, Provost
Dr. Gregory Hecht, Chair, Department of Biological Sciences
Dr. Robert Newland, Chair, Department of Chemistry & Biochemistry
Computer Science Curriculum Committee

Department of Computer Science

MEMORANDUM

To: Dr. Jennifer Kadlowec

From: Dr. Jennifer S. Kay, Chair, Department of Computer Science

Date: March 7, 2005

Subject: Curriculum Proposal: Concentration in Bioengineering

The Department of Computer Science has become aware of your curriculum proposal for a Concentration in Bioengineering through the open hearing announcement. We believe this will be a great opportunity for Engineering students and support the initiative, but we would like to express some concerns.

- On page 1 of your proposal, your definition of bioengineering as an "umbrella terminology for technology and science to improve life and our surroundings" is very broad. Our department has been in discussions with the Biology and the Chemistry and Biochemistry departments about a possible program in Bioinformatics. We would like to confirm that your initiative would not preclude our ability to establish a program of this type.
- On page 2 of your proposal, you state that "new faculty will be hired in the bioengineering areas." We feel strongly that such hiring should not duplicate existing resources at the university. As you may be aware, the CS department already has faculty with expertise in the areas of bioinformatics, algorithms, databases, visualization, simulation, parallel systems, distributed systems, robotics, natural language processing, embedded systems, software systems, networking, graphics, and artificial intelligence among others. Furthermore, the Memorandum of Understanding between the CS department and the ECE program states that "ECE makes a commitment not to put significant resources into developing new capabilities in the software/algorithms area." Should you be interested, we would be happy to collaborate with you in your proposed program.

These concerns could have been addressed earlier in the process, had our Department been consulted on this proposal or invited to participate in this program.

Attachment: Memorandum of Understanding between the CS department and the ECE program

Cc: Dr. Eric Milou, Chair, University Curriculum Committee
Dr. Jay Harper, Dean, College of Liberal Arts & Sciences
Dr. Dianne Dorland, Dean, College of Engineering
Dr. Patricia Mosto, Associate Provost
Dr. Christy Faison, Provost
Dr. Gregory Hecht, Chair, Department of Biological Sciences
Dr. Robert Newland, Chair, Department of Chemistry & Biochemistry
Computer Science Curriculum Committee

201 Mullica Hill Road • Glassboro, New Jersey 08028 • T:(856)256-4806 F:(856)256-4741

Memorandum of Understanding

7 April 1999

Purpose: The purpose of this memorandum of understanding is to clarify some of the issues relating to shared curriculum interests between the Department of Computer Science (CS) and the Electrical and Computer Engineering (ECE) Program.

Background: The active collaboration between ECE and CS is of significant value; efforts to date have resulted in funded NSF proposals, course development, and laboratory development. We would like to continue to develop our interaction, building upon the strengths of our respective areas. We also recognize that both CS and ECE must operate in such a way as to meet the program needs developed by their respective faculties to achieve their curricular goals and to meet the requirements of accrediting bodies such as Computing Sciences Accreditation Board (CSAB) and the Accreditation Board for Engineering and Technology (ABET). Both CS and ECE believe that their current curricula are accreditable essentially as they now stand without significant changes in content.

1. **Areas of significant efforts.** Both CS and ECE deal broadly with computers; however, each will concentrate most of their efforts in one of two areas. CS will emphasize *software* and *algorithms* and ECE will emphasize *hardware systems*. Recognizing that hardware and software are part of a continuum, this agreement does not preclude the inclusion of an appropriate balance of hardware and software in either program. However, ECE makes a commitment not to put significant resources into developing new capabilities in the software/algorithms area, and CS makes a commitment not to put significant resources into developing new capabilities in the hardware area.
2. **Future curriculum development.**
   a. **Undergraduate programs:** Planning for possible future curriculum development related to Computer Engineering or to Software Engineering as a major, minor, or concentration should include both ECE and CS, and in all probability the result will be jointly administered.
   b. **Graduate programs:** CS will support (if proposed) an MS in ECE in the College of Engineering, and ECE will support (if proposed) an MS in CS or an MS in Software Engineering in the College of Liberal Arts and Sciences.
3. **Minor in Computer Science.** Some of the courses included in the current ECE program are requirements or elective options for a minor in CS; other courses in the ECE program are similar to required or elective courses for the CS minor. It would be a benefit for students majoring in ECE if they could obtain a minor in CS within the existing curriculum requirements of the 4-year, 128-hour degree, and this does appear to be possible. Clarifying the coursework equivalence between the CS minor and the ECE program will facilitate this process and can be done as part of the process of developing the equivalences relating to a dual major in ECE and CS.

Don C. Stone, Chair of CS

John L. Schmalzel, Chair of ECE

Pearl Bartelt, Dean, CoLAS

James H. Tracey, Dean, CoE

Concentration in Bioengineering - Chemical Engineering Program Guide
03/10/05

There are three basic components to earning a concentration in bioengineering:

A. two courses that are part of the standard curriculum
B. focused selection of chemical engineering electives and jr / sr clinic projects
C. one more bioengineering-related non-chemical engineering course

These three components will guide you towards the 18 s.h. of courses required for the bioengineering concentration. The most challenging aspect will be completing component C.
The curriculum listed below guides you through components A and B of this process. Standard courses that count towards the bioengineering concentration and courses that require a focused selection of electives are highlighted in **Bold**. Bear in mind that only one of your jr / sr clinic projects must be bioengineering-related.

CHEMICAL ENGINEERING CURRICULUM - *Class of 2007*

Sep-03

FIRST YEAR

Composition I *1501.111*	3	Calculus II *1701.131*	4
Calculus I *1701.130*	4	Comp Sci & Prog or *0704.103* or[4] Intro to Programming *0701.102*	3
Advanced College Chemistry I *1906.105*	4	Fresh. Engineering Clinic II *0901.102*	2
Fresh. Engineering Clinic I *0901.101*	2	Physics I *1902.200*	4
General Education	3	General Education	3
Total	**16**	**Total**	**16**

SECOND YEAR

Principles Chemical Processes I *0906.201*	2	Math for Engineering Anal II *1701.236*	4
Math for Engineering Anal I *1701.235*	4	Principles Chemical Processes II *0906.302*	2
Biological Systems & Appl *0401.210*	4	Fluid Mechanics I *0901.341*	2
Advanced College Chemistry II *1906.106*	4	Soph. Engineering Clinic II *0901.202*	4
Soph. Engineering Clinic I *0901.201*	4	Organic Chemistry I *1907.200*	4
Total	**18**	**Total**	**16**

THIRD YEAR

Microeconomics *2204.102*	3		
Process Fluid Transport *0906.309*	2	General Education	3
Heat Transfer Processes *0906.311*	2	Chem. Engineering Thermo. *0906.310*	3
Equilibrium Staged Operations *0906.312*	2	**Junior Engineering Clinic II [3] *0901.302***	2
Material Science *0901.281*	2	Chemical Reaction Engineering *0906.316*	4
Physical Chemistry I *1908.400*	3	Separation Processes *0906.314*	4
Junior Engineering Clinic I [3] *0901.301*	2		
Total	**16**	**Total**	**16**

FOURTH YEAR

		Process Dynamics & Control *0906.405*	3
Transport Phenomena *0906.402*	3	Unit Operations Lab II *0906.404*	2
Approved Chem. Eng. Elec. I [2] *0906.XXX*	3	**Approved Chem. Eng. Elec. II [2] *0906.XXX***	3
Senior Engineering Clinic I [3] *0901.401*	2	**Senior Engineering Clinic II [3] *0901.402***	2
Chem. Process Component Design *0906.401*	4	**Approved Chemistry Elective [1]**	3
Unit Operations Lab I *0906.403*	2	Chemical Plant Design *0906.406*	3
General Education	3		
Total	**17**	**Total**	**16**

TOTAL 131

Notes:
1. Required/Approved Courses taken to satisfy ABET category of "Advanced Chemistry "
May be exchanged with ChE Elective in Fall.
Course must come from a list of approved courses provided by the Ch.E. Chair.
2. Required/Approved courses taken to satisfy Chemical Engineering ABET categories/ AIChE electives.
Courses must be taken from a list of approved courses provided by the Ch.E. Chair.
One of these courses must have substantial advanced chemistry content.
Technical electives may be taken in either semester of Senior year.
3. Junior/Senior Clinics are a project-based experience
Projects must be approved by a ChE Projects Committee and are writing intensive (WI) courses.

Component A consists of two courses that are already required for the standard chemical engineering degree. You must take Biological Systems and Applications (0401.201) and you must take an advanced chemistry elective. Biological Systems and Applications is typically taken in the fall of your sophomore year. The advanced chemistry elective is typically taken in the spring of your senior year, although sometimes this can be taken in the fall of your senior year. The advanced chemistry elective need not have a bioengineering component, but selecting a course that does include a bioengineering component is encouraged.

Component B consists of a focused selection of chemical engineering electives and jr / sr clinic projects. One semester of jr / sr clinic must be spent on a bioengineering related project. This project can be from any engineering discipline, as long as it has a substantial bioengineering component. Your selection of senior year electives must also be focused on bioengineering electives within the chemical engineering department. Your schedule has space for one chemical engineering elective in the fall of your senior year and one in the spring of your senior year. To earn a concentration in bioengineering, these electives must be from the approved list of bioengineering electives within chemical engineering.

Component C consists of one bioengineering-related course outside of chemical engineering. This course must be from the list of approved electives in biology, chemistry, and other engineering disciplines, and you must determine how this will fit into your schedule. The most likely mechanism is for you to complete your general education requirements early, and then fill this open space in your schedule with an approved elective. Currently, general education blocks appear in the curriculum during both semesters of the freshman year, spring of the junior year, and fall of the senior year.

Concentration in Bioengineering – Civil & Environmental Engineering
Program Guide
04/26/05

There are three basic components to earning a concentration in bioengineering:

A. two courses that are part of the standard curriculum
B. focused selection of civil/environmental engineering electives and jr / sr clinic projects
C. one more bioengineering-related non-civil/environmental engineering course

These three components will guide you towards the 18 s.h. of courses required for the bioengineering concentration. The most challenging aspect will be completing component C.
The curriculum listed below guides you through components A and B of this process. Standard courses that count towards the bioengineering concentration and courses that require a focused selection of electives are highlighted in **Bold**. Bear in mind that only one or two of your jr / sr clinic projects must be bioengineering-related.

Current Curriculum - Civil & Environmental Engineering

First Year

Fall Courses	**Credit Hours**	**Spring Courses**	**Credit Hours**
Composition I	3	Computer Science & Programming	4
Freshman Engineering Clinic I	2	Freshman Engineering Clinic II	2
Calculus I	4	Calculus II	4
General Education Course	3	General Education Course	3
Advanced College Chemistry I	4	Physics I	4
Total Hours	**16**	**Total Hours**	**17**

Second Year

Fall Courses	**Credit Hours**	**Spring Courses**	**Credit Hours**
Sophomore Engineering Clinic I	4	Sophomore Engineering Clinic II	4
Math for Eng. Analysis I	4	Math for Eng. Analysis II	4
Advanced College Chemistry II	4	Surveying and Engineering Graphics	3
Statics	2	Statistics I	3
Dynamics	2	Solid Mechanics	2
Total Hours	**16**	**Total Hours**	**16**

Third Year

Fall Courses	**Credit Hours**	**Spring Courses**	**Credit Hours**
Junior Engineering Clinic I	2	**Junior Engineering Clinic II**	2
Structural Analysis and Design	3	Analysis and Design of Steel Frames	3
Environmental Engineering I	3	**Environmental Engineering II**	3
Fluid Mechanics I	2	Water Resources Engineering	4
Material Science	2	Transportation Engineering	3
Civil Engineering Materials	2	Geotechnical Engineering	
Civil Engineering Systems	3		
Total Hours	**16**	**Total Hours**	**17**

Fourth Year

Fall Courses	**Credit Hours**	**Spring Courses**	**Credit Hours**
Senior Engineering Clinic I	2	**Senior Engineering Clinic II**	2
Civil Engineering Design Project I	2	Civil Engineering Design Project II	2
Civil Engineering Practice	1	**CEE Elective**	3
Microeconomics	3	**CEE Elective**	3
CEE Elective	3	**Technical Elective**	3

CEE Elective		3	General Education Course		3
General Education Course		3			
	Total Hours	**17**		**Total Hours**	**16**

Total Hours: 131

Component A consists of two courses that are already required for the standard civil and environmental engineering degree. You must take Environmental Engineering I and II (0908.311 and 0908.312).

Component B consists of a focused selection of civil and environmental engineering electives and jr / sr clinic projects. Two of your CEE Electives must be focused on bioengineering electives within the civil and environmental engineering department. Please note that two of your CEE Electives must also fulfill your requirement of taking a second course in at least two of the following, geotechnical, transportation, or water resources. As there are four CEE electives, this should be easy to accomplish. If your component C course (see below) is 4 semester credit hours, one semester of jr / sr clinic must be spent on a bioengineering related project. Otherwise, an additional semester of jr / sr clinic must be taken that is at least half-bioengineering related. The jr / sr clinic(s) can be from any engineering discipline.

Component C consists of one bioengineering-related course outside of civil and environmental engineering. This course must be from the list of approved electives in biology, chemistry, and other engineering disciplines, and you must determine how this will fit into your schedule. This course can also be counted at the senior technical elective, or may be an additional course. Prerequisites may make it difficult to take some of the courses listed in this document.

Concentration in Bioengineering – Electrical & Computer Engineering
Program Guide

The ECE department's BME concentration is designed to be as flexible as possible, while ensuring a meaningful depth and breath in bioengineering.

1. All ECE students are required to take two core science classes (from an approved list of science classes) outside of Engineering. The list currently includes the following courses. Therefore, students who wish to concentrate on BME are advised to take one of these courses towards their regular science requirements.

Biological Systems and Applications
Biology I

2. Students need minimum of 8 credits from an approved list of Biological Science Electives. Approved list of electives will be reviewed on a yearly basis depending on the courses offered on campus. In general, these courses are from the Anatomy / Physiology bank or from the Cellular, Molecular Biology bank of the Biology program, or from the Chemistry / Biochemistry program. The students are responsible for either obtaining the prerequisites, or making the necessary arrangements with the professor. The courses listed in (1) do count towards this requirement. In general, students need to satisfy this requirement during their sophomore or junior year.

3. No fewer then 4, no more then 8 credits of Junior / Senior clinic must come from BME related projects. Note that each Ju/Se clinic in ECE is 2 credits. Therefore, 2 ~ 4 semesters of clinic experience must come from BME related projects. Every semester, there are a number of projects that are BME related. Those projects that qualify for this category will be announced every semester.

4. Minimum of 3 credits (one course) from an approved list of Bio-related ECE electives. The list currently includes Principles of Biomedical Systems and Devices (0909.404) and Introduction to Biosensors (0909.476). Additional courses will be added to this bank. Note that every semester the ECE department offers electives under the title "Special Topics in ECE" (0909.403.xx). Some of these classes are BME related and will count towards this requirement. Special Topics courses that qualify for BME concentration will be announced every semester. This course will be taken during the senior year.

5. Minimum of 3 credits from an approved list of Bio-related non-ECE engineering electives. Any course that is on the approved list of other engineering departments' BME bank will count towards this requirement. This course will also be taken during the senior year.

Students are encouraged to discuss their intentions on Bioengineering specialization as early as possible with the BME advisor in the ECE department. Currently, Dr. Robi Polikar is the ECE department's BME advisor. He will be able to advise and guide students on which courses and in what sequence to take for a meaningful and rewarding BME experience.

Concentration in Bioengineering - Mechanical Engineering Program Guide
03/10/05

There are two basic components to earning a concentration in bioengineering for mechanical engineering:

A. a focused selection of mechanical engineering, non-mechanical engineering and science electives and jr / sr clinic projects that are part of the standard curriculum
B. one more bioengineering-related non-mechanical engineering course

This document will guide you towards the minimum of 20 s.h. of courses required for the bioengineering concentration. The most challenging aspect will be completing component B.
The curriculum listed below guides you through component A of this process. A focused selection of electives (both within Mechanical Engineering, as well as outside of ME) that are part of the standard courses and also count towards the bioengineering concentration are highlighted in **Bold**. Bear in mind that only one of your jr / sr clinic projects must be bioengineering-related. Courses that are typically taken elsewhere in the curriculum are in *Italic*.

First Year

Course	c.h.	Course	c.h.
Composition I (1501.111)	3	Computer Sci. & Prog. (0704.103)	4
Freshman Engineering Clinic I (0901.101)	2	Freshman Engineering Clinic II (0901.102)	2
Calculus I (1701.130)	4	Calculus II (1701.131)	4
General Education	3	General Education	3
Adv. College Chemistry I (1906.105)	4	Physics I (1902.200)	4
Total Hours:	16	Total Hours:	17

Second Year

Course	c.h.	Course	c.h.
Sophomore Engineering Clinic I (0901.201)	4	Sophomore Engineering Clinic II (0901.202)	4
Math for Eng. Analysis I (1701.235)	4	Math for Eng. Analysis II (1701.236)	4
Physics II (1902.201)	4	Material Science (0901.281)	2
Statics (0901.271)	2	Manufacturing Processes (0901.282)	2
Solid Mechanics (0901.272)	2	Dynamics (0901.291)	2
		Machine Design (0910.241)	2
Total Hours	16	Total Hours	16

Third Year

Course	c.h.	Course	c.h.
Junior Engineering Clinic I (0901.301)	**2**	**Junior Engineering Clinic II (0901.302)**	**2**
Bioengineering Elective (ME)	**3**	**Bioengineering Elective (ME)**	**3**
Engineering Thermodynamics I (0910.311)	2	Fluid Mechanics I (0901.341)	2
Engineering Thermodynamics II (0910.312)	2	Fluid Mechanics II (0910.313)	2
Mechanical Design & Synthesis (0910.341)	4	Vibrations (0910.201)	2

Networks I (0909.201)	2	Transfer Processes I-Heat (0906.311)	2
		Electronics I (0909.311)	2
Total Hours	15	Total Hours	15

Fourth Year

Course	c.h.	Course	c.h.
Senior Engineering Clinic I (0901.401)	**2**	**Senior Engineering Clinic II (0901.402)**	**2**
Mechanical System Dynamics & Control (0910.343)	3	Microscale Systems (0910.403)	2
Approved Biological Science Elective	**3-4**	**Bioengineering Elective (non-ME)**	**3**
Bioengineering Elective (ME)	**3**	General Education Course	3
Approved Major Elective 1	3	General Education Course	3
Microeconomics (2204.102)	*3*	*Quality and Reliab. in Des. & Mfg. (0910.342)*	*3*
Total Hours	17	Total Hours	16

Component A consists of a focused selection of three mechanical engineering electives, one non-mechanical engineering elective, one science elective and one jr / sr clinic project that are required for the standard mechanical engineering degree. One semester of jr / sr clinic must be spent on a bioengineering related project. This project can be from any engineering discipline, as long as it has a substantial bioengineering component. Your selection of junior and senior year electives must also be focused on bioengineering electives. Three of the four mechanical engineering electives must be from the approved list of bioengineering electives within mechanical engineering. Of the four mechanical engineering electives (three of which are bioengineering related) you must ensure that you meet the mechanical engineering degree requirement that two fulfill the thermal-fluid sciences stem and two fulfill the mechanical systems stem. For the concentration, the technical elective in the standard curriculum is a non-ME engineering course that must be replaced with one of the non-ME bioengineering electives below. Also for the concentration, you must take an approved biological science elective in place of the standard math/science elective.

Component B consists of one additional bioengineering-related course outside of mechanical engineering. This course must be from the list of approved electives in biology, chemistry, and other engineering disciplines, and you must determine how this will fit into your schedule. The most likely mechanism is for you to complete your general education requirements early, and then fill this open space in your schedule with an approved elective. Currently, general education blocks appear in the curriculum during both semesters of the freshman year, spring of the junior year, and fall of the senior year.

Chemical Engineering

Bioprocess Engineering (3 s.h.) 0906.462
prerequisites = Chemistry I (Lecture and Lab) = 1906.100 or Advanced College Chemistry I = 1906.105, Calculus II = 1701.130

Principles of Biomedical Engineering (3 s.h.) 0906.472
prerequisites = 1906.100 or 1906.105, 1701.131

Principles of Bioseparation Processes (3 s.h.) 0906.476
prerequisite = Separation Processes = 0906.314

Principles of Food Engineering (3 s.h.) 0906.482
prerequisites = 1906.100 or 1906.105, 1701.131

Principles of Engineering Exercise Physiology (4 s.h.) 0906.483
prerequisites = 1906.100 or 1906.105, Math for Engineering Analysis = 1701.236

Fundamentals of Controlled Release (3 s.h.) 0906.484
Prerequisites: 1906.100 or 1906.105, 701.131.

Membrane Processes (3 s.h.) 0906.486
Prerequisites: 1906.100 or 1906.105, 1701.131.

Civil Engineering

Environmental Engineering I (0908.311) 3 s.h.
Prerequisites: 1907.300, must be taken with Corequisite 0901.341

Environmental Engineering II (0908.312) 3 s.h.
Prerequisites: 0908.311 or permission of instructor

Site Remediation Engineering Principles (0908.422) 3 s.h.
Prerequisites: Senior standing or permission of instructor

Pollutant Fate and Transport Principles (0908.432) 3 s.h.
Prerequisites: Senior standing or permission of instructor

Principles of Integrated Solid Waste Management (0908.433) 3 s.h.
Prerequisites: Senior standing or permission of instructor

Electrical Engineering

Principles of Biomedical Systems and Devices (0909.404) 3 s.h.
Prerequisite: 0909.311, 0909.321

Mechanical Engineering

Introduction to Biomechanics (0910.470) 3 s.h.
Prerequisite: Dynamics (0901.291)

Introduction to Biofluids (0910.471) 3 s.h.
Prerequisite: Fluid Mechanics I (0901.341).

Introduction to Biomaterials (0910.472) 3 s.h.
Prerequisite: Materials Science (0901.281).

Introduction to Crash Safety Engineering (0910.475) 3 s.h.
Prerequisite: 0901.291

Biological Sciences

Biological Systems & Applications (0401.210)
Pre-requisites: Advanced Chemistry I

Work Physiology (0410.350)
Prerequisites: Bio I (0401.100) and Bio II (0401.101)

Environmental Toxicology (0420.425)
Prerequisites: 0401.100, 0410.101, 1906.100, 1906.101, 1907.200, 0420.310, Junior or Senior class standing; or permission from the instructor

Microbiology (0411.330)
Pre-requisites: Bio I & II

Cell Biology (0401.430)
Pre-requisites: BioI and BioII

Developmental Biology- it will be offered beginning Fall 2006
Pre-requisites: Biology 1 (0401.100), Biology II (0401.101), and any one of the following Genetics (0422.335), Introduction to Biochemistry (0414.348), Introduction to Biochemistry-Lecture only (0414.440), Embryology of Animals (0427.401), Cell Biology (0401.430) or permission of instructor

Concepts in Human Genetics: (undergraduate-0422.410 and graduate-0422.598)
Prerequisites: Genetics (0422.335) is required or permission from the instructor.

Human Anatomy and Physiology I (0410.210)
Pre-requisites: Bio I and Bio II

Human Anatomy and Physiology II (0410.212)
Pre-requisites: Bio I and Bio II

Chemistry

Biochemistry (1907.348) 4 s.h.
Prerequisite: Organic Chemistry II – 1907.201.

Advanced Biochemistry (1907.408) 4 s.h.
Prerequisite: Biochemistry.

Biophysical Chemistry (1908.305) 4 s.h.
Prerequisites: Organic Chemistry II – 1907.201; Calculus II – 1701.131; Physics II (for scientists and engineers) – 1902.201; Quantitative Analysis – 1909.250; and Biology II – 0401.101.

Medicinal Chemistry (1907.410) 3 s.h.
Prerequisite: 1907.201

UCC #04-05-904

Rowan University
Campbell Library

Library Resources Form

Department/School: College of Engineering/ Bioengineering

Proposed by: Dr. Jennifer Kadlowec

Program Title: Concentration in Bioengineering

Anticipated Date for Course/Program Offering: Spring 2006

Resources that should be acquired

The library will acquire the Proceedings of the National Academy of Sciences, as recommended by the sponsor of this proposal.

Resources available in Campbell Library

The library has core holdings in the L.C. subject areas of bioengineering, human engineering, and human-computer interaction. An engineering approval plan is utilized to provide current materials in the engineering disciplines.

List key periodical resources

Campbell Library is fortunate to have access to online journal databases in a large number of academic subjects, including mathematics and the physical sciences.

Of particular significance is Engineering Village and Elsevier Science Direct , which provide journal articles, many full-text, on science and engineering. Also, MathSci provides comprehensive coverage of international research in mathematics and mathematically related research in statistics, computer science, physics, operations research, engineering, biology, and related disciplines. Almost 2,000 journals are represented. Applied Science and Technology, General Science Full-Text, and the specialized databases in physics and chemistry also are available.

Librarian remarks

Given the library's current book holdings and online journal access, this proposal can be supported.

Gregory C. Potter
Library Liaison

March 16, 2005

FORM B

ROWAN UNIVERSITY
BOARD OF TRUSTEES
ACADEMIC AFFAIRS SUBCOMMITTEE

SCC Proposal # **04-05-904**

Department/College: **College of Engineering**

Action Item: **Concentration in Bioengineering**

Submitted by: **Dr. Christy Faison, Interim Provost**

Justification: **With increasing demand for health industry professionals in clinical, industrial and government settings, there is a need for well trained engineers who can design and develop ways of improving quality of life.**

Approved: 1/24/06
(Date)

Signed: Donald A. Jones
(Committee Chair)

Notice of this action item will be **announced** at the full Board of Trustees meeting to be held on February 15, 2006 and will be forwarded to the Academic Issues Committee of the New Jersey Presidents' Council for **notification.**

	YES	DATE
AA/BOT	___	_____
FULL BOARD	___	_____
STATE	___	_____

Rowan University

January 24, 2006

Dr. Carlos Hernandez
Academic Issues Committee Chair
President, New Jersey City University
2039 Kennedy Blvd.
Jersey City, NJ 07305-1597

RE: New Entrepreneurship Specialization for the Masters in Business Administration Major
Graduate Endorsement Program for Teachers of Students with Disabilities
Concentration in Bioengineering

Dear Dr. Hernandez,

On January 24, 2006 the Rowan University Board of Trustees' Academic Affairs Subcommittee approved the following proposals:

New Entrepreneurship Specialization for the Masters in Business Administration Major (SCC#05-06-119)
Justification: To be competitive with regional programs and to respond to the request of prospective and current students we are proposing a MBA specialization in Entrepreneurship

Graduate Endorsement Program for Teachers of Students with Disabilities (SCC#05-06-303)
Justification: The Graduate Endorsement Program for Teachers of Students with Disabilities has been approved to meet the new regulations adopted by the State of New Jersey.

Concentration in Bioengineering (SCC#04-05-904)
Justification: With increasing demand for health industry professionals in clinical, industrial and government settings, there is a need for well trained engineers who can design and develop ways of improving quality of life.

The approval of these proposals will be announced at the full Board of Trustees meeting on February 15, 2006. This is being provided to the Academic Issues Committee as an informational item. If you have any questions, please do not hesitate to contact me.

Sincerely,

Christy L. Faison,
Interim Provost

rw
Encl: 20 copies

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