Agenda Item #14-52
Effective: Summer 2016

Proposed Master's in Biochemistry and Biotechnology
Program Effective Summer 2016

Program Mission: The Master's degree in Biochemistry and Biotechnology is an advanced interdisciplinary program for students interested in pursuing a career in Biochemistry and Biotechnology. Students will gain the skill sets to improve products and services through molecular-biological and analytical techniques while also being trained in the fundamental business strategies to succeed in the fast-paced field of biotechnology and medical services. Graduates from this program will be well prepared to take positions in biotechnology and pharmaceutical industries or pursue advanced degrees especially in the medical sciences. The program size and design facilitates the personal development of students using the combined expertise of faculty from the departments of Biological Sciences and Chemistry. Highly specialized techniques-based courses will train students on the most modern approaches to scientific problem solving while giving them the academic foundations they will need to succeed in the national and global markets.

Admission Requirements: To be eligible for degree candidacy, applicants must meet all the requirements for admission to the Graduate School (see "Admission to Graduate Degree and Certificate Programs"). In addition, each applicant must have completed a bachelor's degree in Biotechnology, Biology, Chemistry, or related field (contact the program coordinator for more information).

Study Plan Approval: A study plan must be approved by the student's advisor and filed with the program coordinator prior to the completion of 12 semester hours of graduate credit.

Degree Requirements: Degree requirements include those outlined for the master's degree by the Graduate School (see "Requirements for the Master's Degree"). All candidates must complete a minimum of 34 semester hours. Additional requirements are outlined below.

Core Courses (19 sh): Students will take core courses in the biochemical sciences as well as an introductory techniques course.

1. BCT 5000 – Techniques in Biochemistry and Biotechnology (0-9-3)
2. BIO 5400 – Cell Physiology - (3-3-4)
3. CHM 4860 – Advanced Biochemistry - (3-0-3)
4. MBA 5680 – Organizational Behavior and Group Dynamics (3-0-3)
5. MBA 5010 – Accounting from a Management Perspective (3-0-3)
6. CHM 5180 – Bioanalytical Problem Solving - (2-3-3) or BIO 5381 – Advanced Biostatistics - (3-0-3) or BIO 5385: Experimental Design for Laboratory and Field (2-2-3)

Electives (9 sh): Students will chose from an elective set that gives them the theoretical background needed in biochemical sciences with an applied laboratory experience.

1. BIO 4751 – Advanced Molecular and Cell Biology - (3-0-3)
2. BIO 4818 - Environmental Microbiology - (2-4-4)
3. BIO 4834 – Neurobiology - (3-0-3)
4. BIO 5204 – Ecotoxicology and Biological Monitoring of Pollution - (1-4-3)
5. BIO 5250 - Biological Microtechniques - (3-3-4)
6. BIO 5333 – Bioenergy and Bioresources - (2-2-3)
7. BIO 5340 – Population Genetics - (3-2-3)
8. CHM 4750 – Environmental Chemistry - (3-0-3)
9. CHM 4790 – Medicinal Chemistry - (3-0-3)

Internship/Practicum (6 sh): Students will participate in a total of 6 semester hours of internship/practicum experience. Ideally, this can be achieved through a 6 semester hour external internship equaling 270 hours of hands-on experience in the biochemical and/or biotechnology fields (BCT 5980 – see below). Alternatively, this can be achieved through a combination of external internship (BCT 5980 - 3 sh- 135 hours) and internal (at EIU) practicum experience (BCT 5001 – 3 sh – 135 hours; see below). If necessary, the entire internship/practicum experience could be achieved through 6 semester hours of BCT5001.

1. BCT 5001 – Practicum in Biochemistry and Biotechnology. (0-9-3), may be repeat once to fulfill the 6 SH.
2. BCT 5980 – Internship in Biochemistry and Biotechnology: (Arr.-Arr.-3 or 6)

Rationale: There is a growing need for students to gain advanced training in the theory and applications of biochemistry and biotechnology that are usually not acquired at the undergraduate level. With the rapid advancements in the medical sciences and in biochemistry and biotechnology, there is a growing need to train students in these advanced topics. Moreover, a knowledge base that brings together science, business, and technology will give students the educational components to be leaders in their fields. According to the Bureau of Labor Statistics, employment of biochemists and biophysicists (as a group) will grow 19% from 2012 to 2022 (http://www.bls.gov/ooh/life-physical-and-social-science/biochemists-and-biophysicists.htm). Medical scientists demand is projected to grow 13 percent in that same time period (http://www.bls.gov/ooh/life-physical-and-social-science/medical-scientists.htm). New discoveries of and uses for pharmaceuticals and an aging population demanding new technologies will be driving forces for hiring of individuals well-

trained in the theory and practical lab techniques employed in biochemistry and biotechnology.

Learning Goals: The learning goals for the Master's in Biochemistry and Biotechnology are that students will (1) demonstrate an understanding of fundamental principles and applications of laboratory techniques and instrumentation, (2) be able to critically analyze a breadth of biochemical and biotech problems and experimental results, (3) be familiar with computer applications in biochemistry and biotechnology, (4) be able to properly utilize chemical information sources, (5) be able to apply the scientific method of investigation, and (6) be able to communicate technical material effectively in speaking & writing.

Resources Required: Because the degree will use current course offerings, minimal additional resources are required.

The additional resources will be:

1) Two faculty (one from CHM and one from BIO) to teach in the six-week summer session for BCT 5000.

2) Faculty to mentor students who choose to take BCT 5001. Faculty will be compensated at a rate of 0.4 CU/student/semester to a maximum of 2.0 CU per semester.

Example Schedules

First cohort - assuming Summer 2015 start-date
Assuming full internships available

Example Schedule #1		***Example Schedule #2***	
Summer 2015		**Summer 2015**	
BCT 5000 Techniques in Biochem/Biotech	3	BCT 5000 Techniques in Biochem/Biotech	3
Fall 2015		**Fall 2015**	
CHM 4860 Advanced Biochemistry	3	BIO 5381 Advanced Biostatistics	3
BIO 5400 Cell Physiology	4	MBA 5680 Organizational Behavior	3
Elective	3-4	Elective	3-4
Spring 2016		**Spring 2016**	
CHM 5180 Bioanalytical Problem Solving	3	MBA 5010 Accounting/Managerial	3
Elective	3-4	Elective	3-4
Elective	3-4	Elective	3-4
Summer 2016		**Summer 2016**	
MBA 5680 Organizational Behavior	3	BCT 5980 Internship in Biochem/Biotech	6
MBA 5010 Accounting/Managerial	3		
Fall 2016		**Fall 2016**	
BCT 5980 Internship in Biochem/Biotech	6	CHM 4860 Advanced Biochemistry	3
		Bio 5400 Cell Physiology	4
	34(min)		34(min)
Red = core			
Blue = core (choice of courses)			
Black = elective			

Courses for the Masters in Biochemistry and Biotechnology Degree

10-8-14 update

Note: **Bolded** text indicate those courses that are new course proposals

BCT 5000 – **Techniques in Biochemistry and Biotechnology** (0-9-3) This course will give students advanced training in laboratory techniques used in biotechnology from both a biological and chemical perspective.

BCT 5001 – **Practicum in Biochemistry and Biotechnology.** (0-9-3) This course is designed to give students an intensive practicum experience in a particular advanced technique in biochemistry and/or biotechnology. The students will be assigned appropriate projects by matching student interests with available faculty expertise.

BCT 5980 – **Internship in Biochemistry and Biotechnology** - (Arr.-Arr.-3 or 6) (Credit/No Credit) Internship experience in an external laboratory setting approved by the Program Coordinator. To be taken credit/no credit for a maximum of six semester hours applicable to the degree.

BIO 4751 – Advanced Molecular and Cell Biology - (3-0-3) A study of the molecular basis of intracellular processes including: gene regulation and expression; molecular biosynthesis and transport; cell motility and adhesion; cell cycle regulation; and intracellular signaling, using case studies from current scientific literature.

BIO 4818 - Environmental Microbiology- (2-4-4) An introduction to the principles, applications, and methodologies of environmental microbiology with emphasis on microbial interactions with animals and plants, on the microbiology of air, water, sewage, and soils, and on the role of microorganisms in biogeochemical cycling. The use of microorganisms in the bioremediation of environmental pollutants and in the recovery and enhancement of environmental resources will also be considered.

BIO 4834 – Neurobiology- (3-0-3) A study of the structure and function of neurons, the principal cells of the nervous system, at the molecular and cellular level. This course will emphasize neurobiological aspects of learning, memory, and behavior.

BIO 5204 – Ecotoxicology and Biological Monitoring of Pollution - (1-4-3) Characterization of pollutants and their qualitative and quantitative effects on biota. Includes laboratory investigation of biological and ecotoxicological effects of pollution.

BIO 5250 - Biological Microtechnique- (3-3-4) Techniques in preparing biological specimens for sectioning, staining, and visualization with a microscope. Light and scanning electron microscopy will be utilized.

BIO 5333 – Bioenergy and Bioresources - (2-2-3) This course explores the components and properties of algae and plants that make them useful for bioenergy applications. Sustainable production of crops and species is discussed, along with the environmental impact of their growth, harvest and utilization.

Bio 5340 - Population Genetics- (3-2-3) Theoretical principles of population genetics and application of experimental methodology using quantitative and analytical methods. Laboratory topics: nucleic acid analyses, enzyme electrophoresis, polytene chromosome examinations, and statistical analyses.

BIO 5381 – Advanced Biostatistics - (3-0-3) Survey of methods of analysis of univariate and multivariate data from biological systems. Techniques will include: survival analysis, ANOVA, MANOVA, ordination methods and regression analysis. Focus will be on the practical application of techniques.

BIO 5385: Experimental Design for Laboratory and Field - (2-2-3) This course will explore the design, implementation and analysis of scientific experiments in

biology from a statistical perspective for field and laboratory based studies. The course will focus on the use of modern statistical approaches that include mixed- model, permutational and multi-model procedures within the context of readily available statistical software packages

BIO 5400 - Cell Physiology - (3-3-4) A study of the fundamental physical and chemical processes which underlie cellular structure and function.

CHM 4750 – Environmental Chemistry -(3-0-3) The chemistry of environmental processes and chemical contaminants in the hydrosphere, atmosphere, and biosphere; the impact of energy generation on the global environment; the toxicology of specific chemical compounds.

CHM 4790 – Medicinal Chemistry - (3-0-3) Basic principles of pharmacology, drug-receptor interaction, physiochemical properties as related to biological activity; synthesis of medicinally important molecules including strategic considerations.

CHM 4860 – Advanced Biochemistry - (3-0-3) F. Topics may include protein structure and function, enzyme mechanisms, transcription, DNA replication, regulation of DNA expression, and cellular signaling pathways.

CHM 5180 – Bioanalytical Problem Solving - (2-3-3) Theoretical bases and practical applications of experimental design and bioanalytical chemistry. Laboratory experiences utilize a team approach to address modern bioanalytical practices and real-world problems.

MBA 5010 – Accounting from a Management Perspective (3-0-3) Effective uses of accounting information in managerial decision-making. Applications include tasks both internal (managerial) and external (financial) to the organization.

MBA 5680 – Organizational Behavior and Group Dynamics (3-0-3) Organizational and business application of theory and research in individual differences, interpersonal relations, and small group dynamics.

Course rotation schedule

The below chart is to be used for general planning purposes. Note that courses offered in a given semester are subject to change based on instructor availability.

Course#	Course Title	CRED	SU15	FA15	SP16	SU16	FA16	SP17	SU17	FA17	SP18	SU18	FA18	SP19
Core coures														
BCT 5000	Techniques in Biotechnolog	3	X			X			X			X		
BIO 5400	Cell Physiology	4		X			X			X			X	
CHM 4860	Advanced Biochemistry	3		X			X			X			X	
MBA 5010	Accounting/Managerial	3	X	X	X	X	X	X	X	X	X	X	X	X
MBA 5680	Organization Behavior	3	X	X	X	X	X	X	X	X	X	X	X	X
CHM 5180	Bioanalytical Chem	3			X						X			
or BIO 5381	Advanced Biostatistics	3			X			X			X			X
or BIO 5385	Experimental Design	3		X			X			X			X	
Electives														
CHM 4750	Environmental Chemistry	3						X						X
BIO 4751	Adv. Molec/Cell Biol.	3					X						X	
CHM 4790	Medicinal Chemistry	3			X						X			
BIO 4818	Environ Microbiol.	4			X						X			
BIO 4834	Neurobiology	3		X			X			X			X	
BIO 5204	Ecotoxicology	3						X						X
BIO 5250	Biol. Microtechniques	4					X						X	
BIO 5333	Bioenergy and Bioresource	3		X			X			X			X	
BIO 5340	Pop Genetics	3						X						X
Internship														
BCT 5001	Practicum in Biotechnology	3	X	X	X	X	X	X	X	X	X	X	X	X
BCT 5980	Intership in Biotechnology	3 or 6	X	X	X	X	X	X	X	X	X	X	X	X

Date approved by the Department of Biological Sciences: May 9, 2014

Date approved by the Department of Chemistry: November 22, 2014

Date approved by the college curriculum committee: December 12, 2014

Date approved by the Honors Council *(if this is an honors course):*

Date approved by CAA: **CGS:**