To be adopted:

**Proposed Changes in Course Requirements for the Bachelor of Science and Bachelor of Arts Degrees in Biochemistry**

### MAJOR

The course work required for the Biochemistry degree is rigorous and comprehensive, and gives students a solid grounding on which to base their career goals. There are two emphasis areas within the Biochemistry major: Chemistry and Biology. The choice of emphasis depends on the career plans of the student, and determines from which course groupings upper-division electives are selected to complete the major requirements. The Biology emphasis is geared toward students interested in the health professions, while the Chemistry emphasis is generally chosen by students interested in pharmacy, forensics, or biophysical sciences. The program focuses on the development of laboratory and critical thinking skills, and hands-on laboratory experience. In addition, participation in an independent research project (BCH 197) or research tutorial (BCH 190), carried out under the supervision of a faculty member, is possible. Internships in industry (BCH 198-I) are also available, and often lead to valuable job experience and employment opportunities.

### Major Requirements

1. Lower-division requirements (51 units)
   - a) BIOL 005A, BIOL 05LA, BIOL 005B, BIOL 005C
   - b) PHYS 002A, PHYS 002B, PHYS 002C, PHYS 02LA, PHYS 02LB, PHYS 02LC
   - c) CHEM 001A, CHEM 001B, CHEM 001C
   - d) MATH 009A, MATH 009B, MATH 009C

2. Upper-division requirements (46-49 units)
   - d) Two courses from BCH 120, BMSC 120, BCH 153/BIOL 153/BPSC 153, BCH 162, BCH 183, BCH 185/BPSC 185, BCH 210, BCH 211, BCH 212, BCH 241/ CHEM 241

### Biology Emphasis

- a) Upper-division requirements (9-15 units). Choose three biological science courses from the following:

### PROPOSED

The course work required for the Biochemistry degree is rigorous and comprehensive, and gives students a solid grounding on which to base their career goals. There are three emphasis areas within the Biochemistry major: Chemistry, Biology, and Medical Sciences. The choice of emphasis depends on the career plans of the student, and determines from which course groupings upper-division electives are selected to complete the major requirements. The Biology and Chemistry emphases are geared for students interested in post-graduate education or employment in the basic areas of the discipline of Biochemistry. The goal of the Medical Sciences emphasis of the Biochemistry Major is to prepare students for admission to post-baccalaureate education in the health professions. The Biology, Chemistry, and Medical Sciences emphases focus on the development of laboratory and critical thinking skills, and hands-on laboratory experience. In addition, participation in an independent research project (BCH 197) or research tutorial (BCH 190), carried out under the supervision of a faculty member, is encouraged. Internships in industry (BCH 198-I) are also available, and often lead to valuable job experience and employment opportunities.

### Major Requirements

1. Lower-division requirements (47-51 units)
   - a) BIOL 005A, BIOL 05LA, BIOL 005B, BIOL 005C
   - b) PHYS 002A, PHYS 002B, PHYS 002C, PHYS 02LA, PHYS 02LB, PHYS 02LC
   - c) CHEM 001A, CHEM 001B, CHEM 001C
   - d) MATH 009A, MATH 009B, MATH 009C

2. Upper-division requirements (46-49 units)
   - d) For the Biology and Chemistry emphases, Two courses from BCH 120, BCH 153/BIOL 153/BPSC 153, BCH 162, BCH 183, BCH 185/BPSC 185, BCH 210, BCH 211, BCH 212, BCH 241/ CHEM 241
   - e) For the Medical Science emphasis: BCH 120.

### Biology Emphasis

- a) Upper-division requirements (9-15 units). Choose three biological science courses from the following:
Medical Sciences Emphasis

a) Lower-division requirements (2 units):
   BCH 096, BCH 098I

b) Upper-division requirements (4 units):
   CBNS 101

c) Highly recommended (15 units):
   BIOL 161A, BIOL 161B, BIOL 171

Justification for Proposed Changes:

MAJOR

Editorial changes and new wording includes the proposed Medical Sciences Emphasis.

MAJOR REQUIREMENTS

1. d) Editorial change to indicate MATH 009C required only of the Biology and Chemistry emphases.

2. d) Editorial change to specify upper-division requirements refer to the Biology and Chemistry emphasis.

3. e) Editorial change to specify upper-division requirements refer to the Medical Sciences emphasis.

BIOLOGY EMPHASIS

a) Editorial change to be consistent with changes made by Biomedical Sciences Department with respect to the deletion of BMSC 120 for their majors. Formerly cross-listed with BCH 120.

PROPOSED MEDICAL SCIENCES EMPHASIS

Introduction:

The objective of the new emphasis is provide students with the opportunity to achieve a sound major in biochemistry which also prepares them for the admissions examinations required as part of a post baccalaureate degree program in one of the health professions. The major reason for creation of this new emphasis is that, historically, a large number of our Biochemistry majors have one of the several health professions as their career objective (e.g. medical, dental, pharmacy or veterinary school). The Medical Sciences emphasis represents a re-focusing of the existing emphases of the major in Biochemistry to help our students achieve this goal.

The Medical Sciences Emphasis was formulated by a committee of 5 faculty in the Biochemistry department who met at regular intervals over the past summer. As part of our evaluative process, the Committee met with Dean Craig Byus of the Division of Biomedical Sciences and with Ms. Carol Moffett, the CNAS Career Health Professions Advisor both at the beginning of its deliberations and again at the end when this proposed program had been articulated. In addition, the Committee met with a group of five students who are currently in various stages of the process of applying to medical school. The proposed new emphasis and two necessary new courses were approved by the Biochemistry faculty on October 8, 2003.

Justification:

Historically, a large number of Biochemistry majors in the present Biology or Chemistry emphases have had as their career objective application to a post baccalaureate degree program in one of the health professions. Given the highly
The competitive nature of the many applications for admission to medical, dental, veterinary or pharmacy schools, the Biochemistry faculty postulated that a new emphasis that focused on medical sciences, rather than the more general ‘biology’ or ‘chemistry’ would better serve the educational goals of this subset of our students. The examples provided in the accompanying document (Proposed Changes in Course Requirements for the Bachelor of Science and Bachelor of Arts Degrees in Biochemistry) and in this Justification focus as an example on application to medical school, but similar statements could also be made for admission to dental school, veterinary school and pharmacy school.

The objectives of the proposed new Medical Science Emphasis of the Biochemistry Major are to provide students with the opportunity to achieve a sound major in Biochemistry and also to provide them with the opportunity to be very well prepared for the Medical College Admissions Test (MCAT). Three different Sample Programs are presented for the Medical Sciences Emphasis which permits optimal preparation for the MCAT by the students that are reflective of (a) their academic background as they enter UCR and (b) their willingness to take Chemistry 112A/B in summer school following their first year. A description of these three Sample Programs is provided in the accompanying document.

The Medical Sciences Emphasis has a common foundation of courses identical to the Biology and Chemistry emphases. These include the following courses: Math 9A/B, Chemistry 1A/B/C, 109 or 110A, 112A/B/C, Physics 2A/B/C and 2LA/LB/LC, Biology 5A/LA,B/C, and Statistics 20, 100A or 105. Math 9C is currently required for the Biology and Chemistry emphases. None of the required courses (see below) for the Medical Sciences emphasis require Math 9C, so it is not included in this emphasis.

The Medical Sciences Emphasis has a common core of biochemistry courses that are also required by the Biology and Chemistry emphases. These include Biochemistry 102, 110A/B/C, and 184.

The four unique distinguishing features of the Medical Sciences emphasis are as follows:

- Requiring Biochemistry 120 (Molecular Endocrinology) rather than two elective courses selected from a menu as is done for the Biology and Chemistry emphases
- Requiring CBNS 101 (Cell Biology) and strongly recommending Biology 161A/B (Functional Anatomy of the Vertebrates) and 171 (Human Anatomy and Physiology) rather than two or three courses from a menu as is required in the Chemistry and Biology emphases, respectively. The content of CBNS 101 and Biology 171 is encountered in a significant fashion in the Biological Sciences sections of the MCAT. Biology 161A/B is a prerequisite for Biology 171.
- Requiring two new one-unit courses, Biochemistry 96 and 98I. Biochemistry 96, "Introduction to Humanitarian and Health Care Service" and Biochemistry 98I "Internship Activities in the Humanitarian or Health Care Arenas" will offer students the opportunity to validate their commitment to a career in the health care arena and to community service. A copy of the "Worksheet Request for a New Course" for each of the proposed two new courses is provided as accompanying documents. Both of these documents have been submitted to CRAMS.
- Although not a formal component of the Medical Sciences emphasis, the Biochemistry department proposes to create a Pre-Professional Committee. This Committee will interview students enrolled in the Medical Sciences emphasis of the Biochemistry major and provide letters of recommendation for admission to professional schools based on these interviews.

The following page presents a comparison of the elements of the Biochemistry Chemistry, Biology and Medical Sciences emphases.

The Biochemistry Committee formulated three Sample Programs (see accompanying document). While the course requirements are identical for all of the Sample Programs, (because they are the same Medical Sciences emphasis), each Sample Program illustrates how this set of required courses can be used to fit to the personal educational circumstances of a variety of students. These differences are summarized below:

Program 1: This plan is for the pre-professional student who wishes to carefully prepare for the MCAT exam in the summer following the second year (with a possible repeat of the MCAT exam in April of the third year) and with submission of the AMCAS application to be completed by June of the third year.

Program 2: This plan is for the pre-professional student who may not wish to take Chemistry 112A/B in the summer following the first year, but who still wishes to take the first MCAT exam in the summer following the second year (with a
possible repeat of the MCAT exam in April of the third year) and with submission of the AMCAS application to be completed by June of the third year.

Program 3: This plan is for the pre-professional student who may need to take Math 5, or Chemistry W or Basic Writing in the first quarter of the first year, and who wishes to carefully prepare for the first MCAT exam in the summer after the third year (with a possible repeat of the MCAT exam in April of the fourth year) and with submission of the AMCAS application to be completed by June of the fourth year. A 12-quarter and 14 quarter version of this Program have been articulated.

Background Information:

The following section summarizes some important background information describing the general process of admission to U.S. medical schools. The same information could be put forward relative to the admission to highly competitive veterinary schools, dental schools or pharmacy schools.

(a) There are 117 allopathic (MD) medical schools in the U.S. that annually matriculate approximately 17,000 students each August/September.

(b) The minimum entrance requirement for most medical or osteopathic schools is four years of college with specific core science courses (see below).

(c) The Medical College Admissions Test (MCAT) exam is required for application to all US allopathic medical schools. It is offered only two times per year, in April and August. The total number of times a student takes the MCAT exam is reported to the medical schools to which the student applies; in addition, some medical schools require submission of all MCAT scores.

The MCAT exam consists of one writing section (2 topics in 60 minutes) and three numerically scored sections: Physical Sciences section (77 questions in 100 minutes); Verbal Reasoning section (60 questions in 85 minutes); and Biological Sciences section (77 questions in 100 minutes) each graded on an ascending scale of 1 to 15 points. For most medical schools the prerequisite for serious consideration is a MCAT score of 30 (out of 45; most schools do not include consideration of the writing sample). The Biochemistry Committee reviewed the comprehensive list of topics covered under the MCAT Biological Sciences and Physical Sciences sections; see the comment on the Biological Sciences section below.

(d) The majority of U.S. colleges of medicine participate in a centralized application service; these are the American Medical College Application Service (AMCAS) for allopathic (MD) or the American Association of Colleges of Osteopathic Medicine Application Service (AACOMAS) for osteopathic (DO) schools. The deadline for receipt from the student applicant of the AMCAS application is in June, 14 months before the desired matriculation into medical school. Typically this will be in June of the third year for students graduating in 4 years (Sample Programs 1 and 2) or June of the fourth years for students graduating in 5 years (Sample Program 3B).

(e) Admission to a medical school generally requires volunteer or paid experience in a health care and/or humanitarian setting.

The general course requirements for admission to most medical schools are summarized below; these are also similar to the UCR/UCLA Thomas Haider Program in Biomedical Sciences.

>> One year of college English (English Composition 1A/B/C).
>> One year of college physics with laboratory (Physics 2A/B/C and 2LA/B/C).
>> Two years of college chemistry to include the study of inorganic chemistry and organic chemistry with laboratory, (Chemistry 1A/B/C and Chemistry 112A/B/C).
>> One year of general biology laboratory with laboratory (Biology 5A/B/C).
>> Mathematics to include introductory calculus (Math 9A/B) and statistics (Statistics 100A or 105 or 120A).
>> A one-quarter course in biochemistry to cover structure, function and metabolism of biological molecules, while not required is strongly recommended.
>> Courses in the Spanish language and the humanities are also highly recommended.

The MCAT Biological Sciences section also has a significant number of questions related to biochemistry. These include the following topics:: enzyme structure and function; control of enzyme activity; basic metabolism including glycolysis, Krebs cycle electron transport and oxidative phosphorylation, metabolism of fats and proteins, DNA structure and function, DNA replication, repair of DNA, recombinant DNA, protein synthesis including genetic code, transcription and translation, control of gene expression in eukaryotes.

Effective: FALL 2004

Approved by: Biochemistry Faculty, Justin K. M. Roberts, Chair 10/9/03
Approved by: CNAS Executive Committee* 10/22/03
Approved by: Committee on Educational Policy 11/3/03

* After 1 year, the CNAS Executive Committee will review any existing medical biology undergraduate program.