

Presidential Advisory Committee of Michigan Technological University

Proposal 16-05 (Voting Units: Academic Senators)

Chemistry Department Degree Proposal Pharmaceutical Chemistry B.S.

1. General description and characteristics of the program.

Pharmaceutical Chemistry is the study of the molecular and mechanistic aspects of pharmaceuticals. The discipline emphasizes the chemistry of drug design and development, drug action, drug transport, and drug delivery, and targeting. The development of new pharmaceuticals is critically dependent on a molecular-level understanding of biological processes and mechanisms of drug action. Progress in the field now depends on the design and synthesis of new molecules using tools such as structure activity relationships, combinatorial chemistry, and computer-aided drug design. In recent years rational design of drugs tuned to specific target sites is becoming a reality due to concurrent advances in chemistry and biology, including elucidation of the human genome. Chemists continue to be at the forefront of drug design, synthesis, testing, and development. A bachelor's program in Pharmaceutical Chemistry will emphasize the molecular basis underlying the creation of new drugs and health applications of bioactive compounds. The proposed program will prepare students to fully and confidently participate in health and biomedical careers.

2. Rationale

The pharmaceutical industry is a major employer of chemists; in recent years more than 20% of graduates with BS and Ph.D. degrees in chemistry work in the pharmaceutical industry. Pharmaceutical companies need employees with strong skills in modern chemical techniques as well as a good understanding of biomedical issues such as drug action, drug design and drug development. Students are increasingly career-oriented and are motivated by early exposure to applications of their studies. Although the proposed program in Pharmaceutical Chemistry suggests a clear career goal, it includes sufficient grounding in fundamental chemistry to allow graduates flexibility if their career plans change.

Graduates of this program will have a solid foundation in basic chemistry with a focus on pharmaceutical applications. They will have skills necessary to work productively in the pharmaceutical industry, especially in the areas of research and development. Those seeking further education will be prepared for graduate work in chemistry or biochemistry, or professional programs in pharmacy or other health sciences.

Degrees of this type, combining basic science with real-world applications, are an ideal preparation for medical school or law school. (Pharmacy schools, of course, are not excluded, but they usually only require for a pre-pharmacy curriculum completion of the sophomore year or approximately 70 semester hours at an institution of higher learning - although the acquisition of a baccalaureate degree is often considered a plus in applying to pharmacy school, and graduates are ranked higher during the initial screening.) In addition, pharmaceutical chemistry will provide an excellent groundwork for careers in patent law.

The employment outlook is as follows: for Chemists and Material Scientists, an average growth in job opportunities with about 11,300 new jobs will be created by 2012. This represents about a 12% growth. Most job growth is expected in pharmaceutical and medicine manufacturing and research and development firms, reflect a demand for new drugs and personal care products.

3. Discussion of related programs within the institution and at other institutions.

Degree programs at MTU that are most closely related to pharmaceutical chemistry are Chemistry, Biology, Bioinformatics, and the two concurrently proposed degrees in Cheminformatics and Biochemistry. The Pharmaceutical Chemistry degree builds on the courses and faculty expertise of those programs.

Degrees related to Pharmaceutical Chemistry are offered at only one other university in the state, the University of Michigan, which offers a BS in Medicinal Chemistry and a BS in Pharmaceutical Sciences.

Pharmaceutical chemistry is distinct from pharmacy, which is offered as a graduate level program leading to a professional Doctor of Pharmacy (Pharm.D.) degree at the University of Michigan, Wayne State, and Ferris State.

4. Projected Enrollment

Our goal is a total of 32 students in this program (approximately 8 incoming per year).

5. Schedule for Implementation

The program in Biochemistry will be a regular on-campus degree program. It is scheduled to begin Fall Semester 2005. During the first year, we will concentrate our efforts on advertising the new degree program and work with the recruiting staff to widely publicize the new degree program.

6. Curriculum Design

Pharmaceutical Chemistry Curriculum

Chemistry Core

CH1110 University Chemistry I.....	4
CH1111 University Chemistry Lab I.....	1
CH1130 Orientation.....	1
CH1120 University Chemistry II.....	4
CH2410 Organic Chemistry I.....	3
CH2411 Organic Chemistry Lab I.....	1
CH2420 Organic Chemistry II.....	3
CH2421 Organic Chemistry Lab II.....	2
CH3510 Physical Chemistry I – Thermodynamics and Equilibrium.....	3
CH3511 Physical Chemistry Lab I.....	2
CH3520 Physical Chemistry II – Kinetics and Molecular Structure.....	3
CH3521 Physical Chemistry Lab II.....	2
CH4222 Intro. to Quantitative and Instrumental Analysis.....	5
CH4910 Senior Seminar II.....	1
TOTAL	35

Biochemistry/Biology

BL1040 Principles of Biology.....	4
CH4710 Biomolecular Chemistry I.....	3
CH4720 Biomolecular Chemistry II.....	3
BL4820 Biochemical Techniques.....	2
TOTAL	12

Pharmaceutical Chemistry

CH4110 Pharmaceutical Chemistry I –Drug action.....	3
CH4120 Pharmaceutical Chemistry II – Drug design.....	3
CH4412 Spect. of Organic Chemistry.....	4
BL4860 Toxicology	3
TOTAL	13

Mathematics

MA1150 or 1160 Calculus I.....	4
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MA2150 or 2160 Calculus II.....	4
MA2320 Elementary Linear Algebra.....	2
MA3150 or 3160 Multivariable Calculus.....	4
MA2720 Introduction to Statistical Analysis.....	4
TOTAL.....	18

Computer Science

CS1121 Intro to Computer Science.....	3
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Physics

PH2100 University Physics I-Mechanics.....	3
PH1100 Introductory Physics Lab I.....	1
PH2200 University Physics II – E&M.....	3
PH1200 Introductory Physics Lab II.....	1
TOTAL.....	8

General Education Distribution

UN1001 Perspectives.....	3
UN1002 World Cultures.....	4
UN2002 Institutions.....	3
UN2001 Re-Visions.....	3
General Education Distribution	6
General Education Distribution.....	9
TOTAL.....	28

Electives for Pharmaceutical Chemistry..... 11

Must include 3 credits of CH4xxx

CH4310 Inorganic Chemistry.....	3 cr
CH4311 Inorganic Chemistry Laboratory.....	2 cr
CH4430 Intermediate Organic Chemistry.....	3 cr
CH4510 Intermediate Physical Chemistry.....	3 c
CH4610 Intro to Polymer Science.....	3 cr
CH4990 Undergrad Research in Chemistry.....	1-6 cr
CH5560 Computational Chemistry.....	3 cr
BL2200 Genetics.....	3 cr
BL3300 Genomics.....	3 cr
BL3240 Cell Biology.....	3 cr
BL4020 BiochemistryII.....	3 cr
BL4030 Molecular Biology.....	3 cr
BL3210 General Microbiology.....	4 cr
FW4089 Bioinformatics.....	3 cr

TOTAL..... 128 cr

7. New Course Descriptions

Two new courses are being developed in pharmaceutical chemistry. The first will incorporate much of the material that is currently covered in CH4510, Intermediate Chemistry, which will be phased out. The second is entirely new.

In addition, a new course in Biomolecular Chemistry will be added. This course will support both Pharmaceutical and Biochemistry Chemistry programs.

New courses

CH4110 Pharmaceutical Chemistry I: Drug action

This course deals with pharmaceuticals on a molecular level and focuses on structural and mechanistic approaches to understanding drug action. The first part of the course will provide an overview of the general principles of absorption, distribution, action, metabolism and toxicity of drugs. The mechanism of action of various drug classes such as antibiotics, cardiovascular, and anti-inflammatory drugs will be discussed.

CH4120 Pharmaceutical Chemistry II: Drug design

This course deals with the concepts that must be considered in the design and synthesis of drugs. Rational basis for drug design and development including synthetic, computational and biochemical concepts will be discussed. Topics include structure-activity relationships, organic synthesis, organic reaction mechanism, mechanism of drug action, computer-aided drug design and case studies of drugs will be discussed.

CH4720 Biomolecular Chemistry II

This course deals with structural and chemical logic of bioprocesses with emphasis on bioorganic mechanisms. Topics include metabolic pathways, membrane biophysics, ion-channels, cell communication, transcriptional control and molecular biology.

8. Library and other learning resources

The library subscribes to a broad collection of chemistry journals appropriate to degrees in pharmaceutical chemistry. The library also provides access to the Medline database, the premier source for biomedical research results, as well as most of the chemistry/biochemistry-related journals referenced through that venue.

9. Computing Access Fee

Students will pay the basic computer access fee in Chemistry.

10. Faculty resumes:

Faculty resumes are posted online.

Chemistry: <http://www.chemistry.mtu.edu/pages/faculty/index.php>

11. Description of available/needed equipment

No additional equipment is required.

12. Program costs, years 1, 2 and 3.

The only anticipated costs are for advertising of the new degree and associated student recruiting. These expenses will be supported by the Department.

Space.

No new space is needed.

Policies, regulations and rules.

No new regulations are anticipated.

15. Accreditation requirements.

None available for pharmaceutical chemistry. The content of courses in the Chemistry Department is approved by the American Chemical Society.

16. Internal status of the proposal

Entity	Date submitted	Date Approved
Department/School		10/25/04
Dean, College of Sciences & Arts		11/15/04

Provost		
Academic Affairs Committee		
University support units		
University Senate		
Board of Control		
Provost- final approval		

17. Planned implementation date.

September 2005.

Appendix

Sample 4 year course plan

B.S. Pharmaceutical Chemistry Degree
A Four Year Outline

FALL

**SPRING
FIRST YEAR**

CH1110 University Chemistry I	4	CH1120 University Chemistry II	4
CH1111 University Chemistry Lab I	1	MA2150 or 2160 Calculus II	4
CH1130 Orientation	1	PH1200 Introductory Physics Lab II	1
PH1100 Introductory Physics Lab I	1	PH2100 University Physics I- Mechanics	3
MA1150 or 1160 Calculus I	4	UN1002 World Cultures	4
UN1001 Perspectives	3		
TOTAL	14	TOTAL	16

SECOND YEAR

CH2410 Organic Chemistry I	3	CH2420 Organic Chemistry II	3
CH2411 Organic Chemistry Lab I	1	CH2421 Organic Chemistry Lab II	2
PH2200 University Physics II – E&M	3	MA3150 or 3160 Multivariable Calculus	4
MA2320 Elementary Linear Algebra	2	UN2001 Re-Visions	3
UN2002 Institutions	3	CS1121 Intro to Computer Science	3
BL1040 Principles of Biology	4	General Education Distribution	3
TOTAL	16	TOTAL	18

THIRD YEAR

CH3510 Physical Chemistry I	3	CH3520 Physical Chemistry II	3
CH3511 Physical Chemistry Lab I	2	CH3521 Physical Chemistry Lab II	2
CH4222 Intro to Instrumental Analysis	5	CH4720 Biomolecular Chemistry II	3
CH4710 Biomolecular Chemistry I	3	CH4412 Spectro. of Organic Chemistry	4

MA2720 Statistical Methods

4 CH4110 Pharmaceutical Chem I

3

Electives

2

TOTAL

17

TOTAL

17

FOURTH YEAR

CH4120 Pharmaceutical Chemistry II

3

CH4910 Senior Seminar II

1

BL4860 Toxicology

3

BL4820 Biochemical Techniques

2

General Education Distribution

6

General Education Distribution

6

###Electives

4

###Electives

5

TOTAL

16

TOTAL

14

GRAND TOTAL

=

128

Adopted by the PAC (formerly Senate): 9 February 2005

Approved by President Mroz: 21 February 2005