

**BOARD OF HIGHER EDUCATION**

**REQUEST FOR COMMITTEE AND BOARD ACTION**

**COMMITTEE:** Academic Affairs

**NO:** AAC 13-23

**COMMITTEE DATE:** April 23, 2013

**BOARD DATE:** April 30, 2013

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**APPLICATION OF UNIVERSITY OF MASSACHUSETTS LOWELL TO AWARD THE  
MASTER OF SCIENCE AND DOCTOR OF PHILOSOPHY IN PHARMACEUTICAL  
SCIENCES**

**MOVED:** The Board of Higher Education hereby approves the application of **the University of Massachusetts Lowell** to award the **Master of Science and Doctor of Philosophy in Pharmaceutical Sciences**.

Upon graduating the first class for these programs, the University shall submit to the Board a status report addressing its success in reaching program goals as stated in the application and in the areas of enrollment, curriculum, faculty resources, and program effectiveness.

Authority: Massachusetts General Laws Chapter 15A, Section 9(b)

Contact: Aundrea Kelley, Deputy Commissioner for P-16 Policy and Collaborative Initiatives

**BOARD OF HIGHER EDUCATION**  
**April 2013**  
**University of Massachusetts Lowell**  
**Master of Science in Pharmaceutical Sciences**  
**Doctor of Philosophy in Pharmaceutical Sciences**

**INTENT AND MISSION**

The University of Massachusetts Lowell (UML) has filed an expedited application for the approval of a proposed Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) in Pharmaceutical Sciences.

The proposed M.S. and Ph.D. in Pharmaceutical Sciences support UML's mission "to enhance the intellectual, personal and cultural development of its students through excellent, affordable educational programs. The University seeks to meet the needs of the Commonwealth today and into the future and supports the development of sustainable technologies and communities through its teaching, research, scholarship and engagement." The proposed degrees in pharmaceutical sciences align with UML's strategic plan<sup>1</sup> to meet both the academic and industry needs of the Commonwealth for highly skilled pharmaceutical science experts who can contribute to the biotech and pharmaceutical industries as well as higher education.

The field of Pharmaceutical Sciences blends scientific foundations and methodological techniques from the Bioscience, Chemistry, Physics, Clinical Lab Science, Engineering and other academic fields to promote research that advances the development and evaluation of new drugs and the investigation of emerging pharmaceutical challenges. The proposed M.S and Ph.D. programs are intended to help meet the need for new drugs to treat human disease and to evaluate the effectiveness of drug therapies, including drug safety. UML's approach to doctoral education involves developing interdisciplinary programs. The proposed program includes options in clinical research, medicinal chemistry, nanopharmacology, nuclear pharmacology and imaging, pharmacogenomics, and drug discovery.

The M.S. and Ph.D. in Pharmaceutical Sciences proposal has obtained all necessary governance approvals on campus and was approved by the UML Board of Trustees on February 27, 2013. The required letter of intent was circulated on January 22, 2013. No comments were received.

**NEED AND DEMAND**

*National and State Labor Market Outlook*

According to the U.S. Bureau of Labor Statistics, employment for medical scientists is expected to grow by 20% from 2006-2016. This rate is faster than the average for all other occupations in the United States. The American Association of Pharmaceutical Scientists (AAPS) reports that the pharmaceutical industry is one of the fastest growing with stable positions despite economic instability. According to a survey conducted by the AAPS in 2011 with 1822 responses from organization members, the majority of Ph.D. pharmaceutical scientists were found in academic

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<sup>1</sup> *UMASS Lowell 2020: A Strategic Plan for the Next Decade*

settings, with the majority of those not in academic settings being employed in private industry in the areas of pharmaceutical development, pharmacokinetics, biopharmaceutics, administration of research and development, and pharmaceutical analytical development. Establishing the proposed M.S. and Ph.D. in Pharmaceutical Sciences would support keeping the pharmaceutical industry in Massachusetts. Projections by the state's Biotechnology Council indicate a 17% growth rate in the pharmaceutical industry through 2018 and calls for academia, industry and government to work together so that new companies will stay in the Commonwealth. UML reports multiple years of inquiries from potential applicants requesting a graduate program in Pharmaceutical Sciences.

### *Duplication*

No public university in Massachusetts offers a Ph.D. in pharmaceutical sciences. The proposed public M.S. and Ph.D. degree programs in Pharmaceutical Sciences at UML would provide a public option for in-state students who currently choose between private institutions or public universities in other states.

Private accredited universities and colleges in Massachusetts offering graduate programs in pharmaceutical sciences include:

- Massachusetts College of Pharmacy and Health Sciences offers an M.S. and Ph.D. in Pharmaceutics with a focus on pharmacokinetics and the study of pharmaceutical dosage forms.
- Northeastern University offers an M.S. in Pharmaceutical Sciences with a focus on Pharmaceutics and Drug Delivery Systems and a Ph.D. in Pharmaceutical Sciences with specializations in medicinal chemistry/drug discovery, pharmacology, and pharmaceutics/drug delivery systems.

## **ACADEMIC AND RELATED MATTERS**

### *Admission*

Applicants to the M.S. in Pharmaceutical Sciences program must possess a BS degree or be in the last semester of their baccalaureate program.

Applicants to the Ph.D. in Pharmaceutical Sciences program must possess a BS or MS degree or be in the last semester of their baccalaureate or master's program. UML policy allows transfer of an international or American master's degree toward doctoral requirements. Based on Ph.D. Graduate Committee review and approval, all courses in the degree can be transferred into the Ph.D. program. This may result in an increased number of total credits earned for the doctoral degree completion beyond the master's, or the Ph.D. Graduate Committee can require that a Ph.D. student complete all the course work in the Ph.D. program in Pharmaceutical Sciences rather than accept a prior Master's degree. To qualify for admission into the Ph.D. program, applicants are expected to be graduates of an accredited U.S. college or university or an approved international equivalent institution and have a minimum of two years of relevant laboratory experience either involved in faculty led research or in an industry setting. Applicants

must submit an application, a personal essay, GRE scores, three letters of recommendation, and official academic transcripts. It is expected that applicants will have a baccalaureate level GPA of 3.25 or higher and/or a master's level GPA of 3.5 or higher.

UML policy for graduate admissions requires all international applicants to graduate programs to submit results of the TOEFL exam with some exceptions for English Speaking countries. International students are expected to at least meet the minimum UML TOEFL requirements. The TOEFL requirement can be waived if an applicant can demonstrate successful completion of at least two academic semesters of full time college/university study in the USA with a GPA of 3.25 by the date of submission of the application.

*Projected Enrollment*

| <b>Students</b>                     | <b>Year 1</b> | <b>Year 2</b> | <b>Year 3</b> | <b>Year 4</b> | <b>Year 5</b> |
|-------------------------------------|---------------|---------------|---------------|---------------|---------------|
| <b>M.S. – New Full Time</b>         | --            | 10            | 15            | 15            | 20            |
| <b>M.S. – Continuing Full Time</b>  | --            | --            | 10            | 15            | 15            |
| <b>M.S. – New Part Time</b>         | --            | 10            | 10            | 10            | 10            |
| <b>M.S. – Continuing Part Time</b>  | --            | --            | 10            | 20            | 20            |
| <b>Ph.D. – New Full Time</b>        | --            | 5             | 5             | 5             | 5             |
| <b>Ph.D. – Continuing Full Time</b> | --            | --            | 5             | 15            | 20            |
| <b>Ph.D. – New Part Time</b>        | --            | --            | --            | --            | --            |
| <b>Ph.D. – Continuing Part Time</b> | --            | --            | --            | --            | --            |
| <b>Totals</b>                       | --            | 25            | 55            | 80            | 90            |

Program Effectiveness

| Goal  | Measurable Objective   | Strategy for Achievement   | Timetable  | Assessment   |
|---|--|--|--|--|
| 1. Produce high quality graduates in Pharmaceutical Sciences. |  |  |  |  |
|   | Recruit high quality applicants consistent with target timeline. | Market M.S./Ph.D. to colleges and companies.<br><br>Announce M.S./Ph.D. in academic newsletters and professional meetings.<br><br>Develop a strong web presence.<br><br>Advertise to Alumni. | Market 9 months before program launch, then ongoing. | Annual class profile; perform trend analysis.  |
|   | Ensure Ph.D. candidate research productivity.                    | Support research.<br><br>Fund professional travel.   | Ongoing.   | Measure research output target. Target: each student has 1 refereed journal publication and 3 conference acceptances at internationally-known conferences. |
|   | Graduate high quality students within projected timelines.       | Continually monitor student progress.<br><br>Manage course offerings.<br><br>Manage faculty/staff support.   | Ongoing.   | Track time to graduation and perform trend analysis.   |
|   | Facilitate employment of graduates in quality positions.         | Circulate faculty openings.<br><br>Support faculty networking.<br><br>Circulate research openings.<br><br>Support professional conference participation.                                     | Ongoing.   | Track salaries, placements, and time to employment; perform trend analysis.  |

| <b>Goal</b>                              | <b>Measurable Objective</b>                                 | <b>Strategy for Achievement</b>  | <b>Timetable</b> | <b>Assessment</b>  |
|--|---|--|------------------|--|
|  | Produce competitive graduates.                              | Share internal faculty productivity measures.<br><br>Share characteristics of successful, internal new faculty hires.  | Ongoing.         | Track graduates' research productivity, tenure, and promotions; perform trend analysis.              |
| <b>2. Elevate research productivity.</b> |   |  |                  |  |
|  | Increase refereed journal publications.                     | Support research activities.<br><br>Continue to recruit research-oriented faculty.   | Ongoing.         | Track quality and quantity of faculty publications; perform trend analysis.                          |
|  | Increase grant generation.                                  | Identify and support grant writing opportunities.<br><br>Develop joint proposals.  | Ongoing.         | Track annual grant proposals, acceptances, and research expenditures; perform trend analysis.        |
|  | Increase faculty participation in professional conferences. | Support professional travel.<br><br>Encourage joint research.  | Ongoing.         | Track quantity and quality of annual professional presentations/proceedings; perform trend analysis. |
| <b>3. Improve faculty recruitment.</b>   |   |  |                  |  |
|  | Recruit faculty with high research productivity.            | Recruit faculty to participate in program.<br><br>Recruit faculty at higher ranks or with more established records.<br><br>Recruit faculty with stronger educational profiles. | Ongoing.         | Track research output of candidates, new faculty research records and educational profiles.          |

| Goal   | Measurable Objective  | Strategy for Achievement  | Timetable | Assessment  |
|--|---|---|-----------|---|
|  | Generate a wider and stronger pool of faculty applicants.               | Advertise more widely including information about the M.S./Ph.D. program.                             | Ongoing.  | Track applicant pool quantity and quality, including academic and research profiles.      |
| <b>4. Increase visibility of UMass Lowell.</b> |   |   |           |   |
|  | Generate more faculty representation in the local press.                | Publicize faculty representation in press.<br>Proactively advertise faculty strengths to local press. | Ongoing.  | Track local publications involving faculty.   |
|  | Increase and elevate faculty participation at professional conferences. | Fund professional travel to conferences.  | Ongoing.  | Track faculty activities at conferences, including keynote invitations and presentations. |
|  | Increase fundraising.   | Publicize faculty/student research to companies, at alumni and in the press.                          | Ongoing.  | Track donations and corporate grants; perform trend analysis.                             |
|  | Host professional conferences at UMass Lowell.                          | Advertise venues and resources more widely.   | Ongoing.  | Track number, quality and participation of conferences hosted.                            |
| <b>Program Enrollees</b>                       |   |   |           |   |

| Goal                            | Measurable Objective  | Strategy for Achievement   | Timetable                                     | Assessment |
|---------------------------------|---|--|---|------------|
|                                 | Attract high-quality applicants from a regional, national, and international applicant pool   | Market program through: <ol style="list-style-type: none"> <li>1. Posters and flyers to colleges and the numerous MA programs in related fields</li> <li>2. Announcements in academic association newsletters and at professional meetings</li> <li>3. Web prominence,</li> <li>4. Alumni publications and events</li> <li>5. Recruitment at International Partner Institutions</li> </ol> | 3-6 months before implementation then ongoing |            |
| <b>Retention and Graduation</b> |   |  |   |            |
|                                 | <ol style="list-style-type: none"> <li>1. High retention of first year enrollees [80-90%]</li> <li>2. High graduation rate of second year students, [80-95%]</li> </ol> | Recruit high-quality applicants matched to program strengths   | Ongoing                                       |            |
| <b>Job Placement</b>            |   |  |   |            |



| Goal                    | Measurable Objective   | Strategy for Achievement  | Timetable | Assessment |
|-------------------------|--|---|-----------|------------|
|                         | 100% job placement<br><br>(Please see description of job placement strategies below) | 1. Produce high-quality graduates with superior skill sets<br><br>2. Continue to partner with international universities to facilitate student experiences with non-governmental organizations, international organizations and governments<br><br>3. Create formal partnerships with potential employers to enhance our students having a “track” on possible jobs<br><br>4. Leverage international university partnerships that UMass Lowell has solidified | Ongoing   |            |
| <b>National Ranking</b> |  |   |           |            |
|                         | Achieve ranking as one of top 20 doctoral programs in Pharmaceutical Sciences        | 1. Attract/retain productive faculty<br><br>2. Increase research funding  | Ongoing   |            |

*Curriculum (see Attachment A)*

The proposed Pharmaceutical Sciences program will be delivered through an interdisciplinary Graduate Group model. This model is already in use at UML and calls for identification of relevant faculty members, regardless of their departmental or institutional homes, as the group responsible for curriculum and delivery. This has been an effective and efficient model for interdisciplinary programs because faculty resources are not limited by departmental or institutional boundaries. Instead, they are deployed to meet interdisciplinary curriculum needs and to match research expertise with student interest.

The proposed M.S. curriculum will consist of 37 credits of coursework. Required courses will be offered in the first four semesters of study. Coursework will generally be scheduled in the

fall and spring semesters. Full-time students should finish in two years. Students who attend part-time should finish in four years. Part-time study may be a desirable option for individuals who work full-time. The Program Director and advisors in the program will guide M.S. students through a part-time or full-time program of study. Full-time study is equivalent to 9 credits per semester.

The Ph.D. curriculum, beyond the prerequisite courses, will consist of a minimum of 49 credits of coursework and 12 credits of dissertation. Coursework will generally be scheduled in the fall and spring semesters. The expectation is that full-time students will finish the program in 4 to 5 years. The Program Director and advisors in the Ph.D. program will guide graduate students through a full-time program of study. Full-time study is equivalent to 9 credit hours per semester.

No field experiences or internships are included in this program. The plan of study for the M.S. program and the Ph.D. program is provided below as a grid of course listings per semester. The master's degree students will take all courses in the first two years. Doctoral students will continue on through the full academic program of study.

### Plan of Study by Semester

|                                       |   |                   |
|---------------------------------------|---|-------------------|
| <b>Semester 1</b>                     | PHSC.610 – Principles of Pharmaceutical Sciences      | 4 credits         |
|                                       | 84.550 – Biochemistry I                               | 3 credits         |
|                                       | 30.550 – Human Development and Pathophysiology        | 3 credits         |
|                                       | Total:  | 10 credits        |
| <b>Semester 2</b>                     | 84.562 – Pharmaceutical Biochemistry                  | 3 credits         |
|                                       | 81.542 – Cell Biology                                 | 3 credits         |
|                                       | PHSC.620 – Pharmacokinetics                           | 3 credits         |
|                                       | Total:  | 9 credits         |
| <b>Semester 3</b>                     | 84.7xx – Principles of Medicinal Chemistry I          | 3 credits         |
|                                       | 36.707 – Drug Metabolism                              | 3 credits         |
|                                       | PHSC.630 – Pharmaceutical Research Design and Ethics  | 3 credits         |
|                                       | Total:  | 9 credits         |
| <b>Semester 4</b>                     | PHSC.640 – Pharmaceutical Analysis                    | 4 credits         |
|                                       | PHSC.641 – Drug Delivery                              | 3 credits         |
|                                       | PHSC.710 – Advanced Topics in Pharmaceutical Sciences | 2 credits         |
|                                       | Total:  | 9 credits         |
| <b>Exit point for master's degree</b> |   | <b>37 credits</b> |
| <b>Semester 5</b>                     | Option course   | 3 credits         |
|                                       | Dissertation and seminar                              | 3 to 6 credits    |
|                                       | Total:  | 6 to 9 credits    |
| <b>Semester 6</b>                     | Option course   | 3 credits         |
|                                       | Dissertation and seminar                              | 3 to 6 credits    |

|  |                          |                   |
|--|--------------------------|-------------------|
| Total:   |                          | 6 to 9 credits    |
| <b>Semester 7</b>                              | Option course            | 3 credits         |
|  | Dissertation and seminar | 3 to 6 credits    |
| Total:   |                          | 6 to 9 credits    |
| <b>Semester 8</b>                              | Option course            | 3 credits         |
|  | Dissertation and seminar | 3 to 6 credits    |
| Total:   |                          | 6 to 9 credits    |
| <b>Ph.D. degree – minimum credits required</b> |                          | <b>61 credits</b> |

*Fiscal (Attachment B)*

The proposed revenue for tuition and fees is based on the official table of Fees and Tuition expenses per semester/per credit hour maintained in the UML Bursar's Office. It is anticipated that the majority of students will be in-state residents with 10% non-residents or international students. Faculty will be expected to generate extramural funding to support their research activities. It is expected that this will provide a significant contribution. The budget reflects the amount of grant resources that are needed to support research assistantships for students.

UML will provide \$1.25 Million for faculty to initiate their research activities. Faculty will be expected to generate research grant funds to maintain their research labs.

Starting in Year 3, Pharmaceutical Sciences faculty will contribute to teaching for undergraduates in science courses and for students in the Pharmaceutical Practice doctorate program.

Massachusetts Life Sciences Capital Fund (MLSCF) has awarded UML \$10 Million to design and install state-of-the art laboratories in the Emerging Technology and Innovation Center (ETIC). This will serve as the center of the proposed pharmaceutical sciences research activities.

In Year One the Department Chair will be hired to serve as the primary voice of the proposed Pharmaceutical Sciences program and will be essential to hiring the founding faculty of the program, designing and planning research labs, and providing financial guidance for the program. In Year Two one administrative staff will be hired to support the department chair.

It is planned that full-time tenure track faculty members will teach the proposed program on campus. UML plans to employ up to five additional full-time faculty members over the first four years for this program. The Graduate Group model promotes efficient deployment of all relevant faculty with expertise related to the Pharmaceutical Sciences program.

In Years Two - Five, faculty with unique skills in research and specialized teaching will be hired at a rate of one per year. The budget incorporates funds for advertising and travel for faculty candidates. This will remain as an annual budget item to ensure a strong ongoing recruitment process. It is expected that faculty in Pharmaceutical Sciences will need substantial start-up support to set-up labs and develop external funding for research. Faculty will be expected

to bring in funding to support all their research activities and graduate students working in their labs. Faculty will be provided an average of \$250K for research start-up. Tenure will be dependent on funding success.

The operating budget will cover customary operating expenses such as office supplies, small equipment, laboratory expenses, travel and events. Marketing will be important to promote awareness of the program regionally and nationally to recruit talented graduate students.

Research Assistantships (RA) funded by the faculty research grants will support full-time doctoral students. It is expected that the RA position will provide a stipend and tuition remission. These students will be working on their research dissertations in faculty labs.

The proposed program will need additional funds from the university in the initial years before a critical mass of faculty and students is achieved. The program budget shows a deficit of approximately \$200K in Years One - Two. By Years Three - Five, the program is expected to generate a surplus. The cumulative surplus over five years is \$928,825. In Year Five, the program is projected to have a surplus of \$873,735.

Revenue from the proposed program is expected to provide a small surplus due to tuition and fee income from the M.S. degree students and teaching contributions to undergraduate courses and the proposed doctoral degree program starting in Year Three. It is anticipated that financial gain to the university from this proposed program will come through increased research funding and the development of intellectual property that can be marketed in future years.

#### *Faculty and Administration (Attachment C)*

UML has many senior faculty with expertise related to pharmaceutical sciences. Thirty full-time faculty members from across departments in the School of Health and Environment and the Colleges of Science and Engineering have expressed interest in teaching graduate level courses in the proposed programs. They have also indicated interest in the advising and mentoring of doctoral students, and participation on dissertation committees in addition to teaching in their departments.

The diversity of disciplines represented in the current faculty who have expressed interest will contribute to the interdisciplinary nature of the proposed Pharmaceutical Sciences programs and fit well with the Graduate Group Model. Current faculty members are qualified to offer the core courses and elective courses in each of the areas.

UML plans to hire five additional faculty members over four years with research expertise in areas applicable to the interdisciplinary Ph.D. in Pharmaceutical Sciences Program. This infusion of faculty is designed to help meet both programmatic departmental needs and contribute to supervising doctoral students and the teaching and development of courses within the Ph.D. Pharmaceutical Sciences program.

#### *Facilities, Library, Technology*

Each of the currently existing faculty members has his/her own research lab space. The new ETIC building was officially opened in fall 2012 and during 2013-2014, the third floor of the

building will be designed into a pharmaceutical research space. Capabilities in nanomedicine and biopharmaceutical research will be significantly expanded by this design, which includes the addition of two large nanomedicine and biopharmaceutical labs—one tailored to biological capabilities, the other to chemical capabilities. The floor is also planned to contain a shared instrument room and cell culture space. The clean room bio-bay will have capabilities for handling experiments such as fabricating and testing devices for separating, sensing, and interacting with cells. Equipment for the bio-bay include, biological handling and cell culture and other characterization equipment. Micro- and nano labs feature fabrication equipment and a direct write e-beam lithography system. By locating the third floor nanomedicine labs in ETIC, researchers would be able to interact on a regular basis with other researchers in advanced materials (especially soft materials), nano-manufacturing, sensors, and optics and electronics, leading to cross-pollination of ideas.

Library resources are in bioscience, chemistry, clinical lab sciences, pharmaceutical science, engineering and health science topics. UML makes a multi-million dollar annual investment in library resources that support graduate study in all fields including Pharmaceutical Sciences. No additional funds are planned for library resources due to the strength of current holdings. As one example of the depth and breadth of coverage, UML subscribes to 681 pharmaceutical-related online journals.

Graduate students at UMass Lowell enjoy both discipline-specific and multi-disciplinary support in the overlapping areas of science, engineering, health and the environment:

- In medicine and bioscience, UML subscribes to the CINAHL database for nursing and allied health, the full Ovid journal collection in the health sciences, proprietary access to MEDLINE/PubMed, and the Taylor & Francis Informa collection in bioscience and health. The library also subscribes to the general coverage Health & Wellness Resources Center and the Health Reference Center databases, as well as the American Medical Association journals, the American Cancer Society journals, NEJM Online, and the Cochrane Library.
- For clinical lab sciences, UML subscribes to the full American Chemical Society resources (SciFinder Scholar plus the full journal collection), the Biological Sciences Collection, ChemNetBase, the Merck Index online, the Kirk-Othmer Encyclopedia of Chemical Technology online, full coverage in physics and math, and journals published by the Nature and Science groups.
- In engineering, UML subscribes to the major databases and journal sets across the departments (civil, electrical, mechanical, chemical, optical), including the Compendex general engineering index.
- In the related areas of psychology and psychopharmacology, the UML library subscribes to CogNet, PsychInfo, PsychBooks, and PsychArticles. For general social science we offer the SocIndex from EBSCO.
- The leading multidisciplinary index and journal package is ScienceDirect from Elsevier. This is the source of approximately one-third of the annual scientific publishing, and UML subscribes to the full set of journals. The University also subscribes to full journal bundles from Wiley, Springer, Taylor & Francis, Sage, JStor, Emerald and Oxford. The library also subscribes to the full set of Annual Reviews online, including those in Pharmacology and Toxicology, Public Health, Chemical and Biomolecular Engineering, and Biochemistry; as well as the database of the AARP, Ageline.
- The subscription to Dissertations Online opens a window into prior graduate work, and

for legal aspects of health care Lexis/Nexis provides access to statutes, cases, regulations and law journals. Lastly, UMass Lowell is full member in the Boston Library Consortium as well as the WorldCat network, providing guaranteed interlibrary loan access to virtually any book or journal article that can be identified.

The Massachusetts Medical Device Development Center (M2D2) located at UML serves as a catalyst for the incubation of new biopharmaceutical industries in the region. UML states that M2D2 offers investors and executives “easy, affordable, and coordinated access to world-class researchers and resources at the Lowell and Worcester UMass campuses.” There are presently 11 tenant medical device companies located in M2D2 laboratory space.

## **EXTERNAL REVIEW AND INSTITUTIONAL RESPONSE**

The external reviewers for this program were Andrew Coop, Ph.D., Professor and Chair, Department of Pharmaceutical Sciences, University of Maryland School of Pharmacy and George B. Corcoran, PhD, ATS, Professor and Chairman, Department of Pharmaceutical Sciences, Eugene Applebaum College of Pharmacy and Health Sciences, Wayne State University.

Both reviewers found the proposed programs to be strong, comprehensive, and congruent with the program goals. The content and sequencing of the curriculum were found to be comparable to curricula in highly regarded pharmaceutical sciences programs. The curriculum for the MS program was found to be appropriate in courses covered, and participating faculty viewed as well credentialed for delivering the material. The PhD curriculum was additionally noted to be well-structured for a coursework-heavy program. The utilization of existing courses while new courses were developed by new faculty was commended.

Dr. Coop suggested a rotation system, where students perform short rotations with at least two faculty members, could be introduced in their first year, with one per semester. He maintains that this approach would allow students and faculty to make informed decisions about a permanent advisor as proposed at the end of their first year. A focused research course included in the second year was recommended to expose students to research in their permanent mentor’s laboratory before the qualifying exam. It was also suggested by Dr. Coop, that the reporting structure and responsibilities of the Chair, Graduate Program Director, PhD Graduate Committee, Steering Committee, Admissions Committee, and Graduate Coordinators be more clearly delineated for faculty and students. It was found that the Graduate Group Model makes it essential for a program that spans several Departments and Schools to ensure all members of the program are invested and understand roles and responsibilities.

Dr. Corcoran found that the availability of six specialization options provided significant innovation within the curriculum, are thoughtfully selected and highly relevant, and have the ability to place the program at the forefront of pharmaceutical sciences curricula, attracting significant numbers of highly qualified graduate students. Dr. Corcoran also found that faculty areas of expertise support the goals and focus areas of the program. He suggested that while the program plan provides adequate information about facilities, equipment and library resources, there should be a long term goal of providing contiguous space of appropriate quality and amount to support the full potential of the program.

Dr. Corcoran found the overall design, structure, and program delivery plan to be sound. He made several recommendations: Consider a curriculum adjustment to curtail the amount of content and number of courses allow for increased specialization and expanded breadth, while maintaining competitive teaching loads. Revisit the course content to assure that Seminar, Research Topics, Introduction to Research, Ethics, Leadership Development, and Entrepreneurship be considered for inclusion. Substantial further investment in the number of high quality pharmaceutical sciences faculty will be required for the program to attain its' long range goal of reaching a top-20 ranking among pharmaceutical sciences programs nationally. The personnel budget should be revised to allow the program to attract a sufficient number of mid-career faculty who have earned established scientific reputations and have substantial federal funding. This should be a major goal as the program attracts the first round of faculty hires who will serve as the core of the department and will be the primary drivers of the quality and the external identity of the program. Dr. Corcoran noted that staffing levels appear to be lower than needed to launch and sustain the program. He recommended small additions in order to produce significant returns on investment as the program is established and refined.

Finally, a comprehensive assessment plan, together with a visionary strategic plan, was recommended in order for the evolution of the program to be guided by a systematic, informed, evidence-based, and responsive approach. Dr. Corcoran found elements of assessment in the proposal to be appropriate and important, but incomplete. He recommended that once a chair person is in place and faculty have more experience interacting, a focused and detailed plan should be prepared, vetted with stakeholders, and implemented.

### *Institutional Response*

UML agrees that greater breadth in the curriculum should be considered as the program is implemented. UML plans to achieve this goal through the six specialty options that promote interdisciplinary learning through courses taught by faculty outside of the Pharmaceutical Sciences Department. It was thought that there may have been some confusion about the number of new courses and the content of courses. The course syllabi were available in the proposal materials and most had content outlines within the syllabi. Due to the large number of course syllabi, UML suggested that perhaps the reviewers may have had difficulty finding specific items. UML addressed the reviewer comments to avoid any confusion in the rest of the review process by providing a description of the course development process and content for Seminar, Ethics, Education, and Leadership.

There was agreement between UML and both reviewers regarding doctoral students starting their research experiences earlier in their program of study and using research rotations to help students decide which mentor is the best fit for them. UML also agreed that research committees should be formed early in the doctoral students' research work.

UML agreed with Dr. Corcoran's recommendation to provide an administrative assistant to support the department chair upon hire. Recognizing that the salary required to recruit a skilled and talented department chair may be higher than listed in the draft budget, UML is prepared to offer a higher salary, consistent with market conditions, to candidates with stronger records. UML concurred that hiring mid-career faculty with successful funding records would be desirable as mid-career faculty hires generally bring grant funding and personnel with them. These can be assets that help academic programs grow, and the University intends to provides greater start-up support and adequate facilities to ensure that these faculty members continue to be

successful. UML responded that faculty salaries and start-up listed in the proposal are conservative in an effort to ensure that the budget does not exceed available resources. There is a willingness and desire to have budget projections that will allow these items to be increased.

In regard to lab facilities and equipment, UML is taking advantage of a strategy that places essential shared equipment in specialized core facilities that are supported by technical staff. UML has successfully implemented this strategy in developing facilities for engineering and science faculty. This approach was used in the design of the Emerging Technologies and Innovation Center (ETIC) that will house the new pharmaceutical sciences faculty and it reduced the level of start-up costs for individual faculty hired.

UML responded that it is prepared for the NIH recommendation that training grants and fellowships be increased, and that research-grant support of graduate students be gradually lowered. They maintain that it is unclear when or how NIH will respond to these recommendations, and in any case that UML will deal with the possible shift from research funding to training funding and adjust as necessary.

In response to the reviewers suggestions, UML will charge the new department chair to be hired to develop a Strategic Plan for the Pharmaceutical Sciences program. Discussion of elements to advance the new program will be included in the selection process for the new chair. UML further concurs that the administrative structure and reporting relationships should be strengthened and clarified. This will be an early and important role for the new department chair.

UML expressed appreciation for the input and suggestions made by the external reviewers, noting that their comments reflected their years of expertise as department chairs of pharmaceutical sciences and that will benefit UML as the program is implemented.

## **STAFF ANALYSIS AND RECOMMENDATION**

Staff thoroughly reviewed all documentation submitted by **University of Massachusetts Lowell** and the external reviewers. Staff recommendation is for approval of the **Master of Science in Pharmaceutical Sciences** and **Doctor of Philosophy in Pharmaceutical Sciences**.

Upon graduating the first class for these programs, the College shall submit to the Board a status report addressing its success in reaching program goals as stated in the application and in the areas of enrollment, curriculum, faculty resources, and program effectiveness.



Curriculum Outline (Attachment A)

**M.S. Program Curriculum Outline**

| <b><i>Major Required (Core) Courses (Total courses required = 12)</i></b> |  |                     |
|---|--|---------------------|
| <i>Course Number</i>  | <i>Course Title</i>                        | <i>Credit Hours</i> |
| PHSC.610  | Principles of Pharmaceutical Sciences      | 4                   |
| PHSC.620  | Pharmacokinetics                           | 3                   |
| PHSC.630  | Pharmaceutical Research Design and Ethics  | 3                   |
| PHSC.640  | Pharmaceutical Analysis                    | 4                   |
| PHSC.641  | Drug Delivery                              | 3                   |
| PHSC.710  | Advanced Topics in Pharmaceutical Sciences | 2                   |
| 30.550  | Human Development and Pathophysiology      | 3                   |
| 36.707  | Drug Metabolism                            | 3                   |
| 81.542  | Cell Biology                               | 3                   |
| 84.550  | Biochemistry I                             | 3                   |
| 84.562  | Pharmaceutical Biochemistry                | 3                   |
| 84.7xxx   | Principles of Medicinal Chemistry I        | 3                   |
|   | SubTotal # Core Credits Required           | 37                  |
| <b><i>Concentration Course Choices (Total courses required = 0)</i></b>   |  |                     |
|   | SubTotal # Concentration Credits Required  | 0                   |
| <b><i>Other/Elective Course Choices (Total courses required = 0)</i></b>  |  |                     |
|   | SubTotal # Elective Credits Required       | 0                   |
| <b><i>Curriculum Summary</i></b>  |  |                     |
| Total number of courses required for the degree                           |  | 12                  |
| Total credit hours required for degree                                    |  | 37                  |
| <b><i>Prerequisite or Other Additional Requirements:</i></b>              |  |                     |

Course descriptions are included in the "Detailed Curriculum Plan" beginning on page 3 of this document.

### Ph.D. Program Curriculum Outline

| <i>Major Required (Core) Courses (Total courses required = 12)</i> |   |                     |
|--|---|---------------------|
| <i>Course Number</i>   | <i>Course Title</i>                         | <i>Credit Hours</i> |
| PHSC.610   | Principles of Pharmaceutical Sciences       | 4                   |
| PHSC.620   | Pharmacokinetics                            | 3                   |
| PHSC.630   | Pharmaceutical Research Design and Ethics   | 3                   |
| PHSC.640   | Pharmaceutical Analysis                     | 4                   |
| PHSC.641   | Drug Delivery                               | 3                   |
| PHSC.710   | Advanced Topics in Pharmaceutical Sciences  | 2                   |
| 30.550   | Human Development and Pathophysiology       | 3                   |
| 36.707   | Drug Metabolism                             | 3                   |
| 81.542   | Cell Biology                                | 3                   |
| 84.550   | Biochemistry I                              | 3                   |
| 84.562   | Pharmaceutical Biochemistry                 | 3                   |
| 84.7xx   | Principles of Medicinal Chemistry I         | 3                   |
|  | SubTotal # Core Credits Required            | 37                  |
| <i>Option Course Choices (Total courses required = 4)</i>          |   |                     |
| <b>Clinical Research Option:</b>                                   |   |                     |
| PHSC.711   | Clinical Research Design and Methodology    | 3                   |
| PHSC.712   | Pharmacoepidemiology                        | 3                   |
| 19.577   | Biostatistics for Health Data               | 3                   |
| PHSC.713   | Applied Clinical Pharmacokinetics           | 3                   |
| <b>Nanopharmacology Option:</b>                                    |   |                     |
| 84.566   | Nanomaterials and Nanostructures            | 3                   |
| PHSC.714   | Nanotechnology and Drug Delivery            | 3                   |
| 81.576   | Cell Culture                                | 4                   |
| 81.588   | Structural Biology                          | 3                   |
| <b>Nuclear Pharmacology and Imaging Option:</b>                    |   |                     |
| 98.596   | Introduction to Medical Imaging             | 3                   |
| 98.534   | Internal Radiation Dosimetry & Bioassay     | 3                   |
| 98.541   | Radiochemistry                              | 3                   |
| 98.562   | Radiation Biology                           | 3                   |
| <b>Medicinal Chemistry Option:</b>                                 |   |                     |
| 84.7xx   | Principles of Medicinal Chemistry II        | 3                   |
| 36.708   | Mechanisms of Drug Action                   | 3                   |
| 84.551   | Biochemistry II                             | 3                   |
| 84.xx  | Chemistry elective (see choices below)      | 3                   |
| <b>Pharmacogenomics/Personalized Pharmacotherapy Option:</b>       |   |                     |
| 36.709   | Pharmacogenomic Principles and Applications | 3                   |

|  |   |       |
|--|---|-------|
| 36.551   | Advanced Pathophysiology                                | 3     |
| 36.580   | Clinical Applications of Molecular Genetics             | 3     |
| PHSC.xx  | Pharmaceutical Sciences elective                        | 3     |
| <b>Drug Discovery Option:</b>  |   |       |
| 81.528   | Molecular Biotechnology: Recombinant Protein Production | 3     |
| 81.576   | Cell Culture  | 4     |
| 81.588   | Structural Biology                                      | 3     |
| 36.708   | Mechanisms of Drug Action                               | 3     |
|  | SubTotal # Option Credits Required                      | 12-13 |
| <b><i>Dissertation and Seminar Courses (Total courses required = 4)</i></b>              |   |       |
|  | 4 courses   | 12-24 |
|  | SubTotal Dissertation & Seminar Credits Required        | 12-24 |
| <b><i>Other/Elective Course Choices (Total courses required = 0 to 1)</i></b>            |   |       |
| 81.567   | Molecular Biology                                       | 3     |
| 81.569   | Molecular Biology Laboratory                            | 2     |
| 81.576   | Cell Culture  | 4     |
| 81.532   | Genomics  | 3     |
| 81.534   | Genomics Laboratory                                     | 1     |
| 36.710   | Nutrigenomics   | 3     |
| 36.560   | Molecular Pathology                                     | 3     |
| 84.538   | Biochemical Mechanisms                                  | 3     |
| 84.560   | Advanced Physical Biochemistry                          | 3     |
| 84.568   | Organic Structural Analysis                             | 3     |
| 84.570   | Advanced Protein Chemistry                              | 3     |
| 84.514   | Advanced Analytical Chemistry                           | 3     |
| 98.599   | Advanced Medical Imaging                                | 3     |
|  | SubTotal # Elective Credits Required                    | 0-4   |
| <b><i>Curriculum Summary</i></b>   |   |       |
| Total number of courses required for the degree  |   | 20    |
| Total credit hours required for degree   |   | 61    |
| <b><i>Prerequisite or Other Additional Requirements:</i></b>                             |   |       |
| Qualifying Examination for Doctoral Candidacy after completion of major required courses |   |       |

Program Budget (Attachment B)  
 UMass New Program  
 Approval Budget  
 Campus: UMass Lowell  
 Program:  
 Pharmaceutical  
 Sciences

| <b>REVENUE ESTIMATES</b>  |  |   |  |   |  |   |  |   |  |   |
|---|--|---|--|---|--|---|--|---|--|---|
|   | Year 1<br>2014                         |   | Year 2<br>2015                         |   | Year 3<br>2016                         |   | Year 4<br>2017                         |   | Year 5<br>2018                         |   |
| <i>Full-Time Tuition Rate:<br/>In-State</i>   | \$1,637                                |   | \$1,637                                |   | \$1,637                                |   | \$1,637                                |   | \$1,637                                |   |
| <i>Full-Time Tuition Rate:<br/>Out-State</i>  | \$6,425                                |   | \$6,425                                |   | \$6,425                                |   | \$6,425                                |   | \$6,425                                |   |
| <i>Mandatory Fees per<br/>Student (In-state)</i>  | \$9,592                                |   | \$9,592                                |   | \$9,592                                |   | \$9,592                                |   | \$9,592                                |   |
| <i>Mandatory Fees per<br/>Student (out-state)</i>   | \$14,349                               |   | \$14,349                               |   | \$14,349                               |   | \$14,349                               |   | \$14,349                               |   |
| <i>FTE # of New Students:<br/>In-State</i>  | 0                                      |   | 18                                     |   | 22                                     |   | 22                                     |   | 25                                     |   |
| <i>FTE # of New Students:<br/>Out-State</i>   | 0                                      |   | 2                                      |   | 3                                      |   | 3                                      |   | 5                                      |   |
| <i># of In-State FTE<br/>Students transferring in<br/>from the institution's<br/>existing programs</i>  | 0                                      |   |  |   |  |   |  |   |  |   |
| <i># of Out-State FTE<br/>Students transferring in<br/>from the institution's<br/>existing programs</i> | 0                                      |   |  |   |  |   |  |   |  |   |
|   |  |   |  |   |  |   |  |   |  |   |
|   |  |   |  |   |  |   |  |   |  |   |
| <b>Tuition and Fees</b>   | <b>Newly<br/>Generated<br/>Revenue</b> | <b>Revenue<br/>from<br/>existing<br/>programs</b> | <b>Newly<br/>Generated<br/>Revenue</b> | <b>Revenue<br/>from<br/>existing<br/>programs</b> | <b>Newly<br/>Generated<br/>Revenue</b> | <b>Revenue<br/>from<br/>existing<br/>programs</b> | <b>Newly<br/>Generated<br/>Revenue</b> | <b>Revenue<br/>from<br/>existing<br/>programs</b> | <b>Newly<br/>Generated<br/>Revenue</b> | <b>Revenue<br/>from<br/>existing<br/>programs</b> |
| <b>First Year Students</b>  |  |   |  |   |  |   |  |   |  |   |
| Tuition   |  |   |  |   |  |   |  |   |  |   |
| In-State  | \$0                                    | \$0   | \$29,466                               | \$0   | \$36,014                               | \$0   | \$36,014                               | \$0   | \$40,925                               | \$0   |
| Out-of-State  | \$0                                    | \$0   | \$12,850                               | \$0   | \$19,275                               | \$0   | \$19,275                               | \$0   | \$32,125                               | \$0   |
| Mandatory Fees  | \$0                                    | \$0   | \$201,354                              | \$0   | \$254,071                              | \$0   | \$254,071                              | \$0   | \$311,545                              | \$0   |

|   |              |     |           |     |           |     |           |     |             |     |
|---|--------------|-----|-----------|-----|-----------|-----|-----------|-----|-------------|-----|
| <b>Second Year Students</b>   |              |     |           |     |           |     |           |     |             |     |
| Tuition   |              |     |           |     |           |     |           |     |             |     |
| In-State  |              |     | \$0       | \$0 | \$29,466  | \$0 | \$36,014  | \$0 | \$36,014    | \$0 |
| Out-of-State  |              |     | \$0       | \$0 | \$12,850  | \$0 | \$19,275  | \$0 | \$19,275    | \$0 |
| Mandatory Fees  |              |     | \$0       | \$0 | \$201,354 | \$0 | \$254,071 | \$0 | \$254,071   | \$0 |
| <b>Third Year Students</b>  |              |     |           |     |           |     |           |     |             |     |
| Tuition   |              |     |           |     |           |     |           |     |             |     |
| In-State  |              |     |           |     | \$0       | \$0 | \$29,466  | \$0 | \$36,014    | \$0 |
| Out-of-State  |              |     |           |     | \$0       | \$0 | \$12,850  | \$0 | \$19,275    | \$0 |
| Mandatory Fees  |              |     |           |     | \$0       | \$0 | \$201,354 | \$0 | \$254,071   | \$0 |
| <b>Fourth Year Students</b>   |              |     |           |     |           |     |           |     |             |     |
| Tuition   |              |     |           |     |           |     |           |     |             |     |
| In-State  |              |     |           |     |           |     | \$0       | \$0 | \$29,466    | \$0 |
| Out-of-State  |              |     |           |     |           |     | \$0       | \$0 | \$12,850    | \$0 |
| Mandatory Fees  |              |     |           |     |           |     | \$0       | \$0 | \$201,354   | \$0 |
| <b>Fifth Year Students</b>  |              |     |           |     |           |     |           |     |             |     |
| Tuition   |              |     |           |     |           |     |           |     |             |     |
| In-State  |              |     |           |     |           |     |           |     | \$0         | \$0 |
| Out-of-State  |              |     |           |     |           |     |           |     | \$0         | \$0 |
| Mandatory Fees  |              |     |           |     |           |     |           |     | \$0         | \$0 |
| <b>Gross Tuition and Fees</b>   | \$0          | \$0 | \$243,670 | \$0 | \$553,030 | \$0 | \$862,390 | \$0 | \$1,246,985 | \$0 |
| <b>Grants</b>   | \$0          | \$0 | \$200,235 | \$0 | \$400,470 | \$0 | \$600,705 | \$0 | \$800,940   | \$0 |
| <b>Contracts</b>  | \$0          | \$0 | \$0       | \$0 | \$0       | \$0 | \$0       | \$0 | \$0         | \$0 |
| <b>Campus budget allocation: faculty start-up</b>                             | \$250,000    | \$0 | \$250,000 | \$0 | \$250,000 | \$0 | \$250,000 | \$0 | \$250,000   | \$0 |
| <b>Campus budget allocation: undergraduate and Pharmacy Practice teaching</b> |              | \$0 |           | \$0 | \$148,500 | \$0 | \$216,000 | \$0 | \$297,000   | \$0 |
| <b>Other Revenues: Mass Life Sciences Capital Fund</b>                        | \$10,000,000 | \$0 |           | \$0 |           | \$0 |           | \$0 |             | \$0 |

|              |              |     |           |     |             |     |             |     |             |     |
|--------------|--------------|-----|-----------|-----|-------------|-----|-------------|-----|-------------|-----|
| <b>Total</b> | \$10,250,000 | \$0 | \$693,905 | \$0 | \$1,352,000 | \$0 | \$1,929,095 | \$0 | \$2,594,925 | \$0 |
|--------------|--------------|-----|-----------|-----|-------------|-----|-------------|-----|-------------|-----|

Faculty Form (Attachment C)

Summary of Faculty who will teach in the proposed program.

| Name of faculty member (Name, Degree and Field, Title)                | Tenured Y/N | Courses Taught Put (C) to indicate core course. Put (OL) next to any course currently taught online.  | # of sections                   | Division or College of Employment | Full- or Part-time in Program | Full- or part-time in other department or program (Please specify) | Sites where individual will teach program courses |
|---|-------------|---|---------------------------------|-----------------------------------|-------------------------------|--|---|
| Bello, Dhimiter<br>Sc.D., Occupational Hygiene<br>Associate Professor | Y           | <ul style="list-style-type: none"> <li>• Biomarkers in Occu &amp; Envi</li> <li>• Eval of Work Environment Haz</li> <li>• Exposure and Risk Assessment</li> <li>• Nanomaterials: Exp, Hlth &amp; Safety</li> </ul>      | (1)<br>(1)<br>(1)<br>(1)        | School of Health and Environment  | Part-Time                     | Part-Time, Work Environment Dept.                                  | • Main campus                                     |
| Braunhut, Susan<br>PhD, Pathobiology<br>Professor                     | Y           | <ul style="list-style-type: none"> <li>• Cancer Biology</li> <li>• Immunology</li> <li>• Immunology Lab</li> </ul>  | (1)<br>(1)<br>(8)               | College of Sciences               | Part-Time                     | Part-Time, Biological Sciences Dept.                               | • Main campus                                     |
| Bruce, Alease<br>PhD, Biomedical Physiology<br>Professor              | Y           | <ul style="list-style-type: none"> <li>• Anatomy &amp; Physiology I</li> <li>• Anatomy &amp; Physiology II</li> <li>• Clinical Immunology</li> <li>• Human Dev &amp; Pathophysiology</li> </ul>                         | (1)<br>(1)<br>(1)<br>(3)        | School of Health and Environment  | Part-Time                     | Part-Time, Clinical Laboratory & Nutritional Sciences Dept.        | • Main campus                                     |
| Budhlall, Bridgette<br>PhD, Polymer Science<br>Assistant Professor    | N           | <ul style="list-style-type: none"> <li>• Coatings Science &amp; Tech I</li> <li>• Nanoscale Transport Phenomena</li> <li>• New Plastics Materials</li> <li>• Polymer Sci I Lab</li> <li>• Polymer Sci II Lab</li> </ul> | (1)<br>(1)<br>(1)<br>(2)<br>(2) | College of Engineering            | Part-Time                     | Part-Time, Plastics Engineering Dept.                              | • Main campus                                     |
| Chiang, Long<br>PhD, Organic Chemistry<br>Professor                   | Y           | <ul style="list-style-type: none"> <li>• Org. Chem Lab IA</li> <li>• Org. Chem. Lab II</li> <li>• Organic Synthesis</li> <li>• Princs of Org Chem Lab</li> <li>• Structural Analysis</li> </ul>                         | (3)<br>(1)<br>(1)<br>(1)<br>(1) | College of Sciences               | Part-Time                     | Part-Time, Chemistry Dept.   | • Main campus                                     |

|  |   |  |  |                                  |           |   |               |
|--|---|--|--|----------------------------------|-----------|---|---------------|
| Doyle, Kathleen<br>PhD, Chemistry<br>Professor                                     | Y | <ul style="list-style-type: none"> <li>• Advanced Pathophysiology</li> <li>• Clinical Immunohematology</li> <li>• Human Biochem.</li> </ul>  | (2)<br>(2)<br>(2)                      | School of Health and Environment | Part-Time | Part-Time, Clinical Laboratory & Nutritional Sciences Dept. | • Main campus |
| French, Clayton<br>PhD, Radiological Sciences<br>Professor                         | Y | <ul style="list-style-type: none"> <li>• Certification Prep in Rad Sci</li> <li>• Environmental Health Physics</li> <li>• Int Dosimetry &amp; Bioassay</li> <li>• Math Methods of Rad Sci</li> <li>• Num Methods in Rad Sci</li> <li>• Radiation Safety &amp; Control I</li> </ul> | (1)<br>(1)<br>(1)<br>(2)<br>(2)<br>(3) | College of Sciences              | Part-Time | Part-Time, Physics & Applied Physics Dept.                  | • Main campus |
| Gaines, Peter<br>PhD, Molecular Genetics<br>Associate Professor                    | Y | <ul style="list-style-type: none"> <li>• Cell Culture</li> <li>• Cell Culture Lab</li> <li>• Stem Cell Bio</li> </ul>  | (1)<br>(6)<br>(1)                      | College of Sciences              | Part-Time | Part-Time, Biological Sciences Dept.                        | • Main campus |
| Garb, Jessica<br>PhD, Environmental Science, Policy & Mgmt.<br>Assistant Professor | N | <ul style="list-style-type: none"> <li>• Evolutionary Bio</li> <li>• Genomics</li> <li>• Genomics Lab</li> </ul>   | (1)<br>(1)<br>(1)                      | College of Sciences              | Part-Time | Part-Time, Biological Sciences Dept.                        | • Main campus |
| Gu, Zhiyong<br>PhD, Chemical & Biological Engineering<br>Associate Professor       | Y | <ul style="list-style-type: none"> <li>• Chemical Reaction Engineering</li> <li>• Nanoscale Transport Phenomena</li> <li>• Nanoscale Transp. Phenom. - Lab</li> <li>• Self Assembly &amp; Nanotechnology</li> <li>• Separation Process w/Mass Tran</li> </ul>                      | (1)<br>(1)<br>(1)<br>(1)<br>(1)        | College of Engineering           | Part-Time | Part-Time, Chemical Engineering Dept.                       | • Main campus |
| Guo, Hwai-Chen<br>PhD, Molecular Biology<br>Professor                              | Y | <ul style="list-style-type: none"> <li>• Prac. Protein Crystallography</li> <li>• Prac. Protein Crystallog. Lab</li> </ul>   | (1)<br>(1)                             | College of Sciences              | Part-Time | Part-Time, Biological Sciences Dept.                        | • Main campus |
| Hall, Garth<br>PhD, Biology<br>Associate Professor                                 | Y | <ul style="list-style-type: none"> <li>• Human Neurobio</li> <li>• Life Science I</li> <li>• Physiology</li> </ul>   | (1)<br>(1)<br>(1)                      | College of Sciences              | Part-Time | Part-Time, Biological Sciences Dept.                        | • Main campus |



|   |   |  |                          |                        |           |  |               |
|---|---|--|--------------------------|------------------------|-----------|--|---------------|
| Jahngen, Edwin<br>PhD, Physical<br>Organic Chemistry &<br>Synthetic<br>Methodology<br>Professor | Y | <ul style="list-style-type: none"> <li>• Biochemical Mechanisms</li> <li>• Chem of Natural Products</li> <li>• Org. Chem Lab I</li> <li>• Org. Chem Lab II</li> <li>• Pharmaceutical Biochemistry</li> </ul> | (1)<br>(1)<br>(1)<br>(1) | College of Sciences    | Part-Time | Part-Time, Chemistry Dept.                         | • Main campus |
| Lawton, Carl<br>PhD, Chemical Engineering<br>Associate Professor                                | Y | <ul style="list-style-type: none"> <li>• Biopharm Gmp &amp; Licensing</li> <li>• Biotech Process Proj Lab</li> <li>• Cell &amp; Microbe Cultivation</li> </ul>   | (1)<br>(1)<br>(1)        | College of Engineering | Part-Time | Part-Time, Chemical Engineering Dept.              | • Main campus |
| Mahd, Mufeed<br>PhD, Electrical & Computer Engineering<br>Associate Professor                   | Y | <ul style="list-style-type: none"> <li>• Electronics II</li> <li>• Integrated Power Systems</li> <li>• Real Time DSP</li> </ul>  | (2)<br>(1)<br>(1)        | College of Engineering | Part-Time | Part-Time, Electrical & Computer Engineering Dept. | • Main campus |
| Manohar, Sanjeev<br>PhD, Polymer Chemistry<br>Associate Professor                               | Y | <ul style="list-style-type: none"> <li>• Biopharm Gmp &amp; Licensing</li> <li>• Biotech Process Proj Lab</li> <li>• Intro to Engrg II</li> <li>• Intro to Eng. II Lab</li> </ul>                            | (1)<br>(1)<br>(1)<br>(4) | College of Engineering | Part-Time | Part-Time, Chemical Engineering Dept.              | • Main campus |
| Marx, Kenneth<br>PhD, Physical Biochemistry<br>Professor  | Y | <ul style="list-style-type: none"> <li>• Adv Physical Biochem</li> <li>• Appl Chem for Non-Scientists</li> <li>• Info Retrieval</li> </ul>   | (1)<br>(1)<br>(1)        | College of Sciences    | Part-Time | Part-Time, Chemistry Dept.                         | • Main campus |
| McCarthy, Stephen<br>PhD, Macromolecular Science<br>Professor                                   | Y | <ul style="list-style-type: none"> <li>• Medical Device Design I</li> <li>• Medical Device Design II</li> </ul>  | (1)<br>(2)               | College of Engineering | Part-Time | Part-Time, Plastics Engineering Dept.              | • Main campus |
| McDonald, Melisenda<br>PhD, Biochemistry<br>Professor   | Y | <ul style="list-style-type: none"> <li>• Bioanalytical Chemistry</li> <li>• Biochemistry I</li> <li>• Biochemistry II</li> <li>• Intro to Biochem</li> </ul>   | (1)<br>(1)<br>(1)<br>(1) | College of Sciences    | Part-Time | Part-Time, Chemistry Dept.                         | • Main campus |

|  |   |  |                                 |                                  |           |   |               |
|--|---|--|---------------------------------|----------------------------------|-----------|---|---------------|
| <b>Namm, Theodore<br/>PhD, Genetics<br/>Professor</b>                                      | Y | <ul style="list-style-type: none"> <li>• Anatomy &amp; Physiology I</li> <li>• Anatomy &amp; Physiology II</li> <li>• Clin Appl of Molecular Genetics (O)</li> <li>• Human A&amp;P Lab I</li> <li>• Medical &amp; Clin Genetics</li> </ul> | (2)<br>(2)<br>(1)<br>(1)<br>(3) | School of Health and Environment | Part-Time | Part-Time, Clinical Laboratory & Nutritional Sciences Dept. | • Main campus |
| <b>Rai, Prakash<br/>PhD, Chemical &amp; Biological Engineering<br/>Assistant Professor</b> | N | <ul style="list-style-type: none"> <li>• Material Balances</li> </ul>  | (1)                             | College of Engineering           | Part-Time | Part-Time, Chemical Engineering Dept.                       | • Main campus |
| <b>Ryan, David<br/>PhD, Chemistry<br/>Professor</b>  | Y | <ul style="list-style-type: none"> <li>• Adv Analytical Chemistry</li> <li>• Analytical Chem II Lab</li> <li>• Analytical Chem Lab I</li> <li>• Analytical Chemistry II</li> <li>• Chemical Oceanography</li> </ul>                        | (1)<br>(1)<br>(1)<br>(1)<br>(1) | College of Sciences              | Part-Time | Part-Time, Chemistry Dept.                                  | • Main campus |
| <b>Sajo, Erno<br/>PhD, Physics<br/>Professor</b>   | Y | <ul style="list-style-type: none"> <li>• Lab for Exploring the Universe</li> <li>• Monte Carlo Simul/Rad Trans</li> <li>• Physics I</li> <li>• Radiation Biology</li> <li>• Radiation Interactions &amp; Trans</li> </ul>                  | (3)<br>(1)<br>(1)<br>(1)<br>(1) | College of Sciences              | Part-Time | Part-Time, Physics & Applied Physics Dept.                  | • Main campus |
| <b>Shea, Thomas<br/>PhD, Biology<br/>Professor</b>   | Y | <ul style="list-style-type: none"> <li>• Life Science I</li> </ul>   | (2)                             | College of Sciences              | Part-Time | Part-Time, Biological Sciences Dept.                        | • Main campus |

|   |   |   |  |                        |           |  |               |
|---|---|---|--|------------------------|-----------|--|---------------|
| Tries, Mark<br>PhD, Physics<br>Associate Professor                  | Y | <ul style="list-style-type: none"> <li>• Ext Dosimetry &amp; Shieldng</li> <li>• General Physics I Lab</li> <li>• Nuclear Instrumentation</li> <li>• Radiation and Life Lab</li> <li>• Radiation Safety &amp; Control II</li> <li>• Radiochemistry</li> </ul> | (1)<br>(2)<br>(2)<br>(3)<br>(1)<br>(1) | College of Sciences    | Part-Time | Part-Time, Physics & Applied Physics Dept.         | • Main campus |
| Wang, Xingwei<br>PhD, Electrical Engineering<br>Associate Professor | Y | <ul style="list-style-type: none"> <li>• Electronics I Lab (lecture)</li> <li>• Electronics I Lab (lab)</li> <li>• Electronics Lab II (lecture)</li> <li>• Electronics Lab II (lab)</li> <li>• Intro to Elect &amp; Computer Eng</li> </ul>                   | (2)<br>(6)<br>(2)<br>(6)<br>(2)        | College of Engineering | Part-Time | Part-Time, Electrical & Computer Engineering Dept. | • Main campus |
| Xu, Jin<br>PhD, Biochemistry<br>Assistant Professor                 | N | <ul style="list-style-type: none"> <li>• Chemistry II</li> <li>• Protein Chemistry</li> </ul>   | (1)<br>(1)                             | College of Sciences    | Part-Time | Part-Time, Chemistry Dept.                         | • Main campus |
| Yan, Mingdi<br>PhD, Organic Chemistry<br>Professor                  | Y | <ul style="list-style-type: none"> <li>• Nanomaterials &amp; Nanostructures</li> <li>• Protein Chemistry</li> </ul>   | (1)<br>(1)                             | College of Sciences    | Part-Time | Part-Time, Chemistry Dept.                         | • Main campus |
| Yaroslavsky, Anna<br>PhD, Biophysics<br>Associate Professor         | Y | <ul style="list-style-type: none"> <li>• Advanced Medical Imaging</li> <li>• Physics I</li> <li>• Seminar in Biomedical Optics</li> </ul>   | (1)<br>(2)<br>(2)                      | College of Sciences    | Part-Time | Part-Time, Physics & Applied Physics Dept.         | • Main campus |
| Yoon, Seongkyu<br>PhD, Chemical Engineering<br>Assistant Professor  | N | <ul style="list-style-type: none"> <li>• Material Balances</li> <li>• Processes &amp; Controls Lab (Lect)</li> <li>• Processes &amp; Controls Lab (Lab)</li> <li>• Adv Control Strategies</li> </ul>  | (1)<br>(1)<br>(2)<br>(1)               | College of Engineering | Part-Time | Part-Time, Chemical Engineering Dept.              | • Main campus |