College of Pharmacy & Pharmaceutical Sciences Graduate Catalog 2017-2018

Degrees Offered

Doctor of Philosophy in Experimental Therapeutics

Doctor of Philosophy in Medicinal Chemistry

Master of Science in Medicinal Chemistry

Master of Science in Pharmaceutical Sciences

- Health Outcomes and Socioeconomic Sciences
- Industrial Pharmacy
- Pharmacology/Toxicology

Pharm.D./Doctor of Philosophy in Medicinal Chemistry Dual Degree

Bachelor of Science in Pharmaceutical Sciences (Medicinal and Biological Chemistry) and Master of Science in Medicinal Chemistry (BSPS/MS) combined 5-year option

Master of Science in Pharmaceutical Sciences

The Master of Science in pharmaceutical sciences degree is designed to prepare an individual for responsibilities in professional practice, the pharmaceutical industry and scientific research beyond those possible with a baccalaureate.
Although a single degree is conferred, specialization is possible in that the curriculum is organized into three distinct disciplines, referred to here as "options". Applicants must select the program of study (option) they wish to pursue. The options available to graduate students are pharmacology/toxicology, health outcomes and socioeconomic sciences, and industrial pharmacy.

The requirements for the Master of Science in pharmaceutical sciences degree differ according to the option. The minimum course work for the industrial pharmacy major is 24 semester hours, for the pharmacology/toxicology major 28 semester hours and for the health outcomes and socioeconomic sciences major 27 semester hours. In addition, each major requires a minimum of 6 semester hours of thesis research.

Admission Requirements

In general, a baccalaureate in the sciences is required for admission, although applicants possessing other bachelor's degrees will be considered if the latter represent adequate preparation. Certain options and graduate courses require undergraduate preparation as prerequisites, and this preparation should be completed as soon as possible upon admission. The total time required for completion of the graduate program leading to the Master of Science in pharmaceutical sciences degree will depend upon the preparation of the student entering the program. Normally two years of study and research are required.

The admission requirements of the College of Graduate Studies of the University apply. The

basic requirement is a 2.7 (on a 4.0 scale) GPA on all undergraduate work leading to the bachelor's degree. Applicants having less than a 2.7 GPA on all undergraduate work will be considered for admission if other criteria for estimation of potential success in graduate studies are positive.

Each student must submit three copies of transcripts, one of which must be official and show all post-secondary academic work and degrees granted, three letters of recommendation from college faculty members acquainted with the applicant's character and ability, and scores from the aptitude portion of the GRE.

International students are required to take the TOEFL, which will be given in their own country by the Educational Testing Service.

Normally, acceptance will be decided by April 1 for admission during the following fall semester. The priority deadline for completed applications is January 15th. Complete applications received by this deadline will be considered for admission. Applications received after the January 15th deadline may also be considered, if positions are available in a program. International students are encouraged to submit applications one month prior to the stated deadline to allow for delays in international correspondence.

Curriculum and Options – M.S. Program in Pharmaceutical Science

Pharmacology/Toxicology option: A minimum of 28 semester hours of courses plus a minimum of 6 thesis credit hours are required for the degree.

Undergraduate courses required (or their equivalents):

Course	*Course Name*	*Credit Hours*
CHEM3710	Physical Chemistry for the Biosciences I	3
CHEM3720	Physical Chemistry for the Biosciences II	3
MATH1750	Calculus for the Life Sciences I	4
MATH1760	Calculus for the Life Sciences II	3
MBC3310	Medicinal Chemistry I: Drug Action and Design	3
MBC3320	Medicinal Chemistry II: Drug Targeting to Receptors	3
PHCL2610	Introduction to Human Physiology	3

Graduate courses required:

Course	*Course Name*	*Credit Hours*
PHCL5140	Interpretation of Pharmaceutical Data	2
PHCL5700	Pharmacology I	3
PHCL5720	Pharmacology II	3
PHCL5730	Toxicology I	3
PHCL5760	Toxicokinetics	3
PHCL6600	Seminar in Pharmacology	1**-2
PHCL6700	Pharmacology III	3
PHCL6720	Pharmacology IV	3
PHCL6900*	M.S. Thesis Research in Pharmacology	1-6
PHCL6920*	M.S. Thesis Research in Pharmacology	1-6

***6 credit hours are the required minimum; more than 6 credit hours can be taken.**
****1 credit hour can only be taken for BSPS/MSPS combined degree.**

Elective course work may be selected from the following (up to 6 credits of electives)*:**

***Other electives may be recommended by the department graduate committee.

BSPS-MSPS in Pharmaceutical sciences – PTox

The combination of BSPS and MSPS degrees in PTox gives students the ability and choice to elect to get two degrees in five years. Currently, BSPS students will take 3.5-4 years to graduate and MSPS students will take 2 years. This will take up to 1 year off of the combined BS-MSPS degree.

All BSPS degree requirements remain intact. The student electing this program will need to achieve two things. First, the student taking classes that are required courses in the BSPS curriculum are also taking most of what is required in the MSPS curriculum in PTox. Classes that are required in BSPS that may be waived for the Master's curriculum with an achieved grade of B- or better will be:

PHCL	5700	Pharmacology I	3
PHCL	5720	Pharmacology II	3
PHCL	5730	Toxicology I	3
PHCL	6700	Pharmacology III	3

This will leave the internship which must then be done in the summer between P1 and P2. To fulfill both the internship and degree credit requirements, this must be 9-12 credits during this summer. The student must do the internship and the Master's degree program thesis with the same PI. This allows ideas and training done in the internship phase to be carried forward in the Master's degree program.

Master's degree program students in this combined degree curriculum will be starting in the spring after graduation in December (9 credits). The Master's program will go through the summer (4-6 credits), following fall (10 credits) and spring (9 credits), and a possible 2 credit summer where the students would defend.

Health Outcomes and Socioeconomic Sciences option: A minimum of 27 semester hours of course work plus a minimum of 6 thesis hours are needed for the degree. For students enrolled in the clinical track a minimum of 24 semester hours of course work plus a minimum of 6 thesis hours are needed for the degree. Candidates that would be eligible for the Clinical Track include: 1). University of Toledo students or graduates with eligibility based on satisfactory completion of PHPR 3260 (Pharmacy HealthCare Administration 1) and PHPR 4520 (Pharmacy HealthCare Administration 2) and 2) PharmD. graduates from other programs with eligibility reviewed on a case by case basis with respect to competencies in Pharmacy HealthCare Administration.

Core Courses:

Course	*Course Name*	*Credit Hours*
PHPR5260	Pharmacy & Healthcare Administration I	2
PUBH 6000	Biostatistics	3
PHPR5590	Readings in Health Care Access and Cultural Competence	2
PHPR5610	Pharmacoeconomics and Outcomes Research I	2
PHPR6600	Seminar in Health Outcomes and Socioeconomic Sciences	1
PHPR6530	Research Methods in Pharmacy Practice	2
PHPR6960	Thesis Research in Pharmacy	1-6*
PUBH6060	Advanced Biostatistics	3

Program Tracks, with approved track courses are as follows:

1. Business Administration- Track Courses

- BUAD6100 Accounting for Strategic Decisions 3
- BUAD6200 Corporate Finance 3
- BUAD6300 Strategic Marketing & Analysis 3
- BUAD6500 International Business 3

  PHPR 5520 Pharmaceutical Marketing and Management 3

2. Outcomes Research-Track Courses

- PUBH6600 Health Behavior 3
- PUBH6460 Health Promotion Programs 3
- PUBH6010 Public Health Epidemiology 3
- PUBH6030 Advanced Epidemiology 3
- PUBH6110 Categorical Data Analysis 3
- PHPR6280 Medication Therapy and Disease State Mgmt 2

3. Pharmacoeconomics-Track Courses

- PHPR5620 Pharmacoeconomics and Outcomes II 3
- ECON5750 Health Economics 3
- ECON5810 Econometrics Models and Methods I 4
- ECON5820 Econometrics Models and Methods II 4
- PUBH6110 Categorical Data Analysis. 3
- PUB 6010 Public Health Epidemiology 3

4. Social Behavior Sciences- Track Courses

- PUBH6600 Health Behavior 3
- PUBH6460 Health Promotion Programs 3
- RESM6220 Measurement I 3
- PHPR5520 Pharmaceutical Marketing & Management 3
- PHPR6280 Medication Therapy and Disease State Mgmt 2

5. Clinical Science – Track Courses

- PUBH6460 Health Promotion Programs 3
- PUBH6600 Health Behavior 3
- PUBH6110 Categorical Data Analysis 3
- PUBH6010 Public Health Epidemiology 3
- RESM6220 Measurement I 3

All students admitted to this option, must comply with the policies and procedures stated in the 'graduate student handbook,' provided to students during orientation. Additional requirements, for successful completion of this degree option, are stated in the graduate handbook.

Industrial Pharmacy option: A minimum of 24 credit hours of course work and a minimum of 6 credit hours of thesis work for a total of 30 required minimum credit hours for the degree.

Undergraduate courses required:
Courses will be evaluated for students with a B.S. in pharmacy, Pharm.D. or B.S.P.S. degree.

Course	*Course Name*		*Credit Hours*
MBC3550	Physiological Chemistry I: Structure and Function of Biological Macromolecules		3
MBC3560	Physiological Chemistry II: Chemical Regulation of Cells and Organisms		3
PHPR3070	Pharmaceutics and Pharmaceutical Technology I and		
PHPR3080	Pharmaceutics and Pharmaceutical Technology II	or	8-9
CHEM3710	Physical Chemistry for the Biosciences I and		
CHEM3720	Physical Chemistry for the Biosciences II and		
CHEM3730	Physical Chemistry I		

Graduate required courses:

Course	*Course Name*	*Credit Hours*
MBC5620	Biochemical Techniques	2
PHPR5710	Selected Topics in Pharmaceutical Technology	2-3
PHPR5990	Problems in Pharmacy Practice	1-6
PHPR6530	Research Methods in Pharmacy Practice	2
CHEM6810	Materials Science I	4
PHPR5700	Equilibrium Phenomenon	2
PHPR 5780	Advanced drug delivery systems-II	2
CHEM 6310	Separation methods	2-4

Course	*Course Name*	*Credit Hours*
XXXXXXX	Elective **	2-4
PHPR5720	Pharmaceutical Rate Processes	3
PHCL5760	Toxicokinetics	3
PHPR 5770	Advanced Drug Delivery Systems -1	3
PUBH6000	Biostatistics	3
CHEM6300	Advanced Analytical Chemistry	4
MBC5100	Practices in Pharmaceutical Research	1
PHPR6850	Product Development Laboratory	2
PHPR6950	Seminar	1
PHPR 6960	MS Thesis Research in Pharmacy	6-8*

1) *6 thesis credit hours are the required minimum; more than 6 credit hours can be taken.
2) ** Two credit hours of electives must be satisfied by taking courses within the PHPR Department.
3) Successful oral defense of the thesis before the thesis advisory committee (consisting of the thesis adviser and two other members) and presentation of the results of the thesis research in a seminar before the Division of Industrial Pharmacy.
4) Acceptance of thesis by the M.S. thesis adviser and the thesis advisory committee.

Applicants for the health outcomes and socioeconomic sciences and industrial pharmacy options who possess a B.S. in pharmacy, Pharm.D. or bachelor of science in pharmaceutical sciences degree from an ACPE-accredited institution will be given preference for admission into those options. International applicants must have earned pharmacy degrees from their home institutions.

Master of Science in Medicinal Chemistry

Admission Requirements

Satisfactory completion of a bachelor's degree in chemistry, biology, pharmacy or a related discipline is required. It is assumed the undergraduate training will include differential and integral calculus, college physics, a one-year course in general and inorganic chemistry including a laboratory, a one-year course in organic chemistry including a laboratory, and training in analytical chemistry. An undergraduate course in physical chemistry is recommended.

The admission requirements of the College of Graduate Studies of the University apply.

Degree Requirements

Master's students need to complete the following courses as partial fulfillment of their requirement for an M.S. degree:

Course	*Course Name*	*Credit Hours*
MBC5100	Ethical Conduct of Research	1
MBC5900	Medicinal Chemistry Seminar	3-4[a]
MBC6190	Advanced Medicinal Chemistry	4
MBC6960	M.S. Thesis Research in Medicinal Chemistry	6-16[b]
	Electives	>5[c]
Total		30[d]

[a] One hour can be taken during each semester (fall or spring , not summer). A minimum of 3 credit hours are required, up to 4 count towards degree completion.

[b] A minimum of 6 hours are required , up to 16 hours count toward degree completion.

[c] Other 5000- to 6000-level courses should be taken as electives, as advised. A minimum of 5 hours of electives are required, but more than 5 hours can be taken and will be counted towards degree completion. Typically, students with more biological interests will take MBC 6550 Biochemistry and/or MBC 6200 Biomedicinal Chemistry as electives and students with more chemical interests will take CHEM 6400 Advanced Organic Chemistry and CHEM 6410 Organic Synthesis.

[d] The total number of credit hours at the graduate level (course numbers 5000 and 6000) including classroom courses, seminar and M.S. Thesis Research needs to be at least 30. This total can be achieved in different ways by varying the number of seminar, research and electives while maintaining the range limits for each category specified above.

In addition, the following items also must be completed:

1. Preparation of a written M.S. thesis based upon the results of an original research investigation performed by the student during the M.S. program at The University of Toledo.
2. Successful oral defense of the thesis before the thesis advisory committee (consisting of the thesis adviser and two other members) and presentation of the results of the thesis research in a seminar before the Department of Medicinal and Biological Chemistry.
3. Acceptance of this thesis by the M.S. thesis adviser and the thesis advisory committee.

4. Maintenance of a cumulative graduate GPA of 3.0 or higher.
5. One semester of experience as a teaching assistant. The program believes experience in teaching is critical to solidifying the student's understanding of the basics of the field and improving communication skills.

Medicinal and Biological Chemistry (MBC) Major & Master of Science (M.S.) in Medicinal Chemistry (MC) Option

Admission Requirements

Students need to meet the requirements for entry into the Bachelor of Science of Pharmaceutical Science (BSPS) program. At the beginning of the second semester of their P1 year (spring semester, third year of study) the student applies for provisional acceptance into the graduate program and identifies an MBC faculty mentor for an in-house internship to be taken during the summer between the P1 and P2 year. Once the BSPS degree is awarded the student will be fully accepted into the graduate program. The internship mentor will become the graduate advisor of the student.

Course	*Course Name*	*Credit Hours*
MBC 3310	Medicinal Chemistry I	2
MBC 3330	Techniques in Pharmaceutical and Medicinal Chemistry	2
MBC 3340	Techniques in Pharmaceutical and Medicinal Chemistry Laboratory	1
PHCL 3700	Pharmacology I	3
MBC	3550.Physiological Chemistry I	3
MBC Laboratory (Recommend MBC 3880)[1]...		3
Major Elective [2]		2
*Second Semester**		
MBC 3100	Practices in Pharmaceutical Research	1
MBC 3320	Medicinal Chemistry II	2
MBC 3560	Physiological Chemistry II	3
PHCL 3730	BSPS Pharmacology II	3
MBC Laboratory (Recommend MBC 3880)[1]		3
Major Elective (Recommend MBC 3100)[2]		1
Major Elective (Recommend MBC 4870) [2]		1-4

Third semester (Summer)

MBC 4780 Internship in Med. & Biol. Chem[4] 6-12

P2 Year

First Semester

MBC 4710 Targeted Drug Design[3] 3
Major Elective (Recommend MBC 4850)[2] 1-10
MBC Laboratory (Recommend MBC 4880)[1] or Major Elective 3

Graduation December giving 3.5 years for the B.S.P.S. MBC degree completion +

[1]The MBC major requires that 3 semester hours of laboratory instruction be taken at the 3000 level or higher in a course taught by the MBC Department. Completion of 3 semester hours of any of the following courses will satisfy this requirement: MBC 3880, MBC 4850, MBC 4870, MBC 4880, MBC 4900, MBC 4950, or MBC 4960. MBC 3850 Microbiology & Immunology Lab, 1 semester hour credit does not satisfy this requirement ***unless*** it is taken with an additional 2 credit hours of any of the other approved laboratories listed above.

[2]To be chosen from the MBC electives list. (see College of Pharmacy and Pharmaceutical Sciences Catalogue)

[3]MBC 4720, Advances in Drug Design, when offered, will also fulfill the requirement.

* At the beginning of the second semester the student identifies a MBC faculty mentor for an in-house internship and applies for provisional acceptance to the graduate school.

[4]Internship must be taken in the summer before the P2 year with an in house MBC faculty mentor who will then be the mentor for the M.S. degree.

+ Once the B.S.P.S. degree is awarded the student can move from provisional to accepted in the graduate program. Requirements to be fulfilled for the MS MC degree are given directly above

The student would begin the master's portion in the spring semester following the B.S.P.S. MBC graduation at the end of the Fall term, and could complete the M.S. degree by the end of the Spring semester of the following year. Therefore the two degrees, B.S.P.S. MBC and M.S. MC, could be accomplished in 5 calendar years.

.

Doctor of Philosophy in Medicinal Chemistry

Admission Requirements

Satisfactory completion of a bachelor's degree in chemistry, biology, pharmacy or a related discipline is required. It is assumed that the undergraduate training will include differential and integral calculus, college physics, a one-year course in general and inorganic chemistry including a laboratory, a one-year course in organic chemistry including a laboratory, and training in analytical chemistry. An undergraduate course in physical chemistry is recommended.The ability to excel in graduate studies and research must be evident based on grades from undergraduate studies, recommendations from college faculty, results from standardized aptitude and achievement examinations (Graduate Record Examination), and performance in research and independent study.

Students with M.S. degrees in medicinal chemistry or related fields may be admitted directly to the Ph.D. program. For students entering the Medicinal Chemistry PhD program who have an MS in Medicinal Chemistry, the department will review the prior graduate coursework and may allow up to 30 credit hours towards the 90 credits needed for the PhD. Allowance toward requirements for teaching assistant experience and elective credits will also be considered in the evaluation. Students without M.S. degrees may be admitted directly to the Ph.D. program, but must take 30 credits at the master's level prior to accruing doctoral level credits.

Ph.D. students need to complete the following courses as partial fulfillment of their requirement for a Ph.D. degree. Additional graduate courses (5000 to 8000 level) may be required, as advised during the development of each student's plan of study.

Course	*Course Name*	*Credit Hours*
MBC5100/7100	Ethical Conduct of Research	1
MBC 5900/7900	Medicinal Chemistry Seminar	6-8[a]
MBC6190/8190	Advanced Medicinal Chemistry	4
MBC6200/8200	Biomedicinal Chemistry	4
MBC6300/8300	Biomedicinal Chemistry Laboratory I	1
MBC6310/8310	Biomedicinal Chemistry Laboratory II	3
MBC6550/8550	Biochemistry	4
MBC8960	Ph.D. Dissertation Research in Medicinal Chemistry	>30[b]
	Electives	>8[c]
Total	.....	90

[a] One hour can be taken during each semester (fall or spring, not summer). A minimum of 6 hours, taken over 6 semesters, are required, up to 8 hours count towards degree completion.

[b] A minimum of 30 hours are required, but more than 30 hours can be taken and count towards degree completion.

[c] Other 5000- and above level courses should be taken as electives, as advised. A minimum of 8 hours are required, but more than 8 hours can be taken and will be counted towards degree completion. The following is a list of recommended elective courses:

Chemistry Courses

Course	*Course Name*	*Credit Hours*
CHEM6330	Spectroscopic Methods	2-4
CHEM6400/8400	Advanced Organic Chemistry	2-4
CHEM6410/8410	Organic Synthesis	2-4
CHEM6420	Physical Organic Chemistry	2-4
CHEM6510/8510	Protein Chemistry	2-4
CHEM6520/8520	Enzymology	2-4
CHEM6530/8530	Nucleic Acid Chemistry	2-4

Biology Courses

Course	*Course Name*	*Credit Hours*
BIOL6010/8010	*Advanced Molecular Biology*	*4*
BIOL6020/8020	*Advanced Molecular Biology*	*3*
BIOL6090/8090	*Advanced Cell Biology*	*4*
BIOL6100/8100	*Research Methodology: Cell and*	*3*

Medicinal and Biological Chemistry Courses

Course	*Course Name*	*Credit Hours*
MBC5380/7380	Medicinal and Poisonous Plants	3
MBC6100/8100	Advanced Immunology	2
MBC6800/8800	Methods in Biotechnology	3

Other 5000/7000 or 6000/8000 level courses as advised

In addition, all students must satisfy the following:

1. Minimum of 60 semester hours of graduate credit beyond the master's level (course numbers 7000 and above), including a minimum of 15 hours of courses, laboratories and seminars (exclusive of dissertation research) and a minimum of 30 hours of Ph.D. dissertation research.
4. Subsequent to admission to candidacy for the Ph.D. degree, the student is expected to spend a minimum of two semesters in full-time study at The University of Toledo.
5. Preparation of a Ph.D. dissertation based on the results of an original research investigation performed by the student during his/her Ph.D. program at The University of Toledo.
6. Presentation of the results of the dissertation research in a public seminar before the Department of Medicinal and Biological Chemistry and successful oral defense of the dissertation before the dissertation advisory committee.
7. Acceptance of the dissertation by the Ph.D. dissertation adviser and the dissertation advisory committee.
8. Maintenance of a cumulative graduate GPA of 3.0 or higher.
9. Three semesters of experience as a teaching assistant. The program believes experience in teaching is critical to solidifying the student's understanding of the basics of the field and improving communication skills.

Doctor of Philosophy in Experimental Therapeutics

Program Overview

Experimental therapeutics is the integration of basic and applied sciences focused on the study and development of new treatments for human disease. Research in experimental therapeutics seeks to understand human diseases from the molecular level to the whole organism in order to develop rational approaches for new pharmacological treatments. In addition, experimental therapeutics includes the development of new therapies through systematic investigation at increasing levels of complexity ranging from individual molecules and proteins, to cellular and tissue based assays and to the whole organism. The purpose of the program is to train students at the doctoral level who can translate discoveries in the laboratory to therapies in a clinical setting.

Admission Requirements

Satisfactory completion of a bachelor's degree in chemistry, biology, pharmaceutical sciences, pharmacy or a related discipline is required.

The ability to excel in graduate studies and research must be evident based on grades from undergraduate studies, recommendations from college faculty, results from standardized aptitude and achievement examinations (Graduate Record Examination), and performance in research and independent study.

Students with M.S. degrees in pharmacology or related fields (e.g., pharmaceutical sciences) may be also admitted to the program. However, they are expected to have a minimum of 30 credits at the Master's level prior to accruing doctoral level credits.

Required Courses

Ph.D. students need to complete the following required courses at the 5000 to 8000 level as partial fulfillment of the requirements for a Ph.D. degree. The course level is determined by the number of graduate credits completed at the time of registering for that particular course.

Course	*Course Name*	*Credit Hours*
PHCL5700	Pharmacology I	3[a]
PHCL5100/7100	Principles of Experimental Therapeutics I	3
PHCL5200/7200	Principles of Experimental Therapeutics II	3
PHCL5770/7770	Current Topics in Toxicology I	1[b]
PHCL6650/8650	Seminar in Experimental Therapeutics (Minimum 6 hours required)	2
PHCL5460/7460	Current Topics in Pharmacokinetics/Toxicokinetics	1[c]
PHCL5440/7440	Current Topics in Interpretation of Pharmaceutical Data	1[d]
PHCL6300/8300	Research Experience in Experimental Therapeutics	2-6[e]
PHCL8960	Ph.D. Dissertation Research in Experimental Therapeutics	1-15[f]
MBC6190/8190	Advanced Medicinal Chemistry	4
OR		
PHCL5500/7500	From Experimental to Applied Therapeutics	4
INDI6020/8020	On Being a Scientist	1

[a] Not required if this same course, or PHCL3700 or equivalent was taken previously. If taken by Masters' students admitted to the program with eligibility to take 7/8 level courses, the PHCL 5700credit will not count toward those credits required for the Ph.D. degree.

[b]Requires PHCL4730 or PHCL5730 as pre-requisite or PHCL5730 as co-requisite. If PHCL-5730 taken by Masters' students admitted to the program with eligibility to take 7/8 level courses, the credit for this course will not count toward those required for the Ph.D. degree.

[c]Requires PHCL4760 or PHCL5760 as pre-requisite or PHCL5760 as co-requisite. If PHCL 5760 taken by Masters' students admitted to the program with eligibility to take 7/8 level courses, the credit for this course will not count toward those required for the Ph.D. degree.

[d]Requires PHCL5140 as pre- or co-requisite. If taken by Masters' students admitted to the program with eligibility to take 7/8 level courses, the credit for this course will not count toward those required for the Ph.D. degree.

[e] To fulfill the required laboratory rotations, a minimum of 4 hours must be taken in two different sections of the course (2 hours in each).
[f] A minimum of 30 hours is required

General Elective Courses

In addition to the required courses, general elective courses may be selected from the following. The course level to be taken is dependent on the number of graduate credits earned at the time of registration for that particular course:

Course	*Course Name*	*Credit Hours*
PHCL5750	Toxicology II	3
PHCL5630	Cancer Chemotherapy	3
PHCL5990	Problems in Pharmacology	1-6
PHCL6390/8390	Problems in Experimental Therapeutics	1-6
MBC5620/7620	Biochemical Techniques	2
MBC5380/7380	Medicinal and Poisonous Plants	3
MBC6100/8100	Advanced Immunology	2
MBC6800/8800	Methods in Biotechnology	3
MBC6550/8550	Biochemistry	4
CHEM6510/8510	Protein Chemistry	2-4
CHEM6520/8520	Enzymology	2-4
CHEM6530/8530	Nucleic Acid Chemistry	2-4
BIOL6010/8010	Advanced Molecular Biology	4
BIOL6090/8090	Advanced Cell Biology	4
BIOL6100/8100	Research Methodology: Cell Mol. Biol.	3

Specialized Elective Courses

Specialized elective courses are recommended for students with concentrations in different areas of the program, and may be selected from the following list:

Course	*Course Name*	*Credit Hours*
BMSP6340/8340	CPRA in Cell Signaling and Biology	3
BMSP6330/8330	CPRA Protein Structure & Catalysis	2.5
BMSP6340/8340	CPRA Genes & Genomes	2.5
BMSP6360/8360	CPRA Cell Membrane	3
IITP6020/8020	Advanced Immunology	1
NND5810/7810	Neuroscience	6
BIOE5620	Cellular Electrophysiology	3
MFGM8690	Innovation in Technology Commercialization	3

Other elective courses may be taken with the approval of the department graduate committee

Additional Requirements

In addition, all students must satisfy the following:

1. Minimum of 90 semester hours of graduate credit, including a minimum of 30 semesters hours at the Masters level, and a Minimum of 60 semester hours of graduate credit beyond the master's level. The required minimum 60 credits beyond the Masters level should include a minimum of 30 hours of Ph.D. dissertation research.
2. Students admitted with a minimum of 30 semester hours at a Masters level should sign up for 7/8 level classes, if their Masters degree was conferred by a USA university. Students admitted with a Bachelor's degree or a foreign graduate degree should sign up for 5/6 level classes for the first 30 credit, and for 7/8 level classes thereafter.
3. With the approval of the department graduate committee, certain courses taken in a foreign university may be considered as equivalent to some of the program courses or for full-filling pre-requisite requirements
4. A grade of B- or higher is expected to be maintained for the required courses. A grade of B- or higher is also required for all of the pre-requisite courses.
5. A cumulative graduate GPA of 3.0 or higher must be maintained.
6. Satisfactory overall performance, as an average of 80%, is expected on a written qualifying examination, which is administered after completion of the required graduate courses for that exam. The qualifying examination covers the following graduate courses, including their pre- and/or co-requisites:

PHCL5100/7100	Principles of Experimental Therapeutics I	3
PHCL5200/7200	Principles of Experimental Therapeutics II	3
PHCL5770/7770	Current Topics in Toxicology I	1
PHCL5440/7440	Current Topics in Interpretation of Pharmaceutical Data	1

7. Selection of a doctoral research adviser, preparation of an acceptable written Ph.D. dissertation proposal in consultation with the adviser, and the satisfactory oral defense of the proposal before the dissertation advisory committee. The written qualifying examination and the defense of the dissertation proposal will constitute the examination requirements necessary for advancement to candidacy for the Ph.D. in Experimental Therapeutics. The chair of the doctoral

dissertation advisory committee will be the student's doctoral research adviser. The dissertation advisory committee will consist of at least two additional faculty members plus one member from outside the student's department or college.

8. Subsequent to admission to candidacy for the Ph.D. degree, the student is expected to spend a minimum of two semesters in full-time study at The University of Toledo.
9. Preparation of a Ph.D. dissertation based on the results of an original research investigation performed by the student during his/her Ph.D. program at The University of Toledo.
10. Successful oral defense of the dissertation before the dissertation advisory committee and presentation of the results of the dissertation research in a seminar before the department of pharmacology.
11. Acceptance of the dissertation by the Ph.D. dissertation adviser and the dissertation advisory committee.

Doctor of Pharmacy Degree Programs

The Doctor of Pharmacy degree for applicants having, among other qualifications, a B.S. in Pharmacy, is unavailable at this time.

Combined Pharm.D. – Ph.D. in Medicinal Chemistry Program

Admission Requirements

Students who are admitted to both programs separately may pursue both degrees concomitantly.

Program Requirements

Although the requirements for both programs will be met, there is some overlap and flexibility, allowing a student to complete graduate-level requirements for both degrees in four to four and a half years. In general terms, students will follow the sequence for the Pharm.D. curriculum during the first four semesters, taking one graduate-level medicinal chemistry course each semester. In the fifth semester, students will take the required Pharm.D. clerkships, plus the two- hour seminar, with at least one clerkship rotation involving a research experience. The advisor can approve 6000-level Pharm.D. courses as Ph.D. electives. The Ph.D. requirement for MBC6550 (Biochemistry) may be waived. Beginning with sixth semester (summer following the second year), students will complete the requirements for the Ph.D. in medicinal chemistry.