College of Pharmacy & Pharmaceutical Sciences

Graduate Programs

Master of Science in Pharmaceutical Sciences

Degrees Offered

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 requirements for the Master of Science in pharmaceutical sciences degree differ according to the option. The minimum didactic course work for the industrial pharmacy major is 30 semester hours, for the pharmacology/toxicology major 36 semester hours and for the pharmacy administration major 32 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 to the Graduate School. 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 Graduate School. Normally two years of study and research are required.

The admission requirements of the Graduate School 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

The options available to graduate students are pharmacology/toxicology, administrative pharmacy and industrial pharmacy.

Pharmacology/Toxicology option: A minimum of 36 semester hours of courses plus a minimum of 6 thesis credit hours are required for the degree.

Undergraduate courses required (or their equivalents):

CHEM	3710	Physical Chemistry for the Biosciences I	3
CHEM	3720	Physical Chemistry for the Biosciences II	3
MATH	1750	Calculus for the Life Sciences I	4
MATH	1760	Calculus for the Life Sciences II	3
MBC	3310	Medicinal Chemistry I: Drug Action and Design	3
MBC	3320	Medicinal Chemistry II: Drug Targeting to Receptors	3
MBC	4300	Medicinal Chemistry III: Chemotherapy and Immunotherapy	3
PHCL	2600	Functional Anatomy and Pathophysiology I	4
PHCL	2620	Functional Anatomy and Pathophysiology II	4

Graduate courses required:

PHCL	5140	Interpretation of Pharmaceutical Data	2
PHCL	5700	Pharmacology I-Principles of Pharmacology, Autonomic Pharmacology and Non-Steroidal Anti−inflammatory Agents and Related Pharmacology	3
PHCL	5720	Pharmacology II: Endocrine and CNS Pharmacology	3
PHCL	5730	Toxicology I	3
PHCL	5760	Toxicokinetics	3
or			
PHCL	6600	Seminar in Pharmacology	1-2
PHCL	6700	Pharmacology III: CNS and Cardiovascular/ Renal Pharmacology	3
PHCL	6720	Pharmacology IV: Chemotherapeutics	3
PHCL	6900*	M.S. Thesis Research in Pharmacology	1-6
PHCL	6920*	M.S. Thesis Research in Pharmacology……..	1-6

***6 credit hours are the required minimum, more than 6 credit hours can be taken.**

Elective course work may be selected from the following***:

PHCL	5630	Cancer Chemotherapy (highly recommended)	3
PHCL	5750	Toxicology II	3
PHCL	5990**	Problems in Pharmacology (highly recommended)	6-18

**May replace PHCL-5700, 5720, 5730, 6700, 6720, and 5760 if these were taken at UT at the undergraduate level as PHCL-3700, 3730, 4730, 4810, 4820 and 4760, respectively, and a grade of B- or above received for the course.

MBC	6100	Advanced Immunology	2
MBC	6550	Biochemistry	4
MBC	5620	Biochemical techniques	2
MBC	6800	Methods in Biotechnology	3

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

Administrative Pharmacy option: A minimum of 32 semester hours of course work plus a minimum of 6 thesis hours are needed for the degree.

MKTG	5410	Marketing Systems	3
PHPR	5260	Pharmacy & Healthcare Administration I	2
PHPR	5520	Pharmaceutical Marketing and Management	3
PHPR	5590	Readings in Health Care Access and Cultural Competence	2
PHPR	5610	Pharmacoeconomics and Outcomes Research I	2
PHPR	6600	Seminar in Administrative Pharmacy	1
PHPR	6520	Analysis of the Pharmaceutical Environment	2
PHPR	6530	Research Methods in Pharmacy Practice	2
PHPR	6960	Thesis Research in Pharmacy	1-6*
RESM	5110	Statistics and Quantitative Methods I	3
RESM	6120	Statistics and Quantitative Methods II	3
**Track courses		As approved by advisor	minimum of 9 credit hours

*A minimum of 6 credit hours of Thesis Research In Pharmacy is required.

**Students enrolled in this option must select a Track Focus after the first semester.

Program Tracks, with approved track courses are as follows:

1. Business Administration

- BUAD 6100 Accounting for Strategic Decisions 3
- BUAD 6200 Financial Systems 3
- BUAD 6300 Strategic Marketing & Analysis 3
- BUAD 6400 Results-Based Management 3
- BUAD 6500 International business 3
- BUAD 6600 Supply Chain Management 3
- BUAD 6800 Information Technology & E-Business 3
- BUAD 6900 Strategic management Capstone 3

2. Outcomes Research-Track Courses

- PUBH 6600 Health Behavior 3
- PUBH 6460 Health Promotion Programs 3
- PUBH 601 Public Health Epidemiology 3
- PUBH 603 Advanced Epidemiology 3
- PUBH 611 Categorical Data Analysis 3

3. Pharmacoeconomics-Track Courses

- PHPR 5620 Pharmacoeconomics and Outcomes II 3
- ECON 5750 Health Economics 3
- ECON 5810 Econometrics Models and Methods I 3
- ECON 5820 Econometrics Models and Methods II 3
- ECON 5830 Econometrics Models and Methods III 3

4. Social Behavior Sciences- Track Courses

- PUBH 6600 Health Behavior 3
- PUBH 6460 Health Promotion Programs 3
- RESM 6220 Measurement I 3
- RESM 6230 Measurement II 3

Other Track Courses or electives may be approved by the department graduate committee

Industrial Pharmacy option: A minimum of 30 semester hours of course work and a minimum of 6 credit hours of thesis work is required 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.

MBC	3550	Physiological Chemistry I: Structure and Function of Biological Macromolecules....3
MBC	3560	Physiological Chemistry II: Chemical Regulation of Cells and Organisms....3
PHPR	3070	Pharmaceutics and Pharmaceutical Technology I and
PHPR	3080	Pharmaceutics and Pharmaceutical Technology II
		or
CHEM	3710	Physical Chemistry for the Biosciences I and
CHEM	3720	Physical Chemistry for the Biosciences II and
CHEM	3730	Physical Chemistry I....8-9
PHPR	4520	Pharmaceutical Management and Marketing....3
PHPR	4550	Analysis of the Pharmaceutical Environment....3

Graduate required courses:

CHEM	6300	Advanced Analytical Chemistry....2-4
CHEM	6310	Separation Methods....2-4
EEES	5710	Advanced Biostatistics....4
PHCL	6150	Advanced Pharmacokinetics....2
PHPR	5690	Dosage Form Design....3
PHPR	5700	Equilibrium Phenomenon....2
PHPR	5720	Pharmaceutical Rate Processes....3
PHPR	6600	Seminar in Administrative Pharmacy....1
PHPR	6850	Product Development....3
PHPR	6960	M.S. Thesis Research in Pharmacy....6

Additional course work may be selected from the following:

CHEM	6320	Characterization of Condensed Phases and Surfaces....2-4
CHEM	6330	Spectroscopic Methods and Analysis of Spectra....2-4
CHEM	6720	Physical Chemistry of Material Transformations....2-4
CHEM	6810	Materials Science I....4
CHEM	6820	Materials Science II....4
CHEM	6980	Special Topics in Chemistry....2-4
PHCL	5760	Toxicokinetics....3
PHPR	5680	Parenteral Manufacturing....2
PHPR	5710	Selected Topics in Pharmaceutical Technology....2-4
PHPR	5990	Problems in Pharmacy Practice....1-6
PHPR	6530	Research Methods in Pharmacy Practice....3
PHPR	6610	Seminar I....1

Applicants for the administrative pharmacy 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 Graduate School 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:

MBC	5100	Research Practices in Medicinal Chemistry	1
MBC	5620	Biochemical Techniques	2
MBC	5900	Medicinal Chemistry Seminar (4 hours required)	1
MBC	6190	Advanced Medicinal Chemistry	4
MBC	6200	Biomedicinal Chemistry	4
MBC	6550	Biochemistry	4
MBC	6960	M.S. Thesis Research in Medicinal Chemistry (6 hours required)	1-15

Other 5000- to 6000-level courses as advised

In addition, the following items also must be completed:

a. Minimum of 30 semester hours of graduate credit, of which no more than six hours are counted from the category of M.S. thesis or Ph. D. dissertation research (MBC 6960/8960)
b. 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.
c. 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.
d. Acceptance of this thesis by the M.S. thesis adviser and the thesis advisory committee.
e. Maintenance of a GPA of 3.0 or higher.

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. 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.

MBC	5100/7100	Research Practices in Medicinal Chemistry	1
MBC	5620/7620	Biochemical Techniques	2
MBC	5900/7900	Medicinal Chemistry Seminar (6 hours required)	1
MBC	6190/8190	Advanced Medicinal Chemistry	4
MBC	6200/8200	Biomedicinal Chemistry	4
MBC	6300/8300	Biomedicinal Chemistry Laboratory I	4
MBC	6310/8310	Biomedicinal Chemistry Laboratory II	4
MBC	6550/8550	Biochemistry	4
MBC	8960	Ph.D. Dissertation Research in Medicinal Chemistry (30 hours required)	1-15

Select 8 hours in chemistry, biology, or medicinal and biological chemistry:

Chemistry Courses

CHEM	6330	Spectroscopic Methods	2-4
CHEM	6400/8400	Advanced Organic Chemistry	2-4
CHEM	6410/8410	Organic Synthesis	2-4
CHEM	6420	Physical Organic Chemistry	2-4
CHEM	6510/8510	Protein Chemistry	2-4
CHEM	6520/8520	Enzymology	2-4
CHEM	6530/8530	Nucleic Acid Chemistry	2-4

Biology Courses

BIOL	6010/8010	Advanced Molecular Biology	4
BIOL	6020/8020	Advanced Molecular Biology Laboratory	3
BIOL	6090/8090	Advanced Cell Biology	4
BIOL	6100/8100	Research Methodology: Cell and Molecular Biology	3

Medicinal and Biological Chemistry Courses

MBC	5380/7380	Medicinal and Poisonous Plants	3
MBC	6100/8100	Advanced Immunology	2
MBC	6800/8800	Methods in Biotechnology	3

Other MBC 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 (see master of science in medicinal chemistry), 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.
2. Satisfactory overall performance on a written qualifying examination covering graduate-level medicinal chemistry, biochemistry and either organic chemistry or advanced cell/molecular biology.
3. 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 medicinal chemistry. The chair of the doctoral dissertation advisory committee will be the student's doctoral research adviser. The dissertation advisory committee will consist of two additional faculty plus one member from outside the student's department or college.
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. 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 medicinal and biological chemistry.
7. Acceptance of the dissertation by the Ph.D. dissertation adviser and the dissertation advisory committee.
8. Maintenance of a GPA of 3.0 or higher.

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 Ph.D. requirement for MBC 6550 (Biochemistry) will be waived. Beginning with sixth semester (summer following the second year), students will complete the requirements for the Ph.D. in medicinal chemistry.