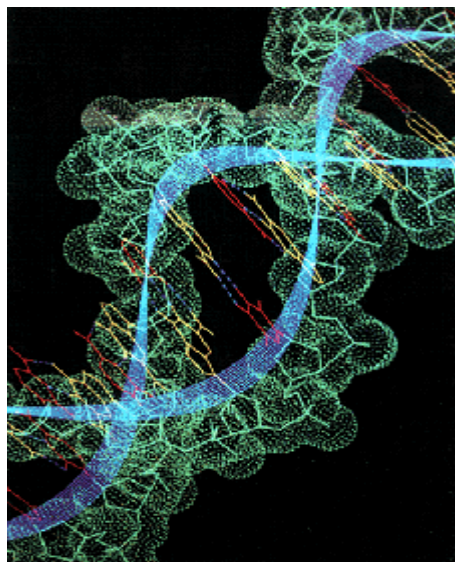




**The GRADUATE PROGRAM IN PHARMACEUTICAL
SCIENCE**

GRADUATE STUDENT HANDBOOK

2026-2027

RUTGERS
THE STATE UNIVERSITY
OF NEW JERSEY

Table of Contents

Officers and Staffs	3
History and Overview	6
Program Objectives and Contacts	7
Getting Started	9
Program Expectations	11
M.S. Program	20
PhD Program	26
Appendix:	
Selected Elective Course Descriptions	39
Pharmaceutical Science Graduate Faculty	46

GRADUATE PROGRAM DIRECTOR'S OFFICE

Arash Hatefi, PharmD, PhD
Professor of Pharmaceutics
Director, Graduate Program in Pharmaceutical Science
Department of Pharmaceutics
Ernest Mario School of Pharmacy
Rutgers, The State University of New Jersey
160 Frelinghuysen Road, Room 226
Piscataway, NJ 08854-8020

Ms. Hui Pung
Senior Program Coordinator
Department of Pharmaceutics
Ernest Mario School of Pharmacy
Rutgers, The State University of New Jersey
160 Frelinghuysen Road, Room 224
Piscataway, NJ 08854-8020
160 Frelinghuysen Road
Piscataway, NJ 08854

<https://pharmacy.rutgers.edu/programs/pharmaceutical-science-ms-and-phd-faculty-and-staff/>
<https://pharmacy.rutgers.edu/programs/pharmaceutical-science-ms-and-phd/>

Department of Pharmaceutics Administration

CHAIRPERSON

Tamara Minko, Ph.D.

DEPARTMENT STAFF

Senior Program Coordinator
Hui Pung

Administrative Assistant
Sharana Taylor

Business Manager
Fei Han

Department of Pharmaceutics
160 Frelinghuysen Road
Piscataway, NJ 08854

<https://pharmacy.rutgers.edu/about/pharmaceutics/>

<https://live-school-of-pharmacy.pantheonsite.io/academic-departments/pharmaceutics-department/>

Department of Chemical Biology Administration

CHAIRPERSON

Wei-Xing Zong, Ph.D.

DEPARTMENT STAFF

Program Coordinator
Aleesha Mahajan

Business Manager
Deborah A. Stalling

Department of Chemical Biology
164 Frelinghuysen Road
Piscataway, NJ 08854

<https://pharmacy.rutgers.edu/about/chemical-biology/>

1. History of Pharmaceutical Science Graduate Program

Graduate education was first instituted at the College of Pharmacy in the Fall of 1947. The initial degree offered was the **Master of Science in Pharmaceutical Chemistry**, and the first degrees were conferred in 1949. In 1953, a second area of specialization, **Pharmacology**, was introduced, and the first **Master of Science in Pharmacology** degree was awarded three years later. In 1956, a third area of specialization, **Pharmacy**, was added, and the first **Master of Science in Pharmacy** degree was conferred in 1958.

By 1958, it was found that 75% of M.S. degree recipients had either earned or were actively pursuing Ph.D. degrees at other universities. It became evident that further expansion of the graduate program and advancement of research in the pharmaceutical sciences at Rutgers would require the College to extend its offerings to the PhD level.

The Graduate School subsequently approved the following degree options under the umbrella of Pharmaceutical Science: Pharmaceutical Chemistry (M.S. and Ph.D.), Pharmacy (M.S. and Ph.D.), and Pharmacology (M.S.). Expansion of the Pharmacology program to the Ph.D. level was not possible at that time due to limited facilities and resources.

Upon the College of Pharmacy's relocation to Busch Campus in 1971, a joint committee composed of representatives from the College of Pharmacy and the College of Medicine and Dentistry of New Jersey recommended the establishment of a collaborative doctoral program leading to the Ph.D. in Pharmaceutical Science. This recommendation was subsequently approved, and the program was adopted by the Rutgers Graduate School as a distinct area of graduate instruction. Graduate instruction in the Pharmaceutical Science program was further expanded in 1971 with the introduction of coursework in Pharmacognosy. In 1983, the Controlled Drug Delivery Research Center was established under the leadership of Yie W. Chien, significantly strengthening the University's research and training capabilities in drug delivery and pharmaceutical sciences.

2. Current Graduate Program in Pharmaceutical Science

The **Graduate Program in Pharmaceutical Science** (hereafter, the “**Graduate Program**”) comprises faculty primarily from the Departments of Pharmaceutics and Chemical Biology within the Ernest Mario School of Pharmacy (EMSOP), although many of its members are affiliated with other departments across Rutgers University. Teaching Assistant (TA) and Graduate Assistant (GA) positions that support students in the Graduate Program are administered primarily through the participating departments. In some cases, TA support may also be provided by the Department of Pharmacy Practice and Administration.

The Graduate Program is a multidisciplinary academic unit consisting of faculty members from diverse departments and research disciplines. This handbook outlines the Program's policies and procedures governing graduate admissions, evaluation of student progress, and certification of degree completion. The Graduate Program is responsible for recruiting and admitting new students, administering the weekly seminar series, and monitoring student academic progress. It also coordinates with participating departments to facilitate graduate student financial support and serves as a liaison between graduate students and the University. The Graduate Program's operations are overseen by the Graduate Program Director. In addition, the Graduate Program works closely with both the School of Graduate Studies (SGS) and EMSOP on matters related to fellowships, scholarships, and teaching, research, and travel awards.

2.1. Graduate Program Objectives

The objective of the Graduate Program in Pharmaceutical Science is to train pharmaceutical scientists capable of advancing knowledge in the pharmaceutical sciences and integrating emerging discoveries in genomics, molecular and cellular biology, and big data analytics into a deeper understanding of human health, disease, and therapeutics. This objective is achieved through a broad-based, interdisciplinary education that encompasses the biological, chemical, pharmaceutical, and physical sciences.

The Graduate Program in Pharmaceutical Science is administered by the following staff members:

Program Director

The Program Director serves as the chief administrative officer of the Graduate Program and is responsible for providing academic leadership and oversight. Key responsibilities include:

- Serving as the primary representative of the Graduate Program, its students, and faculty to the School of Graduate Studies (SGS) and the Ernest Mario School of Pharmacy (EMSOP).
- Establishing and implementing Program policies in consultation with the Graduate Program faculty.
- Maintaining the academic standards, integrity, and overall quality of the Graduate Program.
- Appointing members of the Admissions Committee and Graduate Committee, as well as other committees as needed.
- Facilitating communication among students, faculty, departments, EMSOP, and SGS to ensure effective administration of the Graduate Program.
- Monitoring student academic progress and ensuring compliance with Graduate Program, EMSOP, and SGS policies and requirements.
- Reviewing and approving graduate student academic and administrative forms, including but not limited to:
 - Ph.D. and M.S. Candidacy, Thesis, and Dissertation Forms
 - Grade Change Forms
 - Transfer Credit Forms
 - Change of Status Forms
 - Incomplete Extension Forms
 - Extension of Time Forms
 - Optional Practical Training (OPT) Forms
 - Curricular Practical Training (CPT) Forms
 - Readmission Forms
 - Other forms required by SGS, EMSOP, or Rutgers University.

Program Administrative Assistant

The Program Administrative Assistant serves as the primary administrative support and point of contact for graduate students and faculty within the Graduate Program. Key responsibilities include:

- Serving as the primary resource and contact person for graduate students and faculty regarding Program-related matters.
- Providing administrative support to the Program Director.

- Maintaining accurate and up-to-date records for all students and faculty affiliated with the Graduate Program.
- Distributing and processing graduate student forms and documentation, including those required by the Graduate Program, EMSOP, and the School of Graduate Studies.
- Managing and issuing Special Permission Numbers (SPNs) for graduate courses, as appropriate.
- Assisting with the recruitment, application review, and admission processes for prospective graduate students.
- Coordinating Program communications, meetings, seminars, and other administrative activities.
- Serving as a liaison between students, faculty, departments, EMSOP, and SGS to facilitate efficient Program operations.

Points of Contact

For questions regarding the Graduate Program, students may contact the following individuals:

Arash Hatefi, PharmD, PhD

Program Director

Email: ahatefi@pharmacy.rutgers.edu

Phone: (848) 445-6366

Ms. Hui Pung

Program Coordinator

Email: huipung@pharmacy.rutgers.edu

Phone: 848-445-6369

3. Getting Started at Rutgers University

Welcome aboard!

Whether you are an international or domestic graduate student, you may have already secured housing on or near Busch Campus and are eager to begin your academic journey at Rutgers University. Before starting your studies, however, you must register for courses. As a newly admitted graduate student, you should first consult with your Faculty Advisor to develop an appropriate course plan and receive his/her approval before registering for a course. Full-time graduate students are required to register for a minimum of 9 credits per semester. You may then enroll in courses through the University's online registration system.

Faculty Advisor

In the Pharmaceutical Science Graduate Program, a Faculty Advisor (sometimes referred to as a Research Advisor or Faculty Mentor) is a full-time graduate faculty member who serves as the primary academic, research, and professional mentor to a graduate student. The advisor is responsible for guiding the student through their specialized coursework, supervising their laboratory research or thesis/dissertation project, and fostering their development into an independent scientific professional.

Faculty advisor responsibilities are categorized into the following distinct pillars of graduate development:

1. Research Supervision and Ethical Guidance

- Project Planning: Guiding the student in selecting, designing, and executing an original, feasible research topic within the pharmaceutical sciences.
- Research Ethics: Ensuring the student complies with institutional rules, laboratory safety, and responsible conduct of research including IRB and/or IACUC compliance for human or animal studies.
- Resource Management: Communicating clearly about available laboratory resources, research funding, and stipend support timelines.

2. Academic Progress and Milestone Management

- Curriculum Planning: Assisting the student in choosing advanced electives aligned with their research concentration (e.g., pharmaceuticals, pharmacology, medicinal chemistry).
- Committee Formation: Helping the student select and convene a thesis/dissertation advisory committee.
- Evaluations & Feedback: Providing regular, documented evaluations of academic progress and delivering timely written feedback on manuscript drafts, proposals, and dissertation chapters.

3. Professional Development and Career Mentorship

- Scientific Communication: Giving students appropriate credit for their work through authorship and encouraging them to present at pharmaceutical science conferences.
- Career Alignment: Initiating regular conversations about post-graduation career tracks, whether in the pharmaceutical industry, regulatory agencies (like the FDA), or academia.
-

Teaching and Graduate Assistantships

All students admitted to the Ph.D. Program will receive financial support in the form of either a Teaching Assistantship (TA) or a Graduate Assistantship (GA), subject to the policies of the School of Graduate Studies and availability of funding. Financial support may be provided throughout the student's graduate studies depending on the availability of funding, students' good academic standing and satisfactory progress toward the degree. Teaching Assistantships (TAs) are generally reserved for students enrolled in the Ph.D. program and are awarded based on departmental instructional needs, student qualifications, and the availability of funding.

Students enrolled in the Master of Science (M.S.) with thesis option are generally expected to provide their own financial support. In exceptional circumstances, a Faculty Advisor may elect to support an M.S. thesis student through a Graduate Assistantship (GA) or other research funding, subject to the availability of funds and the approval of the appropriate University offices.

Students enrolled in the Master of Science (M.S.) non-thesis option are expected to be fully self-funded and are not normally eligible for Teaching Assistantships or Graduate Assistantships through the Graduate Program.

Students who receive a Teaching Assistantship (TA) through one of the departments within EMSOP must register for Teaching Assistantship (16:720:877) for 6 E-credits each semester. E-credits do not count toward degree requirements or GPA calculations. Students who receive a Graduate Assistantship (GA) supported by their Faculty Advisor's research funding must register for Graduate Assistantship (16:720:855) for 6 E-credits each semester. As with TA credits, E-credits do not count towards degree requirements or GPA calculations.

International Students

International students must check in with the International Student and Scholar Services (ISSS) office, part of Rutgers Global, and attend the required orientation programs.

Website: <https://global.rutgers.edu/international-scholars-students> ; phone # 848-932-7800).

In addition, new international Teaching Assistants must attend the orientation and training sessions offered by ISSS to ensure compliance with university policies and to prepare for their teaching responsibilities. School of Graduate Studies (SGS) Phone: (848) 932-7034

Pharmaceutical Sciences Graduate Students Association (PSGSA)

The PSGSA, functioning in cooperation with the University-wide Graduate Student Association, facilitates the professional development, intellectual engagement, and social interaction of our students. Its main focus is to build networking opportunities through weekly seminar series which features students, faculty, and leading scholars from across the field who present their original research. This series makes a valuable contribution to the intellectual vibrancy and rigor of both our department and the advancement of pharmaceutical sciences.

LinkedIn Group: [Rutgers University Pharmaceuticals Graduate Student Organization](#)

American Association of Pharmaceutical Scientists (AAPS), Rutgers Chapter

The Rutgers Chapter of the AAPS' mission is to promote the development of talented and capable individuals to achieve technical excellence and recognition in the field of pharmaceutical sciences. Functioning in cooperation with the national AAPS organization, the Rutgers University chapter fosters networking and career development opportunities for students.

LinkedIn Group: [Rutgers University Chapter of American Association of Pharmaceutical Scientists](#)

4. Program Expectations

Regardless of your reason for joining the Graduate Program in Pharmaceutical Science, your goal is likely to obtain an M.S. or Ph.D. degree and pursue a successful career in your chosen field. The faculty of the Graduate Program are committed to helping you achieve these goals. In return, students are expected to demonstrate a high level of dedication, professionalism, and academic excellence. Because admission to this Program is highly competitive, we recognize that our students are among the strongest graduates entering the field. Success in graduate school, however, requires more than academic ability. Students are expected to embody the three Cs: Commitment, Curiosity, and Creativity. Above all, the quality and impact of your research will play the most important role in shaping your future career opportunities.

4.1. Communication, Availability, and Absences

Graduate education requires regular interaction between students and their Faculty Advisors to ensure appropriate academic progress, research productivity, and professional development. Students are expected to maintain regular communication with their Faculty Advisor and to remain actively engaged in their coursework, research activities, and other Program responsibilities.

Students must keep their Faculty Advisor informed of their academic and research activities and respond to their advisor's communications in a timely manner. Extended periods of unavailability or lack of communication may adversely affect a student's academic standing and research progress.

Because Faculty Advisors are responsible for supervising research activities, ensuring compliance with University and funding agency requirements, and monitoring student progress, students are expected to notify their Faculty Advisor in advance of any planned absence from the University or research laboratory that exceeds 48 hours. Such absences may include personal travel, vacations, remote work arrangements, conferences, family obligations, health issues, or other activities that may affect the student's availability.

Students must obtain approval from their Faculty Advisor before taking any absence exceeding 48 hours including vacation, unless prevented by an emergency or other unforeseen circumstance. In the event of an emergency, students should notify their Faculty Advisor as soon as reasonably possible.

Graduate students are not permitted to discontinue participation in research activities, leave the local area for extended periods, or otherwise become unavailable without informing their Faculty Advisor. Failure to maintain communication with the Faculty Advisor or repeated unauthorized absences may be considered a failure to make satisfactory academic and research progress and may result in corrective action by the Faculty Advisor, Program Director, or Graduate Program and ultimately dismissal from the program. The Graduate Program recognizes that students may occasionally need time away from campus for personal, professional, medical, or family reasons. Such requests will normally be accommodated when communicated in advance and coordinated appropriately with the Faculty Advisor.

All extended absences from the Graduate Program, including vacations (including summer vacations), internships, cooperative education (co-op) experiences, and other prolonged periods away from the University or research laboratory, must be communicated to the Faculty Advisor in advance. Such absences require prior approval from both the Faculty Advisor and the Program Director. Students are expected to coordinate these absences to ensure that their academic progress, research responsibilities, and Program obligations are not adversely affected.

4.2. Academic Integrity

Integrity and honesty are fundamental principles of scholarship and are essential to the advancement of science in all disciplines, including the pharmaceutical sciences. The Graduate Program expects all students to uphold the highest standards of ethical conduct in their academic, research, and professional activities.

4.3. Academic Standards and Responsibilities

All graduate students are responsible for understanding and adhering to the academic standards of Rutgers University. Intellectual inquiry and scientific progress depend on a shared commitment to honesty, fairness, and respect for the work of others. High standards of academic integrity are expected of every member of the University community. Because academic integrity is a cornerstone of scholarly and scientific endeavor, students are expected to familiarize themselves with University policies and to conduct themselves in accordance with these standards in all aspects of their coursework, research, teaching, and professional activities. In addition to University policies, many academic disciplines maintain professional codes of ethics that govern research conduct and professional behavior. Graduate students are expected to be aware of and comply with both the University's standards and the ethical guidelines of their respective disciplines. Failure to adhere to these standards may result in disciplinary action, including dismissal from the Graduate Program.

4.4. Original Work and Proper Attribution

It is both unethical and a violation of Rutgers University's Academic Integrity Policy to present the ideas, data, figures, text, or words of another person without proper acknowledgment. Failure to provide appropriate citations may be interpreted as an attempt to misrepresent another individual's work as one's own. Students should use the citation style appropriate to their discipline and provide complete and accurate references.

4.5. Prohibited Academic Conduct

Students may not:

- Quote, paraphrase, or otherwise use another person's ideas, words, data, or creative work without proper citation and attribution.
- Cite a source that has not been personally consulted and verified, even if it was identified through a secondary source.
- Collaborate with others on assignments, examinations, or academic work without the explicit permission of the course instructor.
- Use unauthorized materials, devices, notes, or resources during examinations or other assessments.
- View, copy, or attempt to obtain another student's work during an examination or assessment.
- Submit work completed for one course to satisfy the requirements of another course without prior approval from the relevant faculty member(s).
- Fabricate, falsify, manipulate, or misrepresent research data, results, records, or documentation.
- Engage in plagiarism, research misconduct, or any other form of academic dishonesty.

Students found responsible for any of the aforementioned forms of academic or research misconduct shall be subject to immediate dismissal from the Graduate Program, in accordance with University policies and applicable due process procedures.

4.6. Plagiarism

Plagiarism is the presentation of another person's words, ideas, data, or creative work as one's own in any academic, scholarly, or research activity. Plagiarism is a serious violation of academic integrity and is prohibited by Rutgers University and the Graduate Program in Pharmaceutical Science.

To avoid plagiarism, all direct quotations must be clearly identified through quotation marks or appropriate formatting and must be properly cited within the text or in a footnote. Proper acknowledgment is also required whenever material from another source—whether obtained from print, electronic, audiovisual, or other media—is paraphrased, summarized, or otherwise incorporated into one's own work.

When paraphrasing, students must not merely rearrange or substitute a few words from the original text. Instead, the information should be fully rephrased in the student's own words and accompanied by an appropriate citation. Simply citing a source after a direct quotation does not adequately acknowledge preceding or subsequent paraphrased material. All borrowed ideas, concepts, interpretations, and findings must be properly attributed to their original sources.

Information considered common knowledge—such as widely known historical facts, basic scientific principles, or generally accepted concepts within a discipline—does not require citation. However, facts, data, interpretations, or ideas obtained through reading, research, lectures, or other sources that are not considered common knowledge must be appropriately acknowledged.

Students should include in their bibliographies, or reference lists all sources that directly contributed to the preparation of their work. Additional materials that contributed to a broader understanding of the subject may also be cited when appropriate.

Because plagiarism can sometimes involve complex or ambiguous situations, students are encouraged to consult their Faculty Advisor, course instructor, or the Program Director whenever questions arise regarding proper citation, attribution, or academic integrity. When in doubt, it is always preferable to provide a citation. Violations of plagiarism and academic integrity policies may result in disciplinary action by the University and may jeopardize a student's standing in the Graduate Program.

4.7. Rutgers University Policy on Academic Integrity

The Academic Integrity Policy of the University <http://nbacademicintegrity.rutgers.edu/> recognizes three levels of violations; for graduate students, however, all violations are considered level four violations, the most serious breaches of academic integrity. The sanction for level four violations of the Policy is "permanent expulsion from the university... Notation of 'academic disciplinary separation' will be placed on a student's transcript and remain permanently" (*Policy on Academic Integrity*, page 11).

According to the policy, the following actions constitute a level three violation:

Fabrication of evidence, falsification of data, quoting directly or paraphrasing without acknowledging the source, and/or presenting the ideas of another as one's own in a senior thesis, within a master's thesis or doctoral dissertation, in scholarly articles submitted to refereed journals, *or in other work represented as one's own as a graduate student* (italics added for emphasis). Rutgers-New Brunswick *Policy on Academic Integrity* for Undergraduate and Graduate Students (page 10).

Thus, for graduate students, any form of dishonesty will be viewed as a level three violation and is cause for separation from the university. A copy of the full *Policy on Academic Integrity* may be obtained from the Office of the Dean, School of Graduate Studies, phone: 848-932-7034

Useful References and Guides

If you are not wholly familiar with conventions of citation, purchase a reference guide that is standard for your discipline. Among the most widely used guides are:

The Chicago Manual of Style (14th edition). Chicago: The University of Chicago Press, 1993.

MLA Handbook for Writers of Research Papers (4th edition). Joseph Gibaldi. NY The Modern Language Association of America, 1995.

Publication Manual of the American Psychological Association (4th edition), Washington, DC: American Psychological Association.

If you have questions about academic integrity, get them answered before jeopardizing your career. Speak to your Faculty Advisor, your graduate program director, or one of the Deans of School of Graduate Studies (848-932-7034).

4.8. Coursework

Graduate students are expected to take an active role in their academic development and successfully complete all coursework requirements in a timely manner. Students should:

- Work closely with their Faculty Advisors to develop a program of study that provides the foundational knowledge and skills necessary for successful progression to independent research and dissertation work. Before taking or dropping a course, each student must obtain the approval of his/her Faculty Advisor.
- Attend all classes regularly and participate actively in course-related activities.
- Complete all assignments, examinations, and academic requirements honestly, professionally, and in a timely manner.
- Work independently when required and collaborate effectively with others when group work is appropriate.
- Maintain satisfactory academic progress toward degree completion by completing coursework requirements and scheduling qualifying, preliminary, and other required examinations in a timely manner.
- Allocate sufficient time for the preparation of examinations, presentations, and other academic milestones.
- Utilize appropriate academic resources, including study groups, faculty mentors, and independent reading, to strengthen understanding of subject matter and prepare for examinations.

4.9. Research

Research is the central component of graduate education in Pharmaceutical Sciences. Students are expected to conduct themselves as responsible and ethical scholars while developing the skills necessary for independent scientific inquiry. Students should:

- Work independently whenever possible, collaborate effectively within research teams when appropriate, and seek guidance or assistance when needed.
- Conduct research honestly, ethically, and responsibly, and report all findings accurately and objectively.
- Properly acknowledge the contributions of collaborators, colleagues, and other researchers.
- Maintain accurate, complete, and up-to-date laboratory notebooks and research records (raw data, images, instrument outputs, etc.) in accordance with University and laboratory policies (please see Laboratory Notebook section for more information).
- Become familiar with and adhere to all applicable federal, state, University, and sponsor regulations governing research, including those established by the NIH, NSF, and other funding agencies.
- Meet established research milestones and work diligently toward timely completion of degree requirements.
- Keep their Faculty Advisor and, when appropriate, the Program Director informed of research progress, significant findings, and any challenges affecting academic progress.
- Follow all laboratory, departmental, and University policies regarding data management, intellectual property, confidentiality, and responsible conduct of research.
- Respect the responsibility of Faculty Advisors to maintain high scholarly and scientific standards and remain open to constructive criticism, alternative interpretations, and recommendations for improving research quality and rigor.
- Do not disclose unpublished research data (including preclinical and clinical data), intellectual property, proprietary materials, or other confidential information to individuals outside the research group without the prior approval of the Faculty Advisor. Unauthorized disclosure may compromise research integrity, intellectual property rights, and contractual or regulatory obligations. Violations of this policy may result in disciplinary action, including dismissal from the Graduate Program, in accordance with University policies.

4.10. Professional Development

Graduate education extends beyond coursework and research. Students are encouraged to actively engage in professional development activities that enhance their scientific, teaching, communication, leadership, and career skills. The Graduate Program expects students to take advantage of opportunities that prepare them for successful careers in academia, industry, government, healthcare, and other professional sectors. Students are encouraged to:

- Actively participate in local, national, and international scientific conferences, symposia, workshops, and seminars by submitting abstracts, presenting research findings, and engaging in scholarly discussions that contribute to professional development and scientific advancement.
- Present their research findings through oral and poster presentations whenever appropriate.
- Prepare and submit manuscripts for publication in peer-reviewed scientific journals.
- Develop effective scientific communication skills through writing, presenting, and networking activities.
- Provide faculty members with adequate advance notice when requesting letters of recommendation, references, or other supporting documents.
- Take advantage of career development workshops, mentoring programs, and professional services offered by Rutgers University and external organizations.
- Maintain a professional portfolio documenting research accomplishments, publications, presentations, awards, teaching activities, leadership roles, and service contributions.
- Develop and maintain a teaching portfolio if you serve as a Teaching Assistant or intend to pursue academic careers.

- Join and actively participate in appropriate professional and scientific organizations relevant to their field of study.
- Build professional networks through interactions with faculty, alumni, industry representatives, and fellow scientists.
- Explore and prepare for a broad range of career opportunities, including positions in academia, industry, government agencies, healthcare, regulatory affairs, entrepreneurship, consulting, and other scientific professions.
- Seek opportunities to develop leadership, mentoring, teamwork, project management, and grant-writing skills.

4.11. The Laboratory Notebook

The laboratory notebook is one of the most important records you will maintain during your graduate studies. It serves as the official documentation of your research activities, experimental procedures, observations, results, and scientific discoveries. As such, it is an essential component of responsible research conduct and scientific recordkeeping.

Students should understand that laboratory notebooks and the data they contain are the property of the research laboratory and Rutgers University, not the individual student. Laboratory notebooks must remain within designated University facilities and should not be removed from EMSOP or other approved research locations without the permission of the Faculty Advisor. Since Laboratory Notebook is considered a legal document, failing to follow the delineated instructions may result in dismissal from the graduate program.

Students are expected to maintain complete, accurate, and timely records of all research activities. Experimental procedures, observations, calculations, and results should be recorded directly in the notebook as work is performed rather than reconstructed at a later time. All entries should be dated, clearly written, and sufficiently detailed to allow another researcher to understand and reproduce the work.

In addition to maintaining a laboratory notebook, students are required to maintain electronic copies of all research data and related materials, including but not limited to raw data, graphs, images, instrument output files, processed data, and experimental records. These electronic files must be securely stored on both the student's assigned University computer (or an approved local device) and the University's OneDrive cloud and/or Box storage system to ensure appropriate backup, data security, and accessibility. Students are responsible for maintaining organized, complete, and up-to-date electronic research records throughout their graduate studies in accordance with University policies and laboratory data management practices.

At a minimum, laboratory notebook entries should include:

- The date of each experiment or activity.
- The objective or purpose of the experiment.
- Detailed experimental procedures and protocols.
- Lists of materials, reagents, catalysts, solvents, biological samples, and equipment used.
- Quantities recorded in appropriate units of mass, volume, concentration, or other relevant measurements.
- Experimental observations and results.
- Data analyses, calculations, and interpretations.
- References to support files, instrument outputs, spectra, images, or electronic records when applicable.

The laboratory notebook serves as a permanent scientific record and may be used by your advisor and other members of the research group for years to come as a valuable reference source. It also provides the primary documentation supporting publications, patent applications, grant reports, theses, dissertations, and other scholarly products.

Maintaining a thorough, accurate, and organized laboratory notebook is an essential responsibility of every graduate student and a fundamental component of good scientific practice.

4.12. Seminars

The Pharmaceutical Science Seminar Series is an important component of graduate education and professional development within the Graduate Program. Seminars are typically held in the Conference Room on the second floor of the Pharmacy Building and are generally scheduled on Fridays from 12:00 PM to 1:00 PM. Students will be notified of any changes in location or schedule. All graduate students are expected to attend the seminar series regularly as part of their professional training and engagement with the scientific community.

Presenting students are required to register for Seminar in Pharmaceutical Science (16:720:601 or 16:720:602) only during the semester in which they plan to present a seminar. A grade (e.g., A, B, C) will be assigned to the presenting student by the Faculty Course Coordinator.

Students who attend the Pharmaceutical Science Seminar Series but are not presenting during a given semester must register for 1 credit of “Attending Pharmaceutical Science Seminar (16:720:703/704)” each semester through the end of their fourth year of study. This 1 credit counts as student’s degree research credits. Beginning in the fifth year (and beyond), students are strongly encouraged to continue attending the seminar series as part of their professional and scientific development; however, they are no longer required to register for the 1-credit “Attending Pharmaceutical Science Seminar” course. Based on their seminar attendance and compliance with the attendance requirements, students will receive a grade of Satisfactory (S) or Unsatisfactory (U), as determined by the Faculty Course Coordinator. (please see below for more information).

Seminar Requirements

- Ph.D. students are required to present two seminars during their graduate studies.
- M.S. students are required to present at least one seminar during their graduate studies.

Scheduling a Seminar

Ph.D. students typically take the Seminar courses after passing their Qualifying Examination, at a stage when they have generated some preliminary research data to present meaningful progress on their dissertation project. Students wishing to present a seminar should contact the Program Coordinator, Ms. Hui Pung (huipung@pharmacy.rutgers.edu), well in advance to reserve a presentation date.

Prior to the scheduled seminar, students must provide:

- The seminar title
- A brief abstract
- A short biographical sketch (CV summary)

This information will be used for seminar announcements and for the introduction provided by the Seminar Coordinator on the day of the presentation.

The title, scope, and content of the Seminar presentation must be developed in consultation with and approved by the student's Faculty Advisor prior to the scheduled presentation.

Both Seminar I (16:720:601) and Seminar II (16:720:602) must be directly related to the student's thesis or dissertation research project.

Seminar I should primarily focus on the scientific background, literature review, research rationale, objectives, methodology, and any preliminary data (if available) generated in support of the student's M.S. or Ph.D. research project.

Seminar II should serve as a pre-defense presentation, during which the student presents a comprehensive overview of the research project, including all major experimental findings, data analyses, conclusions, and future directions. The presentation should closely resemble the format and scope of the final thesis or dissertation defense and provide an opportunity to receive constructive feedback before the formal defense.

Seminar Format

A computer and audiovisual equipment will be available for presentations. Students may also use their own laptops if preferred.

Seminars should be structured as follows:

- Approximately 45 minutes for the presentation
- Approximately 15 minutes for questions and discussion

Students are expected to prepare and deliver a professional-quality scientific presentation that demonstrates a thorough understanding of the topic and the ability to communicate complex scientific concepts effectively.

Seminar Evaluation

Seminars will be evaluated by the Seminar Coordinator and/or designated faculty members. Evaluation criteria may include scientific content, organization, presentation quality, clarity, professionalism, and the ability to answer questions.

As a general guideline, presentations that are substantially shorter than the expected 45-minute duration may receive a lower evaluation at the discretion of the Seminar Coordinator and, if deemed unsatisfactory, may require the student to repeat the Seminar course. This expectation applies to both M.S. and Ph.D. student presentations.

Seminar Attendance Policy

Attendance at the Pharmaceutical Science Seminar Series is mandatory for all graduate students. Seminars are a critical component of graduate education, providing exposure to current research, opportunities for

scientific discussion, and training in the effective communication of scientific ideas. Regular attendance is therefore considered an essential requirement of the Graduate Program.

Students are expected to attend all scheduled seminars and to arrive on time. Failure to comply with the attendance requirements may result in academic penalties as outlined below.

Remote Attendance

Remote attendance via Zoom is permitted only for part-time students. Full-time students may attend remotely only with prior approval from the faculty Seminar Coordinator. Approval will be granted at the discretion of the Seminar Coordinator and only under appropriate circumstances.

Excused Absences

Students may be excused from attending a seminar for medical, personal, professional, or other legitimate reasons. Whenever possible, prior approval from the faculty Seminar Coordinator should be obtained before the scheduled seminar.

- Absences due to illness or emergencies require appropriate documentation (e.g., a medical note or other supporting documentation).
- Absences related to professional responsibilities, including teaching assistant duties, conference travel, research obligations, or other academic activities, must be approved by the Seminar Coordinator.

Tardiness and Early Departure

Seminars begin promptly at 12:00 PM.

- Students who arrive more than five (10) minutes late will not receive attendance credit for that seminar.
- Students who leave before the conclusion of the seminar will likewise be considered absent for that seminar unless prior approval has been granted by the Seminar Coordinator.

Attendance Requirement

Students who accumulate two or more unexcused seminar absences during a semester will receive a final grade of "U" (Unsatisfactory) for the seminar course.

Repeated Unsatisfactory Performance

Students (seminar attendees) who receive more than two Unsatisfactory (U) grades in the seminar course during their graduate studies will be required to present an additional seminar before graduation. Repeated or chronic violations of the seminar attendance policy may be referred to the Program Director for further review and corrective action. Such actions may include additional academic requirements, formal warnings, or other measures deemed appropriate by the Graduate Program. The Graduate Program views seminar attendance as an important professional responsibility. Students are expected to demonstrate the same level of commitment to seminar participation as they would to their coursework, research activities, and other degree requirements.

5. The Master of Science (M.S.) Program

The Graduate Program in Pharmaceutical Science offers both thesis and non-thesis Master of Science (M.S.) degree options. These programs are designed to accommodate students with diverse educational and career goals, including full-time students seeking advanced training for careers in the pharmaceutical and biotechnology industries, as well as working professionals seeking to pursue graduate studies part-time while maintaining their current employment. The minimum educational requirement for admission to the MS Program in Pharmaceutical Science is a Bachelor of Science (B.S.) or Bachelor of Arts (B.A.). Other equivalent degrees will be considered on a case-by-case basis.

5.1. M.S. Thesis Option

The M.S. thesis option is intended for students who wish to gain research experience and complete an original research project under the supervision of a Faculty Advisor. A Student Advisory Committee, which is composed of three faculty members from the Graduate Program in Pharmaceutical Science, must be formed during the first year of study, prior to the thesis defense. One member of the Thesis Advisory Committee must be the Faculty Advisor. The proposed committee membership must be submitted to the Program Coordinator as soon as it is formed and must receive approval from the Program Director. The committee meets once per year to review the students' progress. The meeting can be in person or online. It is possible to change the Advisory Committee members if necessary. The Student's Advisory Committee could later become Student's Thesis Committee which is consisted of three internal Faculty Members.

Role of the Student Advisory Committee

The Student Advisory Committee plays an important role in supporting and evaluating the student's academic and research development throughout the graduate program. The Committee serves as a source of scientific guidance, mentorship, and constructive feedback, helping students progress toward the successful completion of their degree requirements.

The responsibilities of the Student Advisory Committee include:

- Evaluating the student's academic performance, research progress, and overall advancement toward degree completion.
- Providing guidance on research direction, experimental design, data interpretation, and professional development.
- Identifying potential challenges or obstacles that may impede progress and recommending appropriate solutions.
- Ensuring that the student is making satisfactory progress toward completion of all Program milestones and degree requirements.
- Providing feedback on coursework, research activities, presentations, publications, and other scholarly accomplishments.
- Assisting the student in developing the scientific, professional, and communication skills necessary for a successful career.
- Advising the student on the preparation for thesis research and final degree requirements.
- Making recommendations to the Program Director regarding the student's academic standing when necessary.

Thesis Committee

The M.S. Thesis Committee shall consist of three members, including Faculty Advisor and two Full Members of the Graduate Faculty in the Graduate Program in Pharmaceutical Science.

The composition of the Thesis Committee must be approved by the Faculty Advisor and Program Director.

Thesis Requirements

The M.S. thesis must be prepared in accordance with all policies, formatting requirements, and submission guidelines established by the School of Graduate Studies (SGS). Prior to scheduling the thesis defense, students must obtain and complete the appropriate “M.S. Candidacy Form” through the Program Coordinator's office. In addition, students should obtain a thesis defense checklist from the Program Coordinator to ensure that all Program and SGS requirements have been satisfied before the defense.

Degree requirements include:

- A minimum of 24 credits of coursework, including 1 credit of Seminar in Pharmaceutical Science (16:720:601/or 602).
- A minimum of 6 research credits (Research in Pharmaceutical Science, 16:720:701 and/or 702).
- Maintain at least a 3.00 GPA with a maximum of two grades of C or C+.*
- Successful completion and defense of an M.S. thesis.

*Rutgers University will not confer graduate degrees to students having a grade point average (GPA) of less than 3.00. Rutgers also limits the number of C or C+ grades that a graduate student can use to fulfill degree requirements.

Following a successful thesis defense:

- An electronic copy of the final approved thesis must be submitted to the Program Director.
- All required revisions requested by the Thesis Committee must be completed before final approval is granted.
- Students must comply with all SGS deadlines and submission requirements for degree completion.
- The title page of the M.S. thesis must be approved and signed by the Thesis Committee members before final submission and degree certification.

5.2. M.S. Non-Thesis Option

The M.S. non-thesis option is designed for students seeking advanced coursework and professional development without a formal research thesis requirement. Degree requirements include:

- A minimum of 30 credits of coursework, including 1 credit of Seminar in Pharmaceutical Science.
- Submission of an essay and approval of the Student Advisory Committee.
- Completion of all academic requirements was established by the Graduate Program.

Students must have a Faculty Advisor and consult with him/her and, if necessary, with the Program Director to develop an appropriate plan of study that aligns with their academic interests and career

objectives. M.S. students in non-thesis program need to form a Student Advisory Committee before graduation for evaluation of their Written Essay. All decisions are made in consultation with their Faculty Advisor and graduate Program Director.

Written Essay

Students pursuing the M.S. non-thesis option are required to prepare a written scholarly essay for evaluation by their Student Advisory Committee. The essay should demonstrate the student's understanding of a topic relevant to the field of Pharmaceutical Science and reflect the ability to critically evaluate and synthesize the scientific literature.

The essay must conform to the following format:

- Maximum of five pages of text (excluding figures, tables, and references);
- Double-spaced;
- Arial, 11-point font;
- One-inch margins on all sides.

The completed essay must be submitted to the Student Advisory Committee at least two weeks prior to the scheduled evaluation to allow sufficient time for review.

Following its review, the Student Advisory Committee will evaluate the essay and assign a grade of Satisfactory (S) or Unsatisfactory (U). Students who receive an Unsatisfactory evaluation may be required to revise and resubmit the essay in accordance with the recommendations of the Student Advisory Committee before the degree requirements are considered complete.

5.3. Credits

To ensure satisfactory academic progress and compliance with Graduate Program requirements, students must adhere to the following policies regarding course credits:

- Undergraduate-level courses numbered below 400 will not be counted toward degree requirements.
- A maximum of two courses with a grade of “C” may be applied toward degree completion. Students are encouraged to maintain a substantially higher academic standard.
- All research credits must be completed with a grade of “S” (Satisfactory).
- Students must maintain a minimum GPA of 3.0 with maximum of two grades of C or C+, and academic standards established by the Graduate Program and the School of Graduate Studies (SGS).

5.4. Transfer of credits

Students may request the transfer of graduate credits earned at another institution or through non-matriculated graduate coursework completed at Rutgers University, subject to the following conditions:

- A maximum of 12 graduate credits may be transferred toward the M.S. degree.
- Students must complete at least 9 credits as a matriculated student at Rutgers University before transfer credits can be applied to their degree program.
- Only courses completed with a grade of “B” or higher will be considered for transfer.
- Transfer credits must be relevant to the student's degree program and academic objectives.

- Approval of transfer credits requires review and authorization by both the Program Director and the School of Graduate Studies (SGS).

Students who are considering the transfer of credits are encouraged to consult with the Program Director early in their academic program to ensure timely evaluation and approval.

5.5. Course Credit Requirements

Core Courses: at least 9 credits from the following list are required

Advanced Pharmaceutics /Physical Pharmacy (Sinko)	16:720:507	3
Advanced Pharmacokinetics /Dynamics (Kagan)	16:720:509	3
Molecular and Cellular Pharmaceutics (Minko)	16:720:614	3
Membrane Transporters in Drug Disposition (You)	16:720:609	3
Dermaceutics (Michniak-Kohn)	16:720:523	3
Genetically Engineered Drug Delivery Systems (Hatefi)	16:720:549	3
Biochemical Foundations of Pharmaceutical Biotechnology I	30:158:309	3
Biochemical Foundations of Pharmaceutical Biotechnology II	30:158:310	3
Molecular Toxicology	16:963:505	4
Molecular Biology & Biochemistry I	16:115:511	3
Pharmacogenomics and Precision Medicine	30:158:409	2

Core Courses: 2 credits from the following list are required

Seminar in Pharmaceutical Science	16:720:601,602	1
Ethical Scientific Conduct	16:115:556	1

Elective Courses: at least 13 credits for MS-Thesis/ at least 19 credits for MS-Non-Thesis:

Design of Experiments	16:960:590	3
General Toxicology I (Principles of Toxicology)	16:963:501	2
Colloidal Chemistry of Food	16:400:612	3
Nanotechnology and Its Applications in Biotechnology and Food	16:400:613	3
Cellular & Molecular Pharmacology: Principles of Drug Action and Targeting	16:718:680	3
Medicinal Chemistry: Research Techniques and Principles (Foundations in Drug Discovery)	16:663:501	3
Principles of Drug Design	16:663:502	3
Immunology	16:681:543	3
Drugs: Structure and Function	16:663:505	3
Basic Statistics for Research	01:960:401	3
Introduction to Molecular Modeling	16:160:510	3
Molecular Biology and Biochemistry II	16:115:512	3
Nano Tech-Based drug Delivery	16-720-550	3
Others*		

*Other electives that are approved by the Faculty Advisor and graduate program director may be accepted. (please see the Appendix)

5.6. Diploma Dates and Graduation Deadlines

Graduation deadlines are established by the School of Graduate Studies (SGS) and may vary slightly from year to year. Students are responsible for verifying the current deadlines with SGS and ensuring that all required forms are submitted on time.

As a general guideline, the following deadlines apply:

Degree Conferral Date	Diploma Application Due	Candidacy Form Due
May 1	April 1	April 1
October 1	October 1	October 1
January 1	January 1	January 1

You may also check the due dates using the following links:

<https://grad.rutgers.edu/academics/graduation/checklist-phd-degree>

<https://grad.rutgers.edu/academics/graduation/masters-degree-thesis-checklist>

<https://grad.rutgers.edu/academics/graduation/masters-degree-without-thesis>

5.7. M.S. Thesis Research and Defense

Students pursuing the M.S. thesis option are strongly encouraged to begin their research projects as early as possible in their graduate studies. Continuous engagement in research throughout the year will facilitate timely progress toward degree completion.

Under the supervision of a Faculty Advisor, each M.S. student is expected to conduct an original research project that contributes to the advancement of knowledge in the pharmaceutical sciences. Upon completion of the research, the student must prepare a written thesis and successfully defend it before the Thesis Committee. The composition of the Thesis Committee is solely determined by the Faculty Advisor.

The School of Graduate Studies (SGS) requires strict adherence to its thesis formatting and submission guidelines. A style guide can be found online at <https://grad.rutgers.edu/academics/graduation/electronic-thesis-and-dissertation-style-guide>.

These guidelines provide detailed instructions regarding document organization, formatting requirements, page layout, margins, figures, tables, references, and electronic submission procedures.

Once the Faculty Advisor determines that the thesis is ready for review, the student should provide a copy of the thesis to each member of the Thesis Committee and schedule the defense examination. Committee members should be given a minimum of two weeks to review the document before the defense.

During the thesis defense, the student will present and discuss the research findings. Committee members may ask questions related to:

- The research project and experimental results.

- Data analysis and interpretation.
- The scientific significance of work.
- The student's general knowledge and preparation in the field.

Thesis Exam Scoring System

At the conclusion of the examination, each committee member will independently evaluate the student's performance using a confidential ballot and assign a score on a scale of 1 to 100. The final outcome will be determined based on the average score of all committee members.

The examination outcomes are defined as follows:

- Pass: Average score of 80 or higher
- Retake: Average score of 71–79
- Fail: Average score of 70 or less

Pass

The student has successfully completed all requirements of the Thesis Exam.

Conditional Pass

Students receiving a Conditional Pass outcome will be provided with written feedback identifying the areas requiring improvement and will receive a formal letter from the Graduate Program outlining the required revisions or corrections. The student will be permitted to address the identified deficiencies, submit the revised materials to the committee members, and obtain their approval. Approval of at least 2 committee members shall constitute successful completion of the M.S. thesis requirements, and the final recommendation will be forwarded to the Program Director for approval and degree certification.

Fail

Students who receive a “Fail” outcome (an average committee score of below 70) on their first M.S. Thesis Examination will be dismissed from the M.S. thesis option in the Graduate Program in Pharmaceutical Science. However, they may be offered the opportunity to complete the M.S. non-thesis option, provided they satisfy all coursework requirements and meet the degree requirements established for the M.S. non-thesis program.

The decision of the examining committee, subject to Graduate Program and University policies, shall be considered final.

6. The Doctor of Philosophy (PhD) Program

6.1. Minimum Admission Requirements

The minimum educational requirement for admission to the PhD Program in Pharmaceutical Science is a Bachelor of Science (B.S.), Master of Science (M.S.), Doctor of Pharmacy (Pharm.D.), Doctor of Medicine (M.D.), or an equivalent degree from an accredited institution. Other equivalent degrees will be considered on a case-by-case basis. Admission decisions are based on the availability of the open positions, applicant's overall academic record, research experience, letters of recommendation, statement of purpose, and alignment with the research interests of the Graduate Program faculty.

6.2. Expectations for PhD Students

A. Time to Degree

The Ph.D. program typically requires five to six years to complete, although the actual duration may vary depending on research progress, scholarly productivity, and successful completion of Program milestones and degree requirements. The School of Graduate Studies (SGS) generally expects students to complete all requirements for the Ph.D. degree within seven years of initial enrollment. Students who have not completed their degree requirements within this period may be required to provide documentation of satisfactory progress and justification for continued enrollment. At the seven-year limit, students may apply for an extension via SGS-Student-IDP <https://grad.rutgers.edu/academics/individual-development-plans>

B. Faculty Advisor Assignment

Students admitted through a specific Faculty Advisor are expected to conduct their dissertation research under the supervision of that Faculty Advisor throughout their Ph.D. studies. The Faculty Advisor serves as the student's primary research mentor and is responsible for providing scientific guidance, evaluating research progress, and overseeing completion of the dissertation research project. Students are expected to work closely with their Faculty Advisor to develop a research plan, establish academic and professional goals, and maintain satisfactory progress toward degree completion.

C. Laboratory Rotations

Because Ph.D. students are admitted directly into the laboratory of a specific Faculty Advisor, laboratory rotations are generally not required or offered. Students are expected to begin their research activities in their advisor's laboratory shortly after enrollment and to remain under the supervision of that Faculty Advisor throughout their doctoral training.

D. Student Advisory Committee Formation

A Student Advisory Committee must be established before the student's second year of study (before the start of the third semester). The committee shall consist of three faculty members from the Graduate Program in Pharmaceutical Science, including the student's Faculty Advisor. It is possible to change the committee members if necessary. The Student's Advisory Committee could later become Student's Dissertation Committee. The composition of the Student Advisory Committee must be approved by the Program Director.

The Student Advisory Committee serves as an important resource for scientific mentorship, academic guidance, and professional development. The committee is expected to meet once annually to review the student's academic and research progress, evaluate progress toward degree milestones, and provide

recommendations regarding the successful completion of Program requirements. Students are responsible for scheduling annual meetings with their Advisory Committee. Students will provide the committee members with appropriate progress reports or supporting materials prior to each meeting.

E. Role of the Student Advisory Committee

The Student Advisory Committee plays an important role in supporting and evaluating the student's academic and research development throughout the graduate program. The Committee serves as a source of scientific guidance, mentorship, and constructive feedback, helping students progress toward the successful completion of their degree requirements.

The responsibilities of the Student Advisory Committee include:

- Evaluating the student's academic performance, research progress, and overall advancement toward degree completion.
- Providing guidance on research direction, experimental design, data interpretation, and professional development.
- Identifying potential challenges or obstacles that may impede progress and recommending appropriate solutions.
- Ensuring that the student is making satisfactory progress toward completion of all Program milestones and degree requirements.
- Providing feedback on coursework, research activities, presentations, publications, and other scholarly accomplishments.
- Assisting the student in developing the scientific, professional, and communication skills necessary for a successful career.
- Advising the student on the preparation for qualifying examinations, thesis or dissertation research, and final degree requirements.
- Making recommendations to the Program Director regarding the student's academic standing when necessary.

F. Change of Advisor

In exceptional circumstances, a change of research advisor may be permitted. A request for a change of advisor may be initiated either by the student or by the Faculty Advisor. Any proposed change must receive approval from the current advisor, the prospective new advisor, and the Program Director. Changes in research mentorship should be undertaken only when they are in the best academic and professional interests of the student and are consistent with the availability of research funding, laboratory space, and other necessary resources. Students considering a change of advisor are encouraged to discuss the matter with the Program Director at an early stage to facilitate a smooth transition and minimize disruptions to their academic progress.

G. Research Integrity

All research activities must be conducted in strict accordance with Rutgers University policies on academic integrity and responsible conduct of research. Data fabrication, falsification, plagiarism, and other forms of research misconduct are strictly prohibited and may result in disciplinary action, including dismissal from the Program.

H. Maintaining Good Standing

To remain in good academic standing, Ph.D. students must be actively engaged in research under the supervision of a Faculty Advisor and be affiliated with a research laboratory. Students who do not

have a Faculty Advisor cannot continue in the Graduate Program in Pharmaceutical Science. Graduate education is a partnership between students, faculty mentors, and the Program. Students who demonstrate intellectual curiosity, professionalism, integrity, and a strong commitment to research are most likely to thrive and achieve success in their graduate careers.

Credits

- 72 total credits are required
- 27 course credits including 9 core credits, 3 core-electives, 15 electives and 45 research credits
- Every PhD student must register 1 credit each semester in “Attendance Pharmaceutical Sci. Weekly Seminar” 16:720:703,704 except when the student is giving the seminar that semester, then the student would register for “Seminar in Pharmaceutical Science” 1 credit with a letter grade, as stated below.
- GPA of above 3 with maximum of two courses with a grade of “C or C+”.*
- All research credits must have a grade of “S”

* Rutgers University will not confer graduate degrees to students having a grade point average (GPA) < 3.00. Rutgers also limits the number of C or C+ grades that a graduate student can use to fulfill degree requirements. It is the policy of the Pharmaceutical Science Graduate Program to limit students to a MAXIMUM of two grades of C or C+. Ph.D. students who exceed two C/C+ grades will not be allowed to continue towards a Ph.D. and will instead be reclassified as terminal M.S. students, where the qualification of the M.S. degree will apply.

Transfer of Credits

- Maximum 24 graduate course credits may be transferred from another institution or from non- matriculated course work at Rutgers
- Credits can only be transferred after 9 matriculated course credits have been completed successfully at Rutgers
- Only courses with a grade of “B or better will be considered
- Approval must be obtained from the Program director and the Dean of the Graduate School-NB
- Approval will be granted only for those courses pertinent to your field

6.3. Course Credit Requirements

Core Courses: at least 9 credits from the following list are required

Advanced Pharmaceutics /Physical Pharmacy (Sinko)	16:720:507	3
Advanced Pharmacokinetics /Dynamics (Kagan)	16:720:509	3
Molecular and Cellular Pharmaceutics (Minko)	16:720:614	3
Membrane Transporters in Drug Disposition (You)	16:720:609	3
Dermaceutics (Michniak-Kohn)	16:720:523	3
Genetically Engineered Drug Delivery Systems (Hatefi)	16:720:549	3
Biochemical Foundations of Pharmaceutical Biotechnology I	30:158:309	3
Biochemical Foundations of Pharmaceutical Biotechnology II	30:158:310	3
Molecular Toxicology	16:963:505	4

Molecular Biology & Biochemistry I	16:115:511	3
Pharmacogenomics and Precision Medicine	30:158:409	2

Core Courses: 3 credits from the following list are required

Seminar in Pharmaceutical Science	16:720:601,602	2
Ethical Scientific Conduct	16:115:556	1

Elective Courses: at least 15 credits from the following list are required:

Design of Experiments	16:960:590	3
General Toxicology I (Principles of Toxicology)	16:963:501	2
Independent Research Proposal*	16:720:540	3
Colloidal Chemistry of Food	16:400:612	3
Nanotechnology and Its Applications in Biotechnology and Food	16:400:613	3
Cellular & Molecular Pharmacology: Principles of Drug Action and Targeting	16:718:680	3
Medicinal Chemistry: Research Techniques and Principles (Foundations in Drug Discovery)	16:663:501	3
Principles of Drug Design	16:663:502	3
Immunology	16:681:543	3
Drugs: Structure and Function	16:663:505	3
Basic Statistics for Research	01:960:401	3
Introduction to Molecular Modeling	16:160:510	3
Molecular Biology and Biochemistry II	16:115:512	3
Nano Tech-Based drug Delivery	16-720-550	3
Others**		

*Students who are interested in taking this course, need to consult with the Program Director and their Faculty Advisors to obtain more information.

**Other electives that are approved by the Faculty Advisor and Graduate Program Director may be accepted. (please see the Appendix)

6.4. Composition of Qualifying Exam and Dissertation Exam Committees

The Qualifying Exam or Dissertation Exam Committees shall consist of four members, including Faculty Advisor, two Full Members of the Graduate Faculty in the Graduate Program in Pharmaceutical Science, and one external member who is not a member of the Graduate Program (Full or Associate Member). Alternatively, the external member could be replaced by an internal Graduate Faculty (Full Member). The members of the Qualifying Exam Committee could be the same or completely different from the Dissertation Exam Committee.

The external member must hold a PhD, MD, PharmD, or an equivalent terminal degree and may be affiliated with either an academic institution, industry, government, or another recognized research organization. The external member should possess expertise relevant to the student's research area.

The composition of the aforementioned Committees must be approved by the Faculty Advisor and Program Director.

6.5. PhD Qualifying Exam

The Ph.D. qualifying exam serves as a gateway from the coursework phase of graduate education to independent dissertation research. The primary purposes are to evaluate whether the student has acquired the knowledge, critical-thinking skills, and research maturity necessary to undertake doctoral-level research.

The PhD qualifying exam in the Pharmaceutical Science Program typically assesses the following:

- A. Mastery of Foundational Knowledge
 - Demonstrates that the student has acquired sufficient knowledge of the field to conduct independent research.
 - Evaluates understanding of fundamental concepts, methodologies, instrumental techniques, and relevant literature.
- B. Critical Thinking and Scientific Reasoning
 - Assesses the ability to analyze scientific problems, interpret data, identify knowledge gaps, and formulate testable hypotheses.
 - Evaluates the student's capacity to think independently rather than simply recall information.
- C. Research Design Skills
 - Determines whether the student can develop a scientifically rigorous research plan.
 - Assesses the ability to design experiments, anticipate potential pitfalls, propose alternative approaches, and interpret possible outcomes.
- D. Scientific Communication
 - Evaluates written and oral communication skills.
 - Assesses the ability to present complex scientific ideas clearly and defend them before a committee.

E. Readiness for Independent Research

- Serves as the faculty's assessment of whether the student is prepared to proceed to the dissertation phase.
- Confirms that the student can function as an independent scientist rather than simply a trainee following instructions.

F. Professional Development

- Encourages students to synthesize knowledge from multiple disciplines.
- Helps develop grant-writing and proposal-development skills that are essential for academic, industry, and government research careers.

In many ways, the qualifying exam answers a single fundamental question:

"Has this student demonstrated the knowledge, scientific judgment, and research skills necessary to conduct independent doctoral research?"

Timing of the Qualifying Exam

The Qualifying Examination must be completed before or during the student's third year (any time before the end of the sixth semester) in the Graduate Program. The timing of the Qualifying Exam is determined by the Faculty Advisor. Under exceptional circumstances, the Program Director may grant an extension to conduct the examination in the fourth year. Such circumstances may include, but are not limited to, prolonged illness, maternity or parental leave, unforeseen personal hardships, natural disasters, pandemics, or other significant events that substantially disrupt academic progress.

The Qualifying Examination is a closed-door oral examination conducted by the PhD Qualifying exam committee. During the examination, committee members will assess the student's understanding of the relevant scientific literature, research area, experimental design and methods, relevant instrument operation and maintenance, data interpretation, and overall readiness to undertake independent research.

To be eligible for the examination, the student must have completed all his/her course work and prepare a written research proposal related to their area of research and distribute it electronically to all committee members at least two weeks prior to the scheduled examination date. The title, scope, and general content of the written research proposal must be developed in consultation with the Faculty Advisor and receive the Faculty Advisor's approval before the proposal is submitted to the examining committee.

Format of the Written Proposal

The written proposal must be formatted as described below and contain the following components:

Formatting guidelines: Font Arial 11; Single-spaced; Margins 0.5" all around; 14-page limit including figures and tables, but excluding references. Please note that 14 pages is the maximum allowed length, not the expected or required length. The proposal itself may be 8, 10, 12, or up to 14 pages, depending on the scope of the project and the amount of data available.

Background: Present the ideas and scientific rationale for the proposed research project. Clearly demonstrate that there is sufficient scientific evidence to support moving into the proposed stage of research.

Hypothesis/Objective: State the hypothesis to be tested and the research objective.

Specific Aims: Concisely explain the project's specific aims. Typically, three aims are proposed.

Preliminary Studies: If available, include preliminary data that you have obtained to date and relevant to the proposed project. Describe how data will be collected, handled and analyzed in a manner that is consistent with the study objectives.

Research Strategy: Describe the experimental design, methods, and analyses, including appropriate randomization, blinding, sample-size estimation, and controls, in sufficient detail for analysis. Address potential problem areas and present alternative methods and approaches. Describe the statistical plan, including a power analysis to demonstrate that the sample size is appropriate to meet the objectives of the study. If cell lines or animals are to be used, justify why the proposed cell line(s) or animal model(s) were chosen. If human subjects, human biological samples, or datasets will be used, describe the study population and include a plan for the recruitment of human subjects or the acquisition of samples.

References: Use a reference manager software (e.g., Endnote) and "NIH style" to organize the references.

Qualifying Exam Scoring System

At the conclusion of the examination, each committee member will independently evaluate the student's performance using a confidential ballot and assign a score on a scale of 1 to 100. The final outcome will be determined based on the average score of all committee members.

The examination outcomes are defined as follows:

- Pass: Average score of 80 or higher
- Retake: Average score of 71–79
- Fail: Average score of 70 or less

Pass

The student has successfully completed all requirements of the Qualifying Exam.

Retake (Conditional Pass)

Students receiving a Retake outcome will receive written feedback identifying areas for improvement and a letter from the Graduate Program. The student will be permitted one additional opportunity to retake the Qualifying Examination within one to three months of the original examination date at the discretion of the Faculty Advisor.

Fail

Students who receive a Fail outcome (average score of 70 or less) on their first Qualifying Examination will be dismissed from the PhD Graduate Program in Pharmaceutical Science and will be offered an M.S. degree. The M.S. degree with a thesis or a no-thesis option is determined by the Faculty Advisor and approval of the Program Director.

Students who receive a Retake outcome on their first examination but subsequently score below 80 in the second examination will also be dismissed from the Graduate Program. They will be offered an M.S. degree. The M.S. degree with a thesis or a no-thesis option is determined by the Faculty Advisor and approval of the Program Director. The decision of the examining committee, subject to Graduate Program and University policies, shall be considered final.

6.6. Dissertation

The doctoral dissertation represents the culmination of a student's independent research and scholarly accomplishments. Students are expected to prepare a dissertation demonstrating original research and making a significant contribution to the pharmaceutical sciences.

Dissertation Preparation

- The dissertation must be prepared in accordance with all formatting, submission, and degree requirements established by the School of Graduate Studies (SGS).
- A complete draft of the dissertation should be provided to all Dissertation Committee members and the Program Director at least three weeks prior to the scheduled dissertation defense.
- Students must obtain and complete the appropriate forms through the Program Coordinator's office before the dissertation defense.
- Students should obtain a dissertation completion checklist from the Program Coordinator and ensure that all Program and SGS requirements are satisfied before graduation.
- Following a successful dissertation defense and completion of all required revisions, an electronic copy of the final approved dissertation must be submitted in accordance with SGS requirements and provided to the Program Director.
- The dissertation title page and all required approval forms must be completed according to SGS guidelines. Any signatures required on official University documents must be provided in the format specified by SGS.

Pre-Dissertation Defense Meeting

Approximately four months prior to the anticipated dissertation defense date, the Ph.D. candidate shall convene a Pre-Dissertation Defense Meeting with the Dissertation Committee. The purpose of this meeting is to review the student's research progress, evaluate the completeness and quality of the data collected, and assess readiness for dissertation completion and defense.

Prior to the meeting, the student should provide the Dissertation Committee with a summary of research accomplishments, key findings, publications, and a proposed timeline for dissertation completion.

Following review of the student's progress, the Dissertation Committee shall determine whether sufficient progress has been made to proceed toward the dissertation defense. If the Committee concludes that the research objectives have been substantially achieved and the dissertation is nearing completion, the student may proceed with scheduling the dissertation defense.

If the Committee determines that additional research, analysis, experimentation, or dissertation development is necessary, the student shall address the Committee's recommendations before scheduling a defense. In such cases, an additional Pre-Dissertation Defense Meeting may be required to review the student's progress and reassessed readiness for defense.

The recommendations and conclusions of the Dissertation Committee shall be documented by the Faculty Advisor and submitted to the Program Director for record-keeping purposes.

Dissertation Defense

The dissertation defense is a public examination of the student's doctoral research and serves as the final academic requirement for the Ph.D. degree.

Students are responsible for:

- Scheduling the defense in consultation with all Dissertation Committee members.
- Coordinating the defense date, time, and location with the Program Coordinator.
- Reserving appropriate rooms for both the public seminar and the closed dissertation examination. Because room availability may be limited to near graduation deadlines, students are encouraged to make arrangements well in advance.
- Providing the Program Director with the name, professional affiliation, and contact information of the external committee member.

If an external committee member is unable to attend the dissertation defense in person, the committee member must provide written confirmation that they have reviewed and approved the dissertation prior to the defense. Appropriate procedures for documenting the external member's participation will be followed in accordance with Graduate Program and SGS policies.

Dissertation Examination

On the day of the defense, the Ph.D. candidate will present the dissertation research in a public seminar attended by faculty, students, and other members of the University community.

The public presentation typically consists of:

- A 45–60-minute seminar describing the research project, findings, and significance.
- A 15-minute question-and-answer session during which members of the audience may ask questions regarding the research.

The audience will then leave the room, and the Dissertation Examination will continue behind closed doors where Dissertation Committee members examine:

- The research project and experimental results.
- Data analysis and interpretation.
- The scientific significance of work.
- The student's general knowledge and preparation in the field.

At the conclusion of the examination, the Dissertation Committee will deliberate and render one of the following decisions:

- Pass: The student has successfully completed all requirements of the dissertation examination.
- Conditional Pass: The student has successfully defended the dissertation but must complete specific revisions, corrections, or additional requirements before final approval is granted.
- Fail: The student's performance does not meet the standards required for successful completion of the dissertation examination. The student will be provided with written feedback identifying areas requiring improvement and will receive a letter from the Graduate Program. The student will be permitted one additional opportunity to retake the Dissertation Defense. The timing of the

retake will be determined by the Faculty Advisor and approval of the Program Director.

The Dissertation Committee will communicate its decision and any required revisions to the candidate following completion of the examination.

Diploma Dates

These slightly vary with the calendar but the general rule of is:

- May 1, with diploma, application on March 15, Candidacy form in on April 1
- October 1, both diploma application and candidacy form in on October 1
- January 1, both diploma application and candidacy for in on same day
- You may also check the due date with the link below
<https://grad.rutgers.edu/academics/graduation>

7. Additional Helpful Information for All Students

Registration Information

- Full time: 9 credits
- TA's must register for 6E credits with the E prefix, 16:720:877
- GA's must register for 6E credits with the E prefix, 16:720:866
- Fellowships must register for 16:720:811 with 0 credits. This allows your fellowship to be recorded on your transcript for future reference. This is important information in the future
- You may register for up to 16 credits including your 6E for a TA or a GA
- If you are taking under 16 credits in total with your TA/GA and courses, make up to the 16 by registering for research credits with your advisor
- If you are taking the undergraduate courses level 400 or above for graduate credits, be sure to use the G prefix
- If you are taking a "not for credit" course, use the N prefix. You will do all the work but won't take the final exam and you will receive an S or U grade
- "N" allows the course to show on your transcripts, whereas if you simply ask the professor to let you sit in on the course (audit), it will never show on your transcripts
- Pre-qualifying doctoral international students (F-1 visa) who have completed all course work and are studying for qualifying exams may register for 1 credit (permitted for a maximum of 2 semesters, NO EXCEPTIONS).
- Domestic student: after completion of your 72 credits requirement may register for only 1 research credit to be considered full time by the SGS
- You must remain registered every semester, either with course and research credits or as matriculation continued, if the situation warrants
- Any lapse will require an Application for Re-Admission form and approval of the Program Director and the Dean of the SGS and the payment of a restoration fee
- A GPA of 3.0 or higher is required to meet degree requirements:
<https://grad.rutgers.edu/current-students/policies-procedures-students>:

Change of Status

- A Change of Status form must be sent to the SGS if you decide to change your degree status in any way
- Pick up the form at the Program Coordinator's office

Incomplete Grades

- Incomplete grades must be made up within one year

Change in Address, Phone or E-mail

- The Program Coordinator should always have your most current contact information, both on and off campus

Summer Research Credits

If you were a full-time TA in the previous two semesters (Fall and Spring), then, you may register for 6 research credits over the summer and your TA tuition remission will cover these credits; by doing this, you may save money for your advisor. If you are appointed with a GA, the GA tuition is from your advisor's own funding unlike the TA appointment, TA tuition is paid by the Dean's office. It is wise to maximize your course credits while you were a full-time TA

- There are 2 summer sessions listed; it doesn't matter which one you sign up for but be sure to let the Program Coordinator and your advisor know

For online courses registration please visit: <https://sims.rutgers.edu/webreg/>

Office Of the Registrar, New Brunswick: <https://nbregistrar.rutgers.edu/>

MAKEUP OF THESIS COMMITTEES

EXAMPLE

Committee Member	Discipline	Institution
1. Faculty Advisor	Pharm. Sci. Program Faculty	Rutgers
2. Member #2	Pharm. Sci. Program Faculty	Rutgers
3. Member #3	Pharm. Sci. Program Faculty	Rutgers
4. Member #4	Pharm. Sci. Program Faculty or Outside member	As desired (within Rutgers but in a different program, another institution or industrial sector)

SAMPLE DOCTORAL THESIS ADVISOR AGREEMENT

SCHOOL OF GRADUATE STUDIES
RUTGERS
Pharmaceutical Science Program

Doctoral Thesis Supervisor Agreement

TO: Graduate Director

FROM: Thesis Supervisor _____

The program outlined in the proposal:

Title: _____

Author: _____

Date: _____

Is adequate for a Doctoral thesis. I believe that appropriate readers for this thesis would be:

Member 1: _____

Member 2: _____

Member 3 (outside member): _____

Member 4: _____

Facilities and support for the research outlined in the proposal are available. I am willing to supervise the research and evaluate the thesis report. I further agree to hold a thesis committee meeting at least once per year to review and guide the student's research.

Signed: _____

Title: _____

Date: _____

Appendix

Selected Elective Course Descriptions

16:115:533 PHYSICAL BIOCHEMISTRY (3)

Prerequisites: Biochemistry, physical chemistry.

Protein folding is used as theme to discuss the principles of physical chemistry of macromolecules of biochemical importance. Specific aspects of thermodynamics and kinetics are related to biopolymers. Spectroscopic techniques, including circular dichroism, as well as other biophysical methods.

16:115:556 ETHICAL SCIENTIFIC CONDUCT (1)

Introduction to ethical issues of scientific investigation, including intellectual property, plagiarism, conflict of interest, human and animal subjects, record keeping, etc. Intended for Ph.D. candidate in the biomedical sciences.

16:148:503 CELLULAR AND MOLECULAR SIGNALING (3)

Prerequisite: General biochemistry.

Signal/transduction at the molecular level. Use of newer research techniques emphasized.

16:148:514 MOLECULAR BIOLOGY OF CELLS (3)

Prerequisites: 01:119:380 and 01:119:460, or equivalents. Corequisite: Graduate course in biochemistry.

Fundamentals of the molecular organization and functions of cells.

16:148:517 CELLULAR AND MOLECULAR MECHANISMS OF DISEASE (3)

Theories on the cellular and molecular mechanisms that underline the development and progression of human diseases. Cell injury, inflammation, regeneration and repair, neoplasia, immune protection and immune disorders, environmental disorders, vascular diseases, connective tissue disorders.

16:148:530 HUMAN GENETICS (3)

Prerequisite: Basic molecular genetics. Recommendation: Biochemistry and physiology.

Examination of molecular and chromosomal bases for human inherited diseases. Molecular approaches to gene identification including position cloning and linkage analysis. Role of mutations, evaluation of repetitive sequences in the human genome.

16:148:550 ADVANCED DEVELOPMENTAL BIOLOGY (3)

Prerequisite: 16:148:514 or equivalent; or permission of the instructor. Suggested: Genetics. Also open to advanced undergraduates.

Molecular mechanisms of cell type differentiation and body part specification. Cell-cell interaction, signal transduction during development, morphogenetic gradients, pattern formation, focusing on three experimental organisms: the nematode *C. elegans*, *Drosophila*, and the mouse. Genetic experimental approaches will be emphasized.

16:148:555 CELL BIOLOGY AND HISTOLOGY (4)

Prerequisite: Permission of instructor.

Study of microscopic structure of cells, tissues, and organs as seen in the light and electron microscopes. Emphasis on correlation of structure and function.

16:148:565 GROSS AND DEVELOPMENTAL ANATOMY (7)

Prerequisite: Permission of instructor.

Study of macroscopic structure of the human body by dissection and other methods with reference to functional mechanisms and changes during development and clinical correlations.

16:148:591 IMMUNOLOGY: CELLULAR AND MOLECULAR (3)

Prerequisite: Basic immunology.

Development of humoral and cell mediated immune systems.

16:150:532 KINETICS OF MATERIALS SYSTEMS (3)

Prerequisite: Differential equations.

Diffusion in solids. Solutions to Fick's first and second laws under important boundary conditions. Ionic diffusion. Diffusion applied to sintering. Solid-state reaction kinetics. Nucleation, crystal growth, and precipitation.

16:155:501 ADVANCED TRANSPORT PHENOMENA I (3)

Prerequisite: Undergraduate transport phenomena.

Momentum transport processes in laminar and turbulent flow systems. Development and application of steady and unsteady boundary layer processes including growth, similitude principles, and separation. Potential flow theory coupled with viscous dissipation at boundaries. Momentum transport in fixed and fluid bed exchangers and reactors.

16:155:502 ADVANCED TRANSPORT PHENOMENA II (3)

Prerequisite: Permission of instructor.

Energy balances derived from first and second law approaches open systems, with reaction. Conduction in fluids and solids, both steady and unsteady examples. Convection in laminar and turbulent flow systems. Diffusion and its treatment in stagnant and flowing media. Two phase systems coupled reaction and mass transfer. Interphase transport.

16:155:503 ADVANCED TRANSPORT PHENOMENA III (3)

Pre- or corequisites: 16:155:501,502.

Advanced topics in momentum, heat, and mass transfer. Special emphasis on computational techniques.

16:155:512 ADVANCED CHEMICAL ENGINEERING MOLECULAR THERMODYNAMICS (3)

Prerequisite: 16:155:511 or equivalent.

Statistical ensembles; ideal and non-ideal gases; liquids; distribution function theories; Ornstein-Zernike equation; computer simulation methods; perturbation theories; engineering semi-empirical equations of state; applications to chemical engineering systems.

116:155:514 KINETICS, CATALYSIS, AND REACTOR DESIGN (3)

Prerequisites: 16:155:501 and 507, or equivalent.

Principles of applied chemical kinetics, reaction mechanisms and rate laws, and engineering design of reactor vessels. Applications to homogeneous and heterogeneous process reaction systems with internal, transphase, and external mass transfer. Noncatalytic gas-solid reaction and gas-liquid absorption with reaction. Micromixing and macromixing in reactor systems.

16:155:531 BIOCHEMICAL ENGINEERING (3)

Prerequisites: Degree or option in biochemical engineering, or 01 or 11:115:301 and 01:119:390, or equivalent.

Integration of the principles of chemical engineering, biochemistry, and microbiology. Development and application of biochemical engineering principles. Analysis of biochemical and microbial reactions.

16:155:533 BIOSEPARATIONS (3)

Prerequisite: Permission of instructor.

Fundamental problems of separation processes important to the recovery of products from biological processes. Topics include membrane filtration centrifugation, chromatography, extraction, electrokinetic methods. Emphasis on protein separations.

16:155:551 POLYMER SCIENCE AND ENGINEERING I (3)

Physical and chemical structure of polymers; morphology of polymer crystals; microscopic texture. Mechanical properties; influence of orientation; effects of temperature and environment; engineering applications.

16:155:552 POLYMER SCIENCE AND ENGINEERING II (3)

Prerequisite: 16:155:551.

Emphasis on a modern treatment of polymers, including statistical mechanics scaling concepts and polymer properties and characterization.

16:155:561 APPLIED SURFACE CHEMISTRY (3)

Prerequisite: Undergraduate or graduate degree in chemical engineering or in biological or physical sciences.

Phenomena and processes relevant to chemical engineering are characterized by large interfacial area relative to phase volume. Fundamental principles of surface chemistry and physics, such as interfacial tension and pressure. Study of colloidal state and colloidal particles. Theories of electrical double layer and stability of suspensions. Application of theory to important processes such as foaming, emulsification, detergency, adhesion, ore flotation, and rate processes controlled at a phase interface, including nucleation and crystallization.

16:160:510 INTRODUCTION TO MOLECULAR MODELING (3)

Prerequisites: 01:160:307, 308, 323, 324, or equivalent.

Introduction to the use of computer-assisted molecular modeling techniques for the study of chemical problems; lectures on theoretical principles; instruction in use of modern modeling programs; computer projects involving solution of chemical problems.

16:160:537 BIOPHYSICAL CHEMISTRY I (3)

Prerequisites: 01:160:327, 328, or equivalent.

Introduction to the physical chemistry of proteins, nucleic acids, and their complexes. Forces that determine biopolymer structure. Principles of protein and nucleic acid structure. Transitions and interactions of biopolymers.

16:160:538 BIOPHYSICAL CHEMISTRY II (3)

Prerequisite: 16:160:537 or equivalent.

Introduction to biophysical techniques used in the study of structure and function. Theoretical methods of macromolecular analysis. Methods of macromolecular engineering and design.

16:198:510 NUMERICAL ANALYSIS (3)

Prerequisites: Ability to use a high-level language such as PL/1 or FORTRAN IV, a minimum of four terms of undergraduate mathematics including calculus and linear algebra.

Derivation, analysis, and application of methods used to solve numerical problems with computers; solution of equations by iteration, approximation of functions, differentiation and quadrature, differential equations, linear equations and matrices, least squares.

16:198:535 PATTERN RECOGNITION THEORY AND APPLICATIONS (3)

Prerequisites: Linear algebra, probability, random variables, and statistics.

Pattern recognition as an inductive process, statistical classification, parametric and nonparametric methods, adaptive methods, error estimation, applications in image processing, character, speech recognition, and diagnostic decision making.

16:198:580 TOPICS IN COMPUTERS IN BIOMEDICINE (3)

Prerequisite: 16:198:513 or 520, depending on the term, or permission of instructor.

A survey of computational methods in biology or medicine; topics vary from instructor to instructor and may include computational molecular biology, medical reasoning, and imaging.

16:332:565 NEUROCOMPUTER SYSTEM DESIGN (3)

Prerequisite: 16:332:563.

Principles of neural-based computers, data acquisition, hardware architectures for multilayer, tree, and competitive learning neural networks, applications in speech recognition, machine vision, target identification, and robotics.

16:642:573, 574 NUMERICAL ANALYSIS (3,3)

Prerequisites: Advanced calculus, linear algebra, and differential equations.

Ideas and techniques of numerical analysis illustrated by problems in the approximation of functions, numerical solution

of linear and nonlinear systems of equations, approximation of matrix eigen-values and eigenvectors, numerical quadrature, and numerical solution of ordinary differential equations.

16:642:575 NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS (3)

Prerequisite: Partial differential equations.

Finite-difference schemes, investigating stability and convergence, other methods such as those of Ritz-Galerkin type and collocation.

16:650:576 POLYMER MECHANICS (3)

Prerequisite: 16:635:511 or permission of instructor.

Mechanical behavior, viscoelastic behavior, effects of external and internal factors on mechanical behavior, yielding and plastic deformation, fracture, fatigue, and effects of high pressure on mechanical, physical, and thermal properties of polymeric materials.

16:681:502 MOLECULAR GENETICS (3)

Prerequisites: 16:115:501 and 502.

Prokaryotic and eukaryotic molecular genetics. Bacteria, bacterio-phage, yeast, *Drosophila*, and mammals.

16:681:530 INTRODUCTION TO MOLECULAR MEDICINE (3)

Application of molecular and cell biology to a wide variety of human diseases; recent advances in understanding basic mechanisms.

16:681:543 IMMUNOLOGY (3)

Cellular basis of immunology; analysis, activation, and function of lymphoid cells; regulatory mechanisms, relevance to tumor and transplantation immunity.

16:681:546 INFECTIOUS DISEASES (4)

Prerequisites: 16:681:544, 545, or equivalent, permission of instructor.

Open to advanced students who can demonstrate the need for a clinically oriented course in infectious diseases. Consists of sixteen three- or four-hour sessions (60 hours total) over a period of two months. Time varies; consult instructor. Diagnosis and management of human diseases caused by infectious agents. Principles of the epidemiology, pathogenesis, and clinical manifestations of common diseases.

16:681:548 CELL SURFACE RECEPTORS (3)

Prerequisites: 16:115:501, 502, or equivalent. Recommended: A course in cell biology.

Diverse prokaryotic and eukaryotic cell-surface receptors and their mechanisms of intracellular signaling are examined to illustrate a range of experimental approaches, structural motifs, and biochemical mechanisms.

16:681:555 MOLECULAR VIROLOGY (3)

Prerequisite: 16:681:501 or equivalent.

Detailed consideration of fundamental physical-chemical properties, schemes of classification, genetics, and modes of replication of selected animal viruses.

16:681:580 FUNDAMENTALS OF MOLECULAR GENETICS (3)

Prerequisites: Genetics; 16:115:511 and 512.

Basic mechanisms of information storage in and retrieval from nucleic acids; organization of prokaryotic and eukaryotic genomes; mechanisms of DNA replication; transposable genetic elements; transcriptional and translational control of gene expression. Designed to provide necessary background for advanced molecular genetics courses 16:681:581, 585, 586, 587, and 588.

16:681:585 CANCER MOLECULAR BIOLOGY (3)

Emphasis on the molecular, cellular, and genetic basis for cancer. Oncogenes and tumor suppressor genes. Signal transduction and cell cycle control in cancer cells. Metastasis. Diagnosis and therapy. Recent understanding of the molecular basis of selected human cancers. Lectures and critical discussion of the current literature.

16:681:587 ADVANCED RECOMBINANT DNA TECHNIQUES (3)

Prerequisite: 16:681:580 or permission of instructor.

Use and properties of restriction endonucleases, prokaryotic and eukaryotic cloning vectors, construction and screening of recombinant DNA libraries, characterization of cloned DNA, and site-directed mutagenesis. Current NIH and FDA regulations governing recombinant DNA research.

16:681:588 CANCER (3)

Prerequisite: 16:681:580 or permission of instructor.

Broad coverage of cancer as a family of diseases of humans and experimental animals. Malignant progression and metastasis, DNA and RNA tumor viruses, cancer genes, chemical carcinogenesis, tumor immunology, therapeutic modalities, epidemiology, and medical oncology.

16:718:573 RECEPTOR LIGAND-PROTEIN INTERACTIONS (2)

Prerequisite: Permission of instructor.

Readings, seminars, and discussions based on the primary literature emphasize current understanding of and methodology for investigating membrane structure, receptor classification, and the principles of ligand-receptor interactions. Emphasis on the mathematics used to analyze receptor-binding experiments. Dopamine receptor serves as a focus for much of the discussion.

16:718:575 INTRACELLULAR SIGNALING SYSTEMS (2)

Prerequisite: Permission of instructor.

Seminar presentations consider intracellular second messenger systems that mediate hormonally induced cellular responses; the role of G-proteins, tyrosine kinases, cAMP, Ca²⁺, and phospho-inositides in transducing regulatory signals and promoting posttranslational modification of proteins.

16:718:605 NUCLEIC ACIDS (2)

Prerequisite: Permission of instructor.

Basic principles of the secondary and tertiary structures of nucleic acids used to explore aspects of nucleic acid biology such as protein-nucleic acid interactions, RNA-catalyzed reactions, and nucleic acid pharmacology.

16:750:627 SURFACE SCIENCE I (3)

Introduction to structure and dynamics of clean surfaces, atoms and molecules on surfaces, and interfaces. Topics include: atomistic description of geometrical structure, surface morphology, electronic structure, surface composition, and theoretical and experimental bases of modern experimental methods.

16:750:628 SURFACE SCIENCE II (3)

Kinetics and dynamics of processes at surfaces; structure and reactivity of molecules at surfaces; thermal and nonthermal excitations; magnetic properties. Surfaces of metals, oxides, and semiconductors, as well as solid-solid and solid-liquid interfaces.

16:761:508 MOLECULAR AND CELL PHYSIOLOGY (3)

Prerequisites: Course in physiology or cell biology, and biochemistry, or permission of instructor.

Lectures on membrane structure, transport phenomena, muscle, nerve, and cell organelles.

16:761:513 CARDIOVASCULAR PHYSIOLOGY (3)

Offered in even-numbered years.

Comprehensive study of the cardiovascular system in mammals. Special consideration given to coronary circulation, myocardial-oxygen consumption, and cardiac arrhythmias.

16:761:515 MEDICAL PHYSIOLOGY (7)

Prerequisite: Permission of instructor.

Study of human physiology from the molecular to the systems level. Emphasis is on the integration of the systems within the healthy individual. Teaching modalities include lectures, small discussion groups, and laboratories in pulmonary and cardiovascular physiology.

16:761:537 EXERCISE PHYSIOLOGY (4)

Prerequisite: 16:761:501. Offered in alternate years.

Examination of the physiological responses associated with an acute exercise stress, in addition to the effects of repeated exercise or training. Emphasis on the control mechanisms involved in these processes. Laboratory involves students making measurements on themselves at rest and during exercise. Experiments utilizing animals are conducted to demonstrate muscle-neural and endocrine functions during exercise.

16:761:555 NEUROBIOLOGY (3)

Recommended: Biochemistry, physiology, or animal behavior.

Introductory survey emphasizing experimental approaches to the study of invertebrate and vertebrate nervous systems. Molecular, biophysical, and biochemical bases of nerve cell function. Higher-level functions shown as emerging from nerve cell properties, anatomical development, and mature connections. See also 16:830:555.

16:761:557 NEUROSCIENCE (4)

Study of the human central nervous system involving gross and microscopic examination and physiological study of the brain, spinal cord, receptors, and effectors with correlated clinical demonstration of neurological disorders.

16:960:584 BIOSTATISTICS I (3)

Prerequisites: One year of calculus, 01:960:484 or equivalent.

Statistical techniques for biomedical data. Analysis of observational studies emphasized. Topics include measures of disease frequency and association; inferences for dichotomous and grouped case-control data; logistic regression for identification of risk factors; Poisson models for grouped data; Cox model for continuous data; life table analysis; and SAS used in analysis of data.

16:960:585 BIOSTATISTICS II (3)

Prerequisite: 01:960:484 or equivalent.

Statistical techniques used in design and analysis of controlled clinical experiments. Topics include introduction to four phases of clinical trials; randomization, blocking, stratification, balancing, power, and sample-size calculation; data monitoring and interim analyses; baseline covariate adjustment; crossover trials; brief introduction to categorical and event-time data; and SAS used in analysis of data.

PHARMACEUTICAL SCIENCE GRADUATE FACULTY

Please see the names and research interests of the participating faculty members here:

<https://pharmacy.rutgers.edu/programs/pharmaceutical-science-ms-and-phd-faculty-and-staff/>