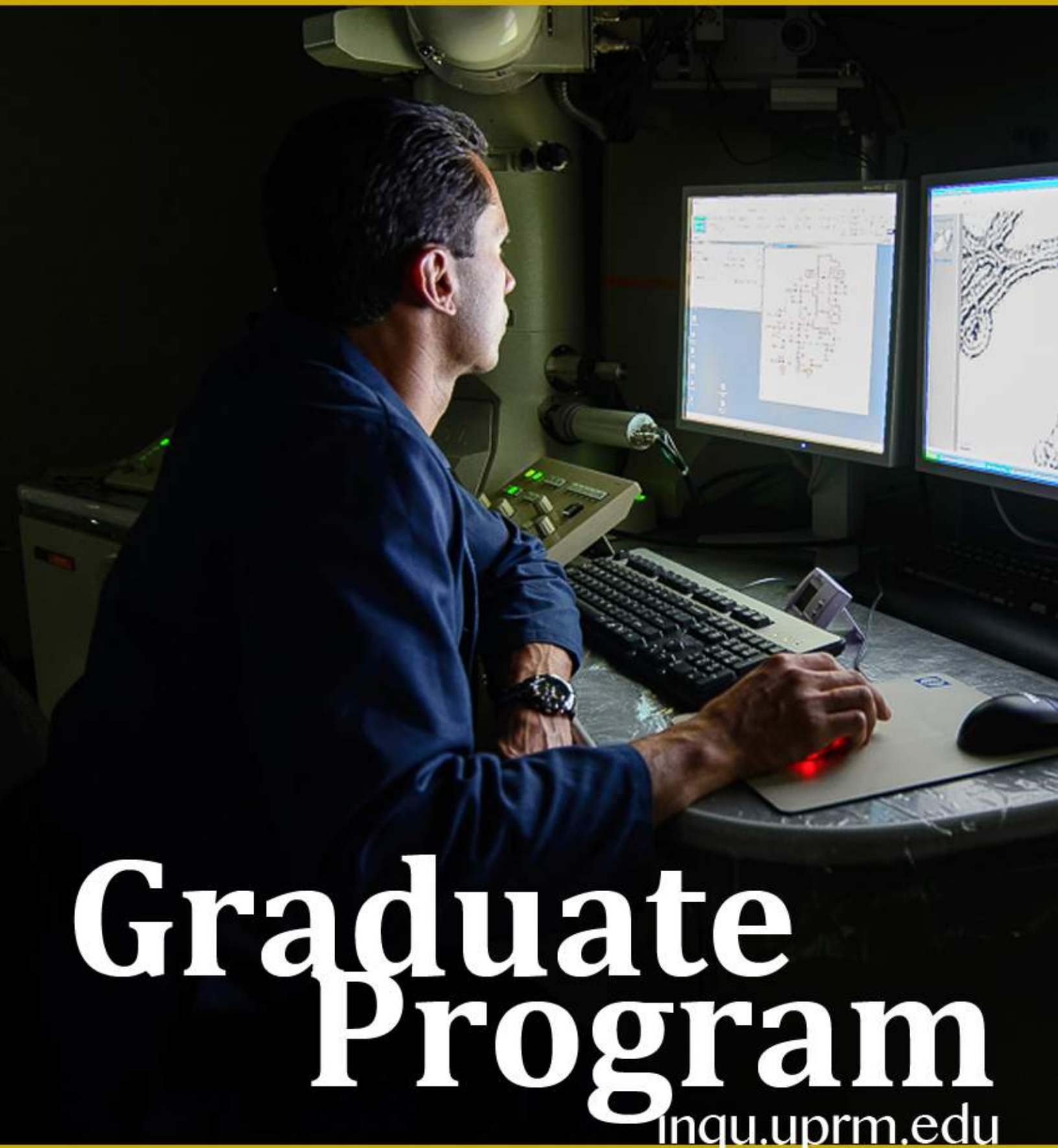
UNIVERSITY OF PUERTO RICO
MAYAGÜEZ CAMPUS

CHEMICAL ENGINEERING



Graduate Program

inqu.uprm.edu

Dear Prospective Student,

For nearly eight decades, teaching Chemical Engineering at the University of Puerto Rico - Mayagüez (UPRM) has centered around one fundamental premise: Academic Excellence. Since our Ph.D. program started in the year 2000, our Department has undergone a major transformation and we have added another fundamental principle: Research Excellence. We have taken great strides to improve the quality of our education at all levels, including our M.S. and Ph.D. programs, while increasing the research productivity in the department. Outstanding faculty hired during the last 10 years have helped fuel our growth in research expenditures and activity. We have established a Center for Nanomaterials Characterization (CeNaC), which houses state-of-the-art electron microscopy and X-ray based spectroscopy instrumentation, acquired several other characterization instruments, and expanded and streamlined the graduate curriculum. Our graduate program has generated more than 200 M.S. degrees and 45 Ph.D. degrees so far, being these numbers testament to the effort made by our research faculty toward preparing professionals with advanced expertise in the evolving field of Chemical Engineering.

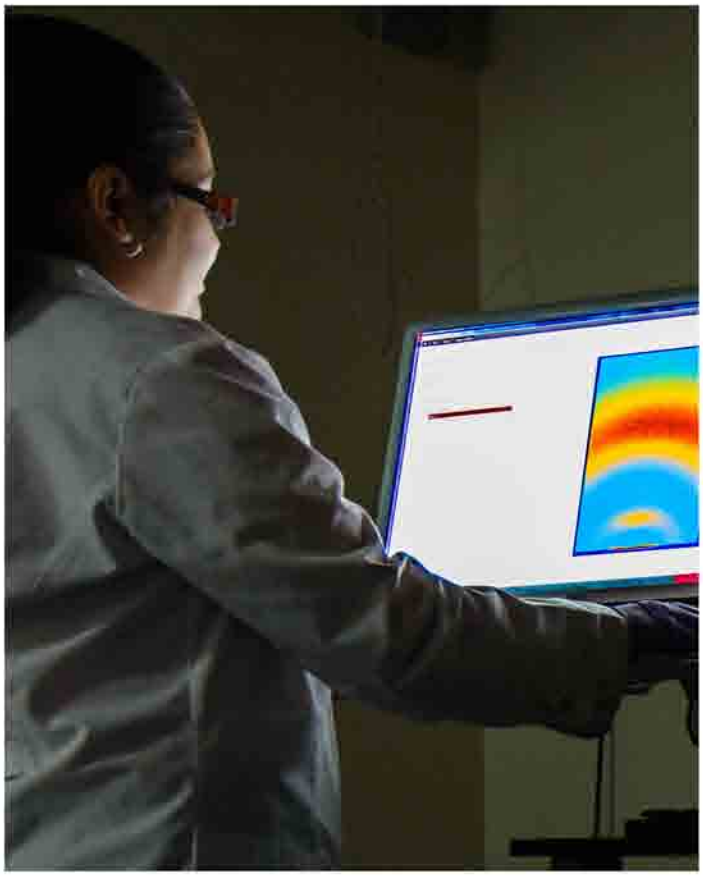
As part of our commitment to these principles, careful, individual attention is given to each student's preparation, interests, and goals in designing a graduate program of study and research. The UPRM Chemical Engineering faculty is conducting scholarly research in the areas of nanomaterials, colloids, pharmaceutical engineering, bioengineering, environmental engineering, and energy, among others. The faculty has developed research specialties in a broad range of areas including synthesis and characterization of nanoporous and nanostructured materials, materials for drug delivery and biosensors, simulations and computational chemistry that span the quantum to continuum length scales, and production of fuels and raw chemicals from renewable feeds, among many others. During the last 10 years, the department has received three highly competitive U.S. National Science Foundation (NSF) CAREER grants, being evidence of the caliber of our individual researchers. In addition, our faculty are active leaders and participants in many interdisciplinary research centers at the UPR, including an NSF Engineering Research Center, an NSF Partnership for Research and Education in Materials, NSF Phase I & II Centers of Research Excellence in Science and Technology, and an NSF UPR Institute for Functional Nanomaterials. The external federal funding portfolio also includes individual and collaborative grants from the National Institutes of Health (NIH), National Aeronautics and Space Administration (NASA), Department of Energy (DoE), Department of Defense (DoD), and the United States Department of Agriculture (USDA). These efforts contribute several million U.S. dollars in external funds yearly. Our laboratory facilities, dedicated to specific and general uses, afford excellent support for fundamental and novel research. As a result of this research activity, the department has generated more than 225 publications in peer-reviewed journals during the last ten years that have accounted for more than 2,400 citations already, in addition to several patent applications, numerous conference proceedings, and presentations at local, national, and international meetings.

Recent developments in science and engineering, as well as changes in both local and national industries, may require changes in the method of training of our students. While we continue to provide our graduates a sound basis in the fundamentals of chemical engineering and mastery of scientific tools, we are also preparing them to adjust to and succeed in a rapidly changing employment environment.

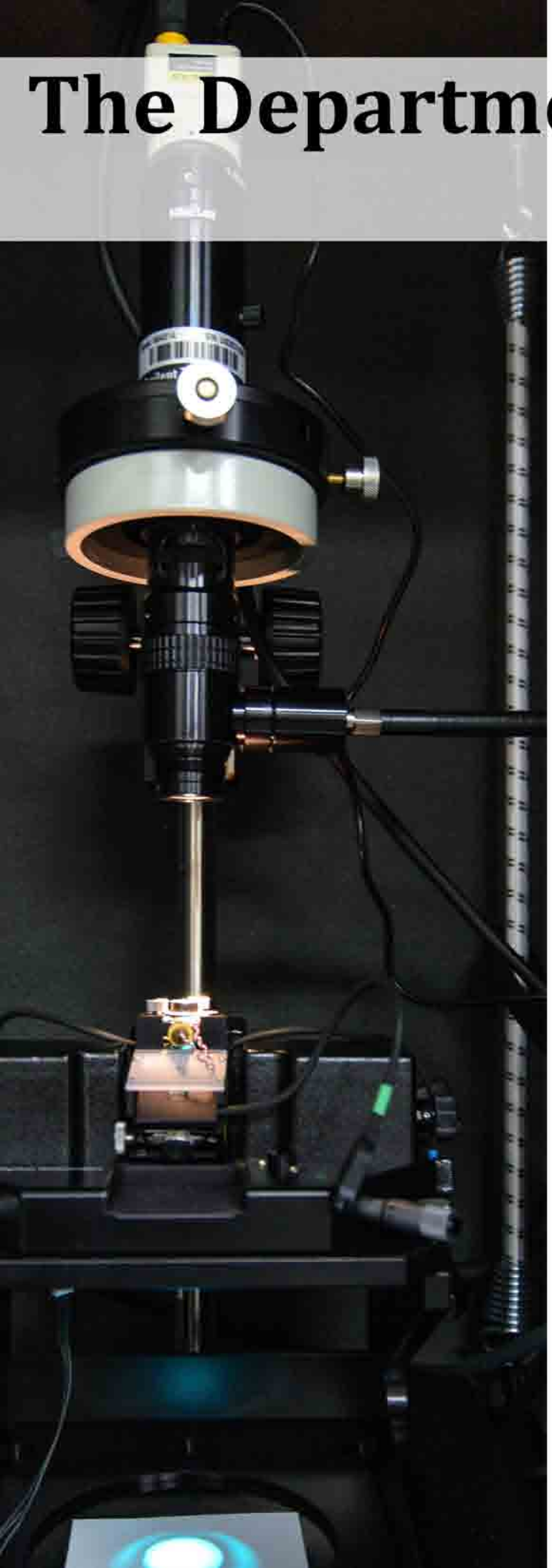
The Department has the distinct advantage of being located in the west coast of the beautiful island of

Puerto Rico, a unique environment for continuing education. Our programs and setting provide outstanding opportunities for intellectual, professional, and personal growth. Minutes away are a myriad of stunning beaches, spectacular rainforests, and excellent dining. Within two hours drive is San Juan, PR's capital with all the amenities and entertainment of a world-class metropolis. Over the years, our programs have produced MS and PhD alumni who have risen to positions of prominence in industry and academia both locally and abroad. As a result, we have developed strong industrial and academic partnerships and we look forward to strengthening them.

Obviously, this brief introduction will not suffice to show all the benefits of continuing your education at UPRM and we hope that you will contact us directly for additional details. Our main goal is to continue on a path of excellence in all facets of research, education, and service. We are proud of our accomplishments and are pleased to share them with you and welcome your interest and future participation in our educational and research activities.



Prof. Arturo J. Hernández-Maldonado, PhD
Chemical Engineering Graduate Program Coordinator



The Department of Chemical Engineering

The Department of Chemical Engineering offers programs leading to the Master of Science, Master of Engineering, and Doctor of Philosophy degrees. Graduate study at UPRM offers you the opportunity to do important, leading-edge research in any of a broad range of innovative areas; to work with our world-renowned faculty, each a leader in his or her chosen specialty; and to take advantage of the extensive resources within the department, throughout the UPRM, and in the intellectually and culturally rich Mayagüez area.

In addition to the admission requirements of the Graduate Studies Office, a Bachelor of Science degree in Chemical Engineering or its equivalent is required.

Academic graduation requirements for the Graduate Programs in Chemical Engineering above those established by the Graduate Studies Office include taking the following four courses: Advanced Thermodynamics, Transport Phenomena, Reactor Design, and Mathematical Methods in Chemical Engineering. Students in the Master of Science program are required to carry out a research project and write their corresponding report. Students in the Doctor of Philosophy program are required to pass a written qualifying exam and prepare a doctoral dissertation. The doctoral dissertation must be an original contribution to the state of the art in the field of study.

Research in the Department of Chemical Engineering spans the spectrum from fundamental work on chemical engineering science to applications development. Research projects broadly falls in four categories:

Bioprocess and Biomedical Engineering - enzymatic reactor design for production of ethanol from starches, modeling of chromatographic separations, hydrogel-based biomedical technologies, biodegradable polymeric drug-delivery materials, hybrid artificial organs, purification of wastewaters for space exploration plications, etc

Environmental Engineering and renewable Energy - airborne pollutant dispersion modeling, characterization of PEM fuel cells, biodiesel processing and implementation, production of alternative fuels from biomass, etc.

Nanostructured Materials Synthesis and Applications - semiconductor nanoparticles with enhanced catalytic properties, metallic nanoparticles and quantum dots for opto electronic and sensing applications, magnetic nanoparticles for sensing and cancer treatment, supercritical fluid tuning of block copolymer properties, nanoporous materials for specialty separations, etc.

Pharmaceutical Engineering - modeling and control of fluidized beds, supercritical fluid processing of pharmaceutical intermediates, mixing in pharmaceutical formulations, etc.
Other research in traditional chemical engineering disciplines is also represented in the department.

Doctor of Philosophy

The Doctor of Philosophy degree in Chemical Engineering at the UPRM requires an intense program of study and research. As such, the Department requires:

- Approval of a minimum of 58 credits as specified by the program with a GPA of 3.0 (out of 4.0) or more.
- Approval of written qualifying exams.
- Approval of a research proposal.
- Perform a research project as outlined on the proposal.
- Approval of dissertation's oral defense exam.
- Prepare a doctoral dissertation document.

Course Requirements

A minimum of 58 credits to complete the degree, which are divided as follows: 12 credits in chemical engineering core subjects; 1 credit in doctoral seminar, 18 credits in doctoral dissertation, 18 credits in non-core chemical engineering subjects, and 9 credits in non-chemical engineering subjects. A maximum of 6 credits in advanced undergraduate (i.e., 5000-level) courses is allowed, which should be approved within the first 30 credits of coursework. The discipline of Chemical Engineering covers many diverse areas and, therefore, the Department provides graduate-level subjects to cover those of most relevance. The philosophy of the Department is to encourage students to develop an in-depth understanding of the fundamental concepts of Chemical Engineering and, at the same time, broaden their perspective by sampling other, more specialized subjects. To this end, the following four subjects have been designated as core

- Mathematical Methods in Chemical Engineering (*InQu 6001*)
- Reactor Design (*InQu 6005*)
- Advanced Transport Phenomena (InQu 6016)
- Advanced Thermodynamics (*InQu 6019*)

It is expected that doctoral students will complete these four core subjects within the first two years of their tenure at the UPRM. The list of core subjects will be periodically reviewed to accommodate modern developments in the discipline. In addition to these core courses, doctoral students must enroll each semester in Doctoral Seminar (*InQu 8099*) and, upon approval of the Doctoral Qualifying Examination, in Doctoral Dissertation (*InQu 8999*). A maximum of 18 credits of Doctoral Dissertation (*InQu 8999*) may be applied to the fulfillment of doctoral credit requirements. To ensure the student's academic and professional development, the Department requires a minimum of 18 credits (typically six courses) in non-core chemical engineering subjects and a minimum of 9 credits (typically three courses) in other departments or disciplines, which should be related to the student's thesis research. These courses should be selected by the student in consultation with his/her thesis advisor.

Qualifying Procedures

The purpose of the doctoral qualifying examination is to assess at an early stage if he/she possesses the necessary intellectual skills and knowledge to earn the degree of doctor of philosophy in Chemical Engineering. This assessment is based on the student's performance in four written subject examinations. The exam is prepared by faculty members and overseen by the Qualifying Exam Coordinator, who is a member of the Graduate Committee. The qualifying examination is offered twice during the first year whenever there at least two students to take it. New students must approve the qualifying exam

before the beginning of the second year of full admission into the doctoral program. According to UPRM's regulations, students have two opportunities to pass the exam. A second failure will result in the student's dismissal from the UPRM graduate programs. The doctoral qualifying examination consists of four, two-hour subject examinations on the topics of: Thermodynamics, momentum and energy transport, mass transport chemical kinetics and reactor design.

Problems included are at the undergraduate level. The four subject examinations are offered in two non-consecutive days, one day apart. Each exam is prepared and graded anonymously by a member of the departtment faculty. This is a double-blind test, where the student does not know the evaluator's identity and vice versa. Subject examinations are closed-book. A handout containing standard formulas of the topics examined will be provided.

Thesis Research

The unique feature of graduate education is the development of the skills necessary to conduct and present independent research. The PhD thesis should demonstrate that the student has:

Acquired the skills necessary to conduct high-quality research including the abilities to think creatively and critically

Completed a coherent piece of independent research that makes a solid contribution to the general pool of scholarship

The length of the actual thesis, the number of associated publications, and the time required will necessarily depend upon the abilities and effort of the student, the details of the project, and the philosophy of the thesis advisor. It is impossible for the department to determine, a priori, how long any given student will remain in residence. However, it is important to recognize that the PhD program is a transition period, one which provides students with an opportunity to expand their intellectual horizons, to learn how to conduct research, and to be creative. The transitionary nature means that students should move as rapidly as possible towards completion of all of the objectives/requirements associated with the PhD degree.

Master of Science

The Master of Science (MS) degree in Chemical Engineering at the UPRM requires an intense program of study and research. As such, the Department requires:

Approval of a minimum of 31 credits as specified by the program with a GPA of 3.0 (out of 4.0) or more.
Approval of a research proposal.
Perform a research project as outlined on the proposal.
Approval of thesis' oral defense exam.
Prepare a thesis document.

Course Requirements

A minimum of 31 credits to complete the degree, which are divided as follows: 12 credits in chemical engineering core subjects; 1 credit in masters seminar, 6 credits in master's thesis, 6 credits in non-core chemical engineering subjects, and 6 credits in non-chemical engineering subjects. A maximum of 6 credits in advanced undergraduate (i.e., 5000-level) courses is allowed. The discipline of Chemical Engineering covers many diverse areas and, therefore, the Department provides graduate-level subjects to cover those of most relevance. The philosophy of the Department is to encourage students to develop an in-depth understanding of the fundamental concepts of Chemical Engineering and, at the same time, broaden their perspective by sampling other, more specialized subjects. To this end, the following four subjects have been designated as core:

Mathematical Methods in Chemical Engineering (*InQu 6001*)
Reactor Design (*InQu 6005*)
Advanced Transport Phenomena (*InQu 6016*)
Advanced Thermodynamics (*InQu 6019*)

It is expected that masters students will complete these four core subjects within the first two years of their tenure at the UPRM. The list of core subjects will be periodically reviewed to accommodate modern developments in the discipline. In addition to these core courses, master's students must enroll each semester in Graduate Seminar (*InQu 6029*) and after the first year in Master's Thesis (*InQu 6037*). A maximum of 6 credits of Master's Thesis (*InQu 6037*) may be applied to the fulfillment of the master's credit requirements. To ensure the student's academic and professional development, the Department requires a minimum of 6 credits (typically two courses) in non-core chemical engineering subjects and a minimum of 6 credits (typically two courses) in other departments or disciplines, which should be related to the student's thesis research. These courses should be selected by the student in consultation with his/her thesis advisor.

How to Apply?

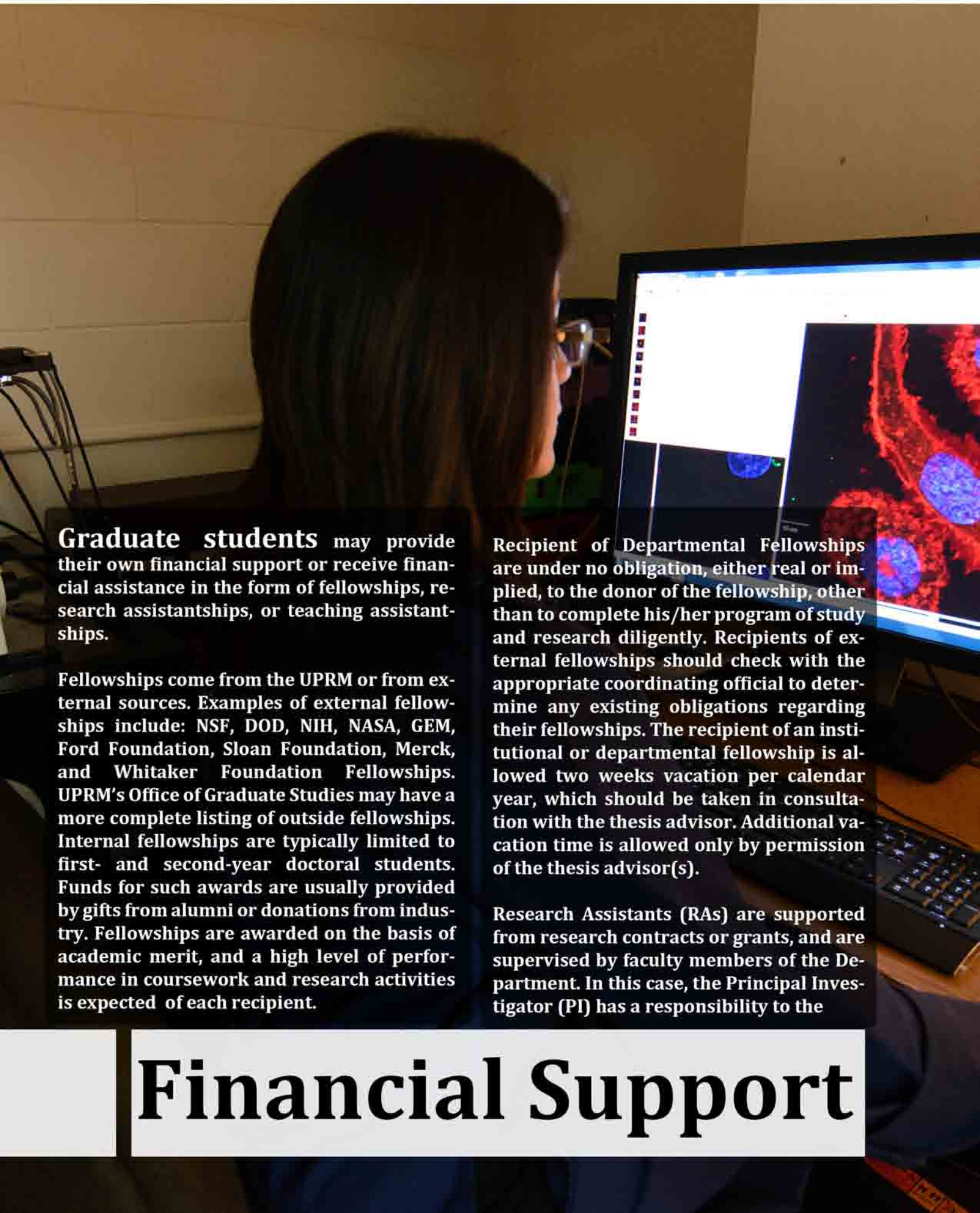
Only online application is available through the Office of Graduate Studies webpage at:
http://grad.uprm.edu
Instructions are given online as you fill in the application form and pay the corresponding fees. Nevertheless, be aware that in addition to your personal and professional background you will be requested to provide:
Contact information from three professional that can provide letters of recommendation (to be submitted by them online).
Submit Statement of Purpose. The Statement of Purpose is divided in two parts.

• Part 1: This statement should be an essay written in English or Spanish that includes the following information: why have you decided to pursue a graduate degree, why have you decided to apply to the University of Puerto Rico, if you have any particular preference for a research area and, finally, discuss any problems or inconsistencies in your records and any special situations that are not dis-closed elsewhere in the application.

• Part 2: This statement should be an essay written in English that includes the following information: what are your aspirations once you acquire your graduate degree and discuss in detail your research experiences and accomplishments such as awards and publications (if any).

Additional documents required by the Office of Graduate Studies are: One (1) official transcript including all university level approved courses, transcript /certificate of conduct, and degree certification (if not specified in transcript).

The Office of Graduate Studies screens out applications that do not meet the criteria described above and incomplete applications. Academic departments only receive completed applications.



Financial Support

Graduate students may provide their own financial support or receive financial assistance in the form of fellowships, research assistantships, or teaching assistantships.

Fellowships come from the UPRM or from external sources. Examples of external fellowships include: NSF, DOD, NIH, NASA, GEM, Ford Foundation, Sloan Foundation, Merck, and Whitaker Foundation Fellowships. UPRM's Office of Graduate Studies may have a more complete listing of outside fellowships. Internal fellowships are typically limited to first- and second-year doctoral students. Funds for such awards are usually provided by gifts from alumni or donations from industry. Fellowships are awarded on the basis of academic merit, and a high level of performance in coursework and research activities is expected of each recipient.

Recipient of Departmental Fellowships are under no obligation, either real or implied, to the donor of the fellowship, other than to complete his/her program of study and research diligently. Recipients of external fellowships should check with the appropriate coordinating official to determine any existing obligations regarding their fellowships. The recipient of an institutional or departmental fellowship is allowed two weeks vacation per calendar year, which should be taken in consultation with the thesis advisor. Additional vacation time is allowed only by permission of the thesis advisor(s).

Research Assistants (RAs) are supported from research contracts or grants, and are supervised by faculty members of the Department. In this case, the Principal Investigator (PI) has a responsibility to the

funding organization to conduct research in specific areas covered by the grant. In most cases, an appointment as a RA coincides with the selection of a research topic and a thesis advisor(s). This means that the selected or assigned thesis advisor is the PI, co-PI or senior personnel of the grant funding the student. In the case of RAs, an arrangement is made with the thesis advisor(s) to provide project funds for tuition and/or stipend. When paid on a 12-month basis, a RA is allowed two weeks vacation per calendar year, which should be taken in consultation with the thesis advisor. Additional vacation time is allowed only by permission of the thesis advisor(s).

Teaching Assistants (TAs) play a central role in the Department's educational program. Service as a TA, which requires working closely with one or more faculty members, is an important and beneficial aspect of the graduate school experience. Each TA is assigned to a specific undergraduate or graduate course. While the exact duties of the TA vary depending on the course and the instructor's teaching methodology, typical duties may include the following:

- Developing and grading problem assignments
- Grading reports and examinations
- Holding regular office hours (6 per week) for individual students and group sessions
- Leading recitation sections and tutorials
- Planning, designing, and supervising laboratory experiments
- Proctoring examinations
- Preparing a course solution book to be archived in the Department
- Attend the classes of the course they are TA'ing
- Attend orientation and training workshops organized by the Department or by the University

Not all students may be selected for TA appointments. Upon assignment as a TA, the student will be provided with a list of detailed responsibilities. TAs are expected to be available for the complete academic period of their assignment. A student working as a full-time TA (6 credit-hours) is expected to devote 18 hours per week to TA duties. Some courses with limited enrollment require only a fractional TA effort, and in those cases, partial TA appointments are made. TAs' stipends are set by the institution and announced each term by the Office of Graduate Studies.

Graduate Graders

A limited number of positions known as graduate graders may be available to assist in the teaching of some high-enrollment undergraduate courses. Graders are involved in grading homework assignments, photocopying handouts, and preparing audiovisual materials for class. Graders should not be responsible for any activity involving direct contact with students. Graders' stipends are set by the institution and announced each term by the Office of Graduate Studies.

Frequently asked questions

Do you consider application for second semester (Spring) admissions?
Applications are considered every semester. However, the graduate program curriculum was developed with new students beginning in the first semester (Fall).

I do not have a BS in chemical engineering, can I still apply?
We do consider applicants with bachelor's degrees in related areas in a case-by-case basis. Applicants must show a strong background in Math, Physics and Chemistry, as well as some knowledge of transport phenomena (Fluids, Heat and Mass Transfer), reaction engineering and thermodynamics, including phase equilibrium. Prospective students that do not meet these criteria may still receive a conditional admission with course deficiencies, if it can be achieved in a timely schedule within the institutional maximum of four deficiencies. Currently, students with bachelor's degrees or equivalent in Mechanical Engineering, Chemistry, Industrial Biotechnology, Agricultural Engineering and Food Sciences are enrolled in our graduate programs.

Is a Master's degree required for the PhD program?
No, the PhD program does not require a MS/ME degree.

I definitely want to do a MS and maybe a PhD afterwards, should I apply to the MS or PhD?
You should apply to the program that is better suited to your personal and professional goals. For example, the PhD program requires a longer commitment that many students are not willing to partake after just completing an undergraduate degree.

Are courses taught in Spanish or English?
Our system is bilingual. Most of the faculty is fluent in both Spanish and English. Written materials (textbooks, exams, papers, etc ...) are normally in English, while spoken language is Spanish. Most courses in Chemical Engineering are taught in Spanish as it is the first language of most professors. Basic English knowledge is desired of applicants.

I want to do research with Professor X when can I begin?
The student selects research projects that interest them and matches are normally made during the fourth month

F.A.Q.

(November or April) of the semester of the first year. This gives you a chance meet the faculty and more senior graduate students, and to explore the wide variety of projects offered. No matches are made in advance of this, however, feel free to contact the relevant faculty members about areas you are particularly interested.

Can I attend the graduate program while working on a private industry/company?
The ME program was designed with part-time students in mind. See the program description. The MS and PhD programs require a full-time commitment for significant and continuous research progress to be made.

Chemical Engineering

When applying online for the Master's program it gives me three options: Plan I (1), Plan II (2) or Plan III (3), what it means?
It refers to the type of Master's. A Plan 1 is a master's with thesis project, Plan 2 is a master's with engineering project, and Plan 3 is a coursework only master's. Thus, Plan 1 and Plan 2 correspond to MS and ME, respectively. The Chemical Engineering Program does not offer coursework only master's.

CHEMICAL ENGINEERING
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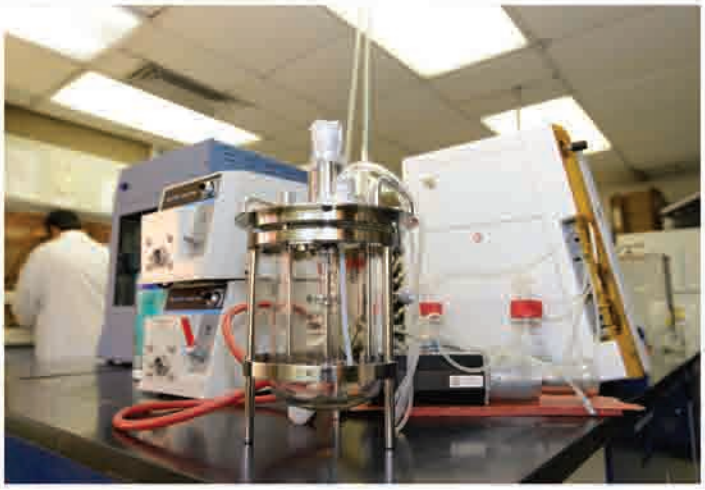
Research



The Center for Biomedical Engineering and Nanomedicine:

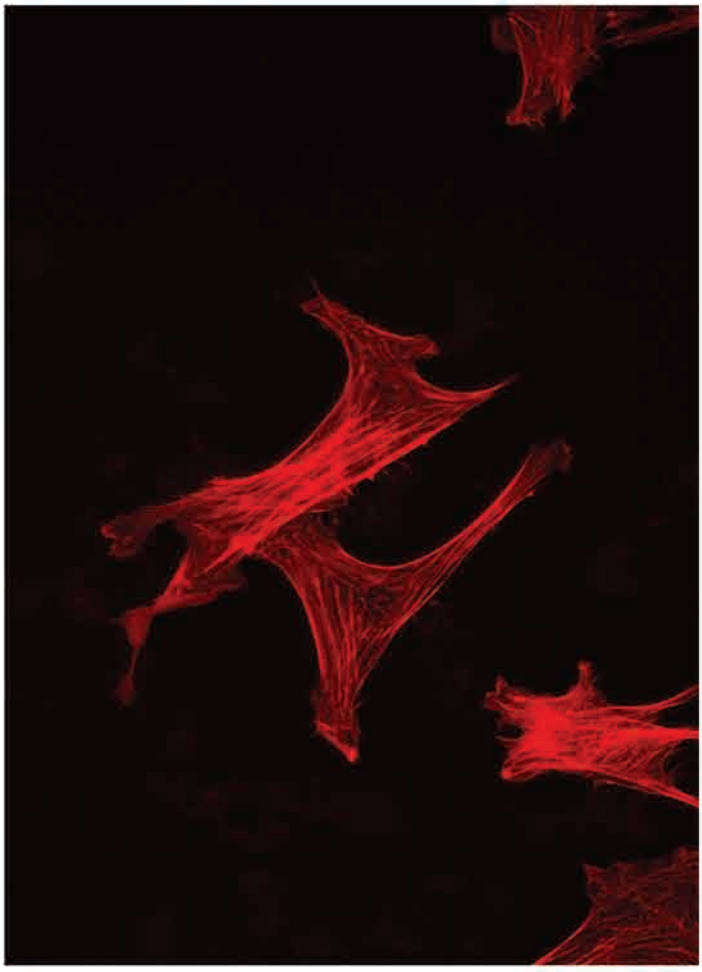
The Center for Biomedical Engineering and Nanomedicine (CBEN) was created with the vision of: (i) Developing novel biomaterials to improve our understanding and treatment of biomedical problems, and (ii) Describing the molecular interactions that occur between these materials and their biological surroundings. The unique nature of the center's constituents provide a forefront multidisciplinary and translational approach to biomedical research. To this end, fundamental characterization and understanding of the physicochemical properties of biomaterials is of utmost importance.

Research focuses in the employment of intelligent hydrogel polymers, composites, and nano-systems as promising biomaterials; the development of microfluidic devices that provide culture environments suitable for the study of multi-cellular signaling networks and for understanding how nanomaterials impact modulation of cell signals, cancer progression, and potential for therapy; and the tailoring and engineering of biopolymeric-based biomaterials for fundamental studies and applications in therapeutics and tissue repair.

Current and future applications include, but are not limited to, the design and characterization of: (i) theranostic nanomaterials for cancer treatment, (ii) microcrystalline composites for antigen delivery, (iii) delivery systems for orphan diseases; and, (iv) tailored controlled of crystallization of biomacromolecules, among other applications.

CBEN houses cell culture facilities, a spinning disk confocal laser scanning microscopy facility, polymer synthesis and characterization instruments, and cellular and molecular analytical equipment.

The rich interdisciplinary nature of the Center for Biomedical Engineering and Nanomedicine provides a fertile ground for learning, collaboration, discovery, and academic and scientific development, which provides our graduates with strong skill sets necessary to pursue a wide range of rewarding careers.

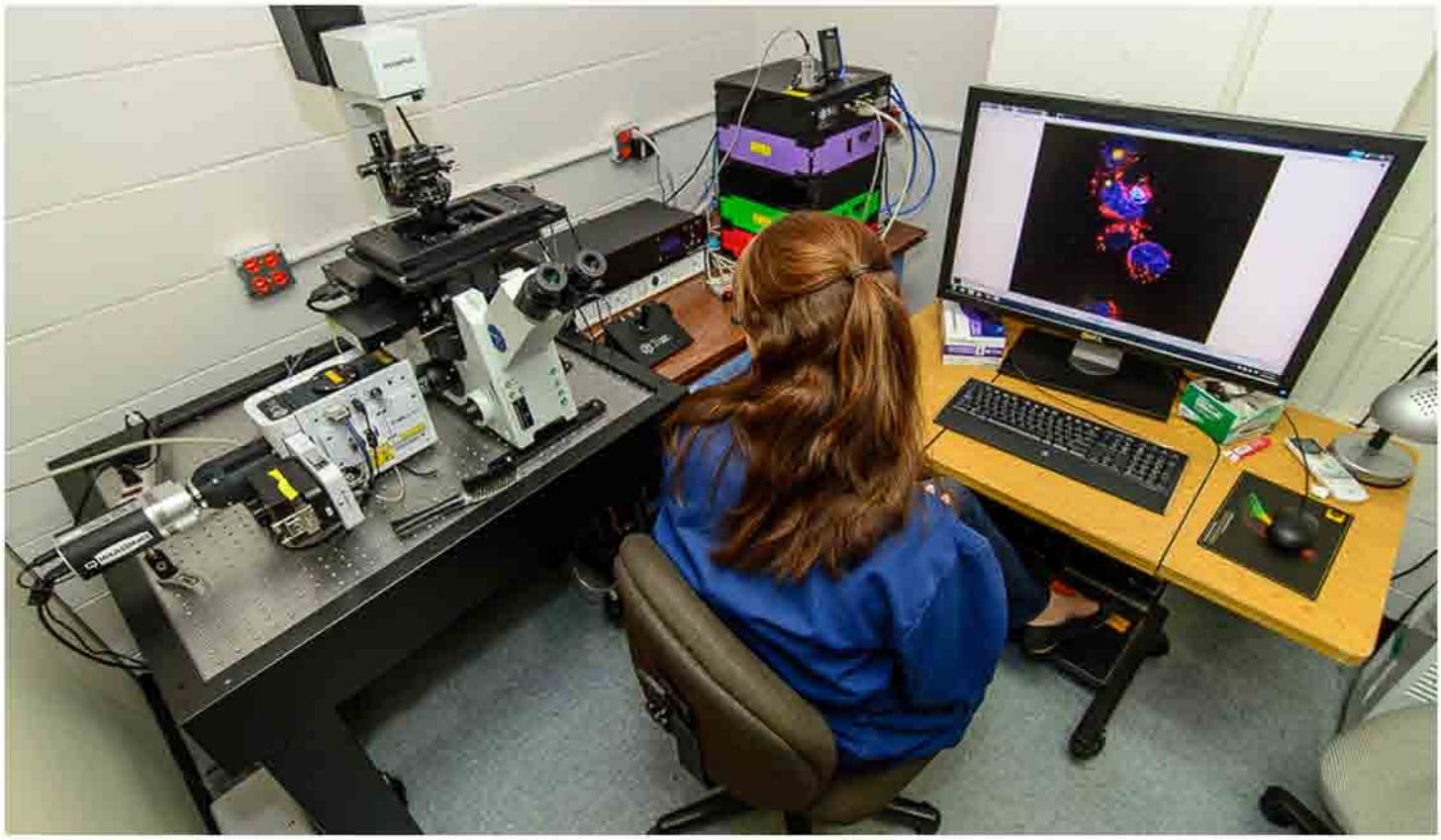


Center for Pharmaceutical Engineering Development and Learning (CPEDaL)

This initiative born in 2006, now it is a reality and an exciting opportunity, especially with the ongoing changes in pharmaceutical manufacturing and the financial challenges that UPR is facing. The importance of Pharmaceutical manufacturing in Puerto Rico has been significant for the last decades and, alike in the rest of the world, it is experiencing changes that demand fundamental understanding for product and process development, better trained professionals with solid fundamentals, and graduated engineers and scientists with better knowledge of the industry and its processes. These requirements led the creation of the CPEDaL. Our main objective is to build a sustainable bridge between industry and academia to provide and develop human and technical assets that will be key for the transformation and competitiveness of the pharmaceutical industry in Puerto Rico. At the same time, CPEDaL will be a vehicle for new business models in the UPR.

We envision CPEDaL as the hub where the pharmaceutical industry can find an academic partner committed to help and catalyze their objectives accomplishment. Besides the technical support, CPEDaL offers academic programs, educational activities, innovative research and professional development programs to thrive the necessary skills and knowledge of students and professionals, feeding the industry with valuable talent.

Materials: Science & Engineering



Materials research in our department combines expertise in theory and modelling for the design of novel materials ranging from the nano to macro scale, with applications in the fields of biomedical, fluidics and complex fluids, heterogeneous catalysis, advanced and specialty separations, pharmaceuticals, and sensing applications. In parallel, in-situ and ex-situ characterization techniques are used to study the electronic, physical, and mechanical properties of materials synthesized and determine the design requirements for the end-use application. Self-assembly, non-equilibrium, and driven/active soft matter are just a few of the many diverse physical processes studied by our researchers in the context of rheology of colloidal suspensions for designing new consumer products, reconfigurable solid-like liquid crystals to improve electronic display technology, novel composite protein microcrystals for the sustained oral delivery of antigens, granular materials for pharmaceutical applications, and bioactive, nanostructurally-designed artificial peptides. Furthermore, soft photolithography techniques are used to fabricate microfluidic devices that provide a culture environment suitable for multi-cellular signaling networks. In the field of catalysis, atomically tailored catalysts are synthesized with properties superior to their analogous counterparts attained by conventional synthesis techniques for the conversion of renewable carbon sources. In advanced separations, nanoporous sorbents with specific framework topologies and novel compositions are designed for chemical separation and recovery processes at ambient or mild conditions. For specialty separations, novel polymer nanocomposite membranes with unique ionic domains are designed to influence transport mechanism and species selectivity in fuel cells, water purification, and polymer photovoltaics. Metal films and nanowires by solid state reduction are synthesized for sensing applications such as the detection of low concentrations of hydrogen in seconds. The combination of theory, experiment, and advanced characterization employed in our department allows us to critically deepen our insight and knowledge to design and synthesis novel and unique materials.

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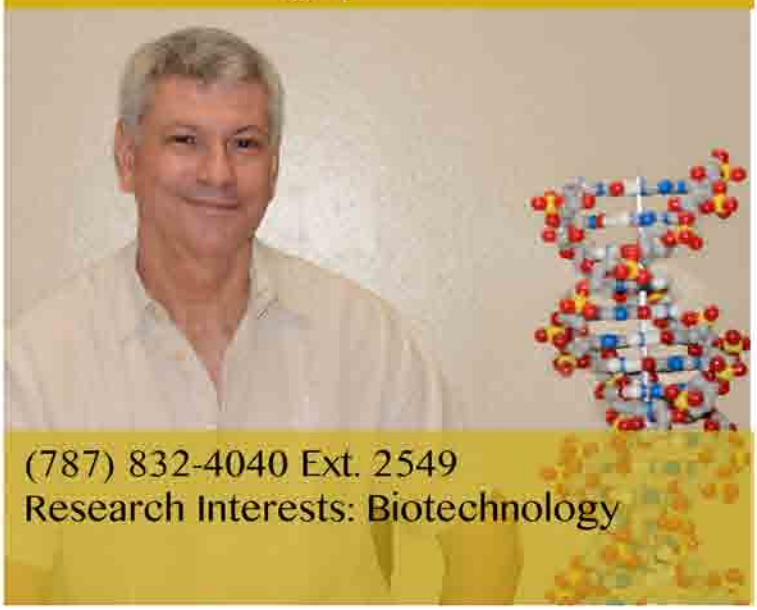

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Location

The University of Puerto Rico-Mayagüez and its Chemical Engineering Department are located in the west coast of the island of Puerto Rico, about ninety miles from San Juan. The location is relatively close to beautiful beaches as well as other island attractions, such as a tropical rain forest called "El Yunque," various phosphorescent bay located in the towns of Vieques, Lajas, and Fajardo, the Arecibo Radio Observatory, and national monuments such as Porta Coeli, located in San Germán.

Chemical Engineering
University of Puerto Rico
Mayagüez Campus

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Graduate Program