



LEHIGH UNIVERSITY®

**Electrical & Computer
Engineering**

Graduate Student Handbook

2022-2023

**P.C. Rossin College of
Engineering and Applied Science**

Welcome from the Department Chair

To our Graduate Students:

On behalf of the ECE Department faculty and staff, I wish to welcome you to Lehigh University. We trust that you will have a successful and rewarding experience in the Department of Electrical and Computer Engineering. During your stay at Lehigh, we encourage you to get to know all ECE faculty and your fellow students, to develop both breadth and depth in your professional training.

The 2022-2023 Department Handbook was prepared to assist you during your graduate experience at Lehigh. The ECE Department Handbook supplements but does not supersede the College of Engineering and Applied Science Graduate Student Handbook. I encourage you to refer to both the University Catalog and the Graduate Student Handbook for further information.

Welcome to Lehigh University!



Dr. Chengshan Xiao
Department Chair

Electrical & Computer Engineering Department Personnel

Prof. Chengshan Xiao, Department Chair	chx417	610-758-4070
Prof. Mihail Cutitaru, Associate Chair	mic520	610-758-4070
Prof. Zhiyuan Yan, Director of Graduate Studies	zhy6	610-758-3415
Ms. Linda Hamel, Undergraduate Coordinator	lah422	610-758-4070
Ms. Jodi Imler, Graduate Coordinator	jli213	610-758-4072
Mr. David Morrisette, Systems Administrator	dpm3	610-758-3218

P.C. Rossin College of Engineering & Applied Sciences Graduate Personnel

Prof. Steve DeWeerth, Dean	spd416	610-758-5308
Prof. John Coulter, Senior Assoc. Dean for Research	jc0i	610-758-6310
Ms. Brianne Lisk, Manager of Graduate Programs	brc3	610-758-6310

Important Resources

Graduate Student Life — ingrador@lehigh.edu

Office of International Students and Scholars (OISS) — intnl@lehigh.edu

Registration and Academic Services (RAS) — ras@lehigh.edu

RAS Academic Calendar — <https://ras.lehigh.edu/content/current-students/academic-calendar>

Bursar — <https://financeadmin.lehigh.edu/bursar>

Deadlines:

Fall applications - January 15th for financial aid (PhD only). April 1st for admission only
Spring applications - November 1st for everyone

Financial Aid:

The department offers three types of financial aid: research assistantships, teaching assistantships, and fellowships. These are exclusively for PhD applicants, except in very rare exceptions as determined by the ECE Department. All generally include a monthly stipend and tuition.

General Information:

Offers of admission may be deferred for up to one full academic year.

Tuition rates for the 2022-2023 academic year are \$1,500/credit. All full-time students and international students are required to take 9 credits each semester to maintain full-time status (for exceptions, please see the College Handbook). International students who are admitted without financial aid will be required to submit an affidavit of support in the amount of roughly \$54,362 which includes tuition, living expenses, insurance, and other fees for one year before any visa documents will be issued.

Applications: All applications must be submitted online. If you have questions concerning the program or application process, please contact the department at inecegr@lehigh.edu. The correct mailing address for transcripts is as follows:

Lehigh University
ECE Graduate Coordinator
19 Memorial Drive West
Bethlehem, PA 18015

Incomplete or late applications **will not** be processed or reviewed. This includes applications without the \$75 application fee which **CANNOT** be waived for any reason. Once the application is submitted you will receive an e-mail confirming its receipt. Please allow time for mailing delays and processing before receipt of e-mail. All communication will be done via e-mail, so please provide one current e-mail address. MS decisions are made on a rolling basis. PhD Decisions for Fall semester will be announced starting in March. PhD Decisions for the Spring semester will be announced starting mid-November.

All the Admissions information and application can be found on our website:
<https://engineering.lehigh.edu/ece/ece-graduate-studies/ece-graduate-admissions>

Degrees Offered:

MS, MEng, PhD in Electrical Engineering
MS, MEng, PhD in Computer Engineering
MS in Photonics

Minimum Requirements:

BS in EE, CompE, CS or related field

GPA:

3.0 out of 4.0 required for PhD applicants
2.75 out of 4.0 required for MS/MENG applicants

Minimum Test Requirements:

GRE General Test

75th percentile or better on Quantitative.
Please note the GRE requirement will continue to be waived during the 2022-2023 admission cycle.

iBT TOEFL

79 composite score
20 Writing, 20 Speaking, 20 Reading, 15 Listening

IELTS

6.5 minimum score
6.0 Writing, 6.5 Speaking, 6.5 Reading, 6.0 Listening

Application Fee: US \$75 which cannot be waived for any reason.

Data Sheet: Asks for personal data, proposed program information, test data, educational background, and work experience.

Transcripts: Upload to online application. If accepted, an official transcript is required from all undergraduate and graduate programs attended. All transcripts must be received in sealed envelopes.

Letters of Recommendation: Two (2) letters of recommendation are required. If you are currently in school, letters from academic advisors and other professors are preferred. If you are currently in industry, letters from employers are acceptable. All letters should be uploaded to the application. We provide two recommendation forms in the PDF application that you may choose to use, however, letters on recommenders' letterhead is also acceptable.

Test Scores: Official test scores must be sent from ETS. Scores must be current and valid. TOEFL and IELTS scores expire after 2 years and expired scores **WILL NOT** be accepted. GRE test scores expire after 5 years. TOEFL and IELTS test scores will be waived **ONLY** if an International Applicant has completed a degree program at a U.S. university.

Essay/Statement of Purpose: A brief statement of career and research objectives. Essays should articulate clearly your experience and goals. Half a page to two pages is sufficient.

Supplemental Information: Applicants should also include a resume or CV, current research or creative work, list of published works, and extracurricular activities.

Application for financial aid: **MUST** be completed in order to be considered for any kind of aid (for PhD applicants).

Procedures for New Graduate Students

Check In and Starting Dates

Students are expected to be on campus at least one week prior to the start of classes in time for new student orientations, testing, and registration. International students must report to the Office of International Students & Scholars, located in Coxe Hall, immediately upon arrival on campus.

Required Orientations

1. [Grad Life Orientation](#) - for all new graduate students
2. [OISS Orientation](#) - for all new international students
3. ECE Department Orientation – for all new graduate students (date to be announced)

English Speaking

Spoken English is the expected language in all labs.

Seminars

ALL full time graduate students in the department are **required** to attend department seminars. Seminar announcements are sent to your Lehigh e-mail accounts. Seminars are generally scheduled at 4:25pm. Full time students must attend at least 75% of all the seminars offered in a semester. **Attendance will be taken.** Please note, we are now allowing graduate students to carry forward a positive or negative balance from the fall semester to the spring semester. This will allow students to catch up on seminars, if needed. If the student still needs to attend additional seminars (in addition to our ECE seminars), they will be allowed to attend other engineering department seminars. If students choose this option, they will be required to email the Graduate Coordinator afterwards with a 300 word essay about the seminar which will then be reviewed by the Graduate Director.

Academic Requirements

Full-Time Certification

All International graduate students must maintain full-time status while attending Lehigh. Full-time students must be registered for 9 credits (3 courses) each semester or satisfy the requirements to be certified full-time. All PhD students that are in Candidacy and taking one credit, need to be certified Full Time. If you need to be certified full-time, Please complete the [Full-Time Certification Form through DocuSign](#). Domestic students who must maintain full-time status for insurance purposes, etc. must also be registered for 9 credits per semester or be full-time certified. If you have any questions regarding this, please ask the Graduate Coordinator. All RAs and TAs must be full-time students as stated in your offer letter. Failure to do so will make you ineligible for any assistantships.

Registration

All current students are asked to register for their semester courses at a specified date during the previous semester. Failure to do so will result in a late fee of \$100 assessed by the Registrar. (January 2 for spring classes and August 1 for fall classes).

All students will have the first week of classes to add and drop classes online through their registration portal as they wish. Students also have the second week of classes to add and drop but must get approval from the instructor and have the Graduate Coordinator provide an override.

Advisors

All students are required to consult with their advisor before they register for courses each semester. The advisor will review the courses and supply the student with their registration PIN#. New registration PIN numbers are assigned each semester.

New Masters graduate students will be assigned an advisor when they arrive on campus. If a Masters student decides to submit a thesis as part of their program, they will need to identify a faculty member who is willing to supervise their research, and that faculty member will become their academic advisor as well. Please be advised that our faculty have many commitments, and the availability of faculty for research supervision is not guaranteed and depends on the specialty within their area.

Graduation

When a student is ready to graduate you will need to complete an Application for Degree form. These forms are available online through the portal. To access the form, log on to the Portal, click the Banner Icon, and click the Student Services tab. Applications must be submitted by the deadlines listed on the [Academic Calendar](#). Once this form is complete, please see the Graduate Coordinator for additional requirements.

Core Requirements

All graduate students are expected to finish their core course requirements in the first two years in their program.

Masters Program Guidelines

The Electrical and Computer Engineering Department offers Master's degrees in Electrical Engineering, Computer Engineering, and Photonics. For both Master's degrees in Computer Engineering, both Electrical & Computer Engineering and Computer Science & Engineering courses are considered in their major field. For both Master's degrees in Electrical Engineering, Electrical & Computer Engineering courses are considered in their major field.

Master's Degree

The MS degree is a 30 credit program. If you choose to do a Thesis, you will take 6 credits of thesis hours in place of 2 courses. Theses must be approved and submitted to the Registrar by the set deadline which can be found on the Academic Calendar. A print out of Thesis guidelines and sample signature and title pages can be obtained in the Department Office. The MEng degree does not require a thesis.

Candidates for the Master's degree have six years to complete their program. MS students may transfer up to 9 approved credits from a previous MS program into their Lehigh program as long as they have not been used for a previous degree. This can be accomplished by completing a petition form once you arrive. Lehigh undergraduates may transfer up to 6 credits of 300 or 400-level courses taken during their undergraduate studies. Please see the College Handbook for full rules regarding this policy. Each program has their own department requirements, and all programs within the P.C. Rossin College of Engineering and Applied Sciences must follow the college requirements as well. Check online for the College of Engineering Graduate Student Handbook.

The ECE Department has a core curriculum requirement for graduate students in each of the degree programs. The purpose of this requirement is to guarantee that all students pursuing graduate studies in the department acquire an appropriate breadth of knowledge of their discipline. Masters students may take up to 6 credits of Independent Study if not writing a thesis.

Requirements for Master of Engineering and Master of Science Degrees

In meeting the requirements for the Master of Science or Master of Engineering degree, the student must satisfy the following common requirements, as outlined in the Graduate Student Handbook.

1. All candidates for a Master's degree must submit the form entitled *Program for Master's Degree* as soon as possible after accruing 15 credit hours of courses but no later than the semester before the student graduates. This form is eventually approved by the Registrar. The timing for completion of this form is critical, as it allows for corrections to a student's course plan if necessary.
2. The minimum program for all Master's degrees includes:
 - o Not less than 30 credit hours of graduate work; audit credits may not be used toward the degree. Research or thesis registration counts as part of the 400-level course requirement.

- Not less than 24 credit hours of 300- and 400-level coursework of which at least 18 hours is at the 400-level.
 - Not less than 18 credit hours in their major field.
 - Not less than 15 credit hours of 400-level coursework in their major field.
3. Eighteen (18) credit hours in the major field are required. These courses must be 300- and 400-level courses. The remaining twelve (12) credit hours may also be taken in their major field (300- and 400-level courses), or they may be taken in any other field in engineering in which courses for graduate credit are offered, subject to the approval of the student's advisor.
 4. A graduate student may include in his or her program courses numbered 200 or higher outside their major field and 300 or higher in their major field. A graduate student registered in 200 or 300 level courses may be assigned additional work at the discretion of the instructors. Courses taken outside their major field are subject to approval by the advisor and the Director of Graduate Studies.
 5. The Master's degree is not granted unless the candidate has earned grades of B- or better in at least eighteen hours of the work in his/her program and in **all** 300-level courses in their major field. No course in which the grade earned is less than C- is credited towards the degree.
 6. A student who receives more than four grades below B- in courses numbered 200 or higher becomes ineligible to qualify for the Master's degree or to register for any other 400-level courses.

MS / MEng EE Core Requirements

To satisfy the core curriculum requirements in Electrical Engineering, students must select three (3) courses from the following five (5) different areas:

- ECE 401 Advanced Computer Architecture
- ECE 402 Advanced Electromagnetics
- ECE 420 Advanced Circuits and Systems
- ECE 441 Fundamentals of Wireless Communications —OR— ECE 414 Machine Learning and Statistical Decision Making
- ECE 451 Physics of Semiconductor Devices

In addition to the three core courses, elective courses can be selected from the offered courses for that term.

MS / MEng Computer Engineering Core Requirements

To satisfy the core curriculum requirements in Computer Engineering, students must complete the following 3 courses:

1. ECE 319 Digital System Design —OR— ECE 362 VLSI Systems
2. ECE 401 Advanced Computer Architecture
3. CSE 303 Operating System Design —OR— CSE 403 Advanced Operating Systems —OR— CSE 340 Design and Analysis of Algorithms —OR— CSE 440 Advanced Algorithms —OR— CSE 441 Advanced Algorithms

In addition to the three core courses, elective courses can be selected from the offered courses for that term.

Master of Science Degree in Photonics

The Master of Science Degree in Photonics is an interdisciplinary program designed to provide students with a broad training in the various aspects of photonics, including topics in electrical engineering, materials science, and physics. Admission to the program requires a B.S. or M.S. in either the engineering or physical sciences.

Applications should be directed to one of the three sponsoring departments (Electrical and Computer Engineering, Materials Science and Engineering, or Physics). Procedures and admission criteria are the same as those followed by the home department. International students must satisfy minimum university language requirements. The admissions process is under the supervision of the individual department to which you apply.

Required Courses* (15 credits):

- PHY 352 (3 Credits) Modern Optics (or PHY 482 Applied Optics)
- PHY 355 (3 Credits) Nonlinear Optics
- ECE 402 (3 Credits) Advanced Electromagnetics (or PHY 421 Elec & Magnetism I)
- ECE 451 (3 Credits) Physics of Semiconductor Devices
(or PHY 363 Physics of Solids)
- MAT 416 (3 Credits) Optical Prop of Materials

Selected pre-requisites for the required courses may be waived by the program director for students with equivalent background.

A minimum of three courses must be selected from the following list:

- ECE 425 (3 Credits) Semiconductor Laser I
- ECE 426 (3 Credits) Semiconductor Laser II
- ECE 438 (3 Credits) Quantum Electronics
- ECE 450 (3 Credits) Nanophotonics & Plasmonics
- ECE 450 (3 Credits) Optoelectronic Phys & Lightwave
- ECE 450 (3 Credits) Introduction to Photovoltaic Energy Systems
- ECE 450 (3 Credits) Applied Quantum Mechanics for Engineers
- ECE 468 (3 Credits) Biophotonics and Optical Biomedical Imaging
- CSE 420 (3 Credits) Biomedical Image Computing
- MAT 302 (3 Credits) Electronic Properties of Materials
- MAT 334 (4 Credits) Electron Microscopy & Microanalysis
- MAT 427 (4 Credits) Electron Microscopy (TEM and SEM)
- PHY 331 (2 Credits) Integrated Bioelectronics/Biophotonics Laboratory
- PHY 422 (3 Credits) Elec & Magnetism II
- PHY 369 (3 Credits) Quantum Mechanics I
- PHY 424 (3 Credits) Quantum Mechanics II

In order to complete the MS degree requirements of the University, candidates must

submit either a Master's thesis or a report based on a research course of up to 6 credit hours. Research courses should be at the 400 level.

Doctor of Philosophy Degree

A PhD candidate is generally expected to devote three or more academic years to graduate study. In no case is the degree awarded to one who has spent less than two full academic years of graduate work.

All post-baccalaureate work toward the doctorate must be completed within 10 years. Doctoral students whose graduate study is carried out entirely at Lehigh University must register for a minimum of 72 credits beyond the Bachelor's degree. Students who have earned a Master's degree at another institution must register for a minimum of 48 credits.

All PhD candidates are required to serve as a half or full TA for a minimum of 1 semester during their PhD studies. Each PhD candidate must serve as a full- or half-time Teaching Assistant for at least one semester in a technical course within the department. This includes any technical course taught by a faculty member in the ECE Department. This is a Departmental requirement for graduation. A student for whom English is not their first language needs to pass the TOPSS (or OPI) test administered by ICAPE in order to be a TA.

Please note a PhD candidate cannot take more than nine (9) credits of Independent Study (ECE 492) courses.

Electrical Engineering PhD Core Requirements

To satisfy the core curriculum requirements in Electrical Engineering, students must select three (3) courses from the following five (5) different areas:

ECE 401 Advanced Computer Architecture
ECE 402 Advanced Electromagnetics
ECE 420 Advanced Circuits and Systems
ECE 441 Fundamentals of Wireless Communications —OR— ECE 414 Machine Learning and Statistical Decision Making
ECE 451 Physics of Semiconductor Devices

Computer Engineering PhD Core Requirements

To satisfy the core curriculum requirements in Computer Engineering, students must complete the following 3 courses:

1. ECE 319 Digital System Design —OR— ECE 362 VLSI Systems
2. ECE 401 Advanced Computer Architecture
3. CSE 303 Operating System Design —OR— CSE 403 Advanced Operating Systems —OR— CSE 340 Design and Analysis of Algorithms —OR— CSE 440 Advanced Algorithms —OR— CSE 441 Advanced Algorithms

Qualifier Exams for ECE

All students in the Ph.D. program must take the appropriate Qualifier Exam within two (2) years of entrance into the program, preferably in the spring of their first year. If a student is unable to fulfill this obligation, the Graduate Coordinator will need to be notified. This exam requires demonstration of competency in selected areas. The exams are offered in six (6) different areas:

EE Qualifier exams offered in six (6) different areas:

BioElectronics and BioPhotonics
Communications, Signal Processing and Networking
NanoElectronics and MEMS
Optoelectronics and Photonics Systems
Power Systems and Power Electronics
Computer Architecture and VLSI Design

CompE Qualifier Exam:

Computer Engineering Ph.D. students may take their qualifier in additional areas more specific to their research as long as they have three faculty members in either the Electrical & Computer Engineering Department or Computer Science & Engineering Department agree to form a committee to offer the specific exam.

Each area has an assigned faculty member who will oversee the examination and communicate with those students signed up for the exam. Exams will typically consist of reading assigned research papers, writing a response paper and taking an oral exam with the examining committee. The Examining Committee will consist of at least three faculty members. The topics can be related to one's research thrust, but not identical to the thesis topic.

The exam is on a pass/fail basis. Students who do not pass the exam the first time will be able to take the exam again after a 5 month waiting period. This will be organized with the help of the Graduate Coordinator and the Qualifier Committee involved on an individual basis. If a student fails to retake the Qualifier Exam within a 12 month period, that student will be removed from the Ph.D. program, and will be forced to reapply. If a student does not pass after the second attempt they will be unable to continue in the Ph.D. program.

Admission to Candidacy

After a Ph.D. student has passed his/her Qualifier Exam he/she may begin preparing to apply for Candidacy. A student should identify faculty to serve on the Doctoral Committee comprised of a minimum of 4 members. Of these, 3, including the committee chair, must be voting Lehigh faculty members. The 4th member must be external which means outside the department, college or university (further guidelines on the formation and membership of this committee can be found in the College Handbook). An information packet on the candidacy application process is available from the Manager of Graduate Programs in the Engineering College and must be completed and submitted two (2) weeks prior to the start of the semester in August or January. A prospective candidate must submit a written program proposal to their **Doctoral Committee** that includes a

discussion of proposed dissertation research. Once the Committee approves the proposal, the candidate submits the proposal along with a completed signature page and the Application to Candidacy packet to the Manager of Graduate Programs in the College of Engineering. The Dean's office will then notify the student and their committee members in writing of the decision.

Once the student has completed their credit hour requirement for the Ph.D. degree (72 credits beyond the BS degree, 48 credits beyond the MS degree, or 42 credits beyond the Lehigh BS degree) they may apply for Maintenance of Candidacy two times per year from that point on. This means that the student is only required to be registered for one (1) credit of Maintenance of Candidacy course (ENGR 499) from that point on until they complete their program.

General Exam

The general examination for the doctorate is designed to test both the student's capacity and his or her proficiency in the field of study. The examination is not necessarily confined to the content of courses that have been taken at Lehigh University or elsewhere. The examination must occur no later than seven months prior to the time when the candidate plans to receive the degree. The student's doctoral committee is in charge of the examination, which may be both written and oral.

Should a candidate fail in the general examination, he or she may be permitted by the doctoral committee to present him or herself for a second examination not earlier than five months after the first. If the results of the second trial are also unsatisfactory, no further examination is set and the candidate is judged to have failed.

Dissertation and Defense

Ph.D. candidates are required to write a dissertation prepared under the direction of their advisor (also typically the Chair of their Doctoral Committee). Guidelines can be found in the College Handbook and all associated dates are listed on the [Academic Calendar](#).

A print out of guidelines and sample title and signature pages can be obtained from the Manager of Graduate Programs in the Engineering College.