

A. BACKGROUND INFORMATION

The Department of Mechanical Engineering and Engineering Science (MEES) at the University of North Carolina at Charlotte (UNC Charlotte) offers a multidisciplinary degree program leading to the Doctor of Philosophy (Ph.D.) in Mechanical Engineering. The program is broad based, allowing students to develop expertise in a number of areas including design, manufacturing, precision engineering, thermal and fluid sciences, computational solid mechanics, biomedical engineering, materials science and engineering, mechanical control and instrumentation, and automotive engineering,

The student body of our Ph.D. program is mainly consisted of international students. The number of enrolled students (from fall 2013 to fall 2018) disaggregated by race and gender can be found in Figures 1 and 2. The detailed student profile data (from fall 2013 to fall 2018) can be found in Appendix A.

- In terms of race, the majority students are international students (~ 67%) and Caucasians (~ 29%). The percentage of African American and Asian American are noticed to be close to zero since AY 14/15. In spring 2022, the percentage of Hispanic students is 1.4%, which is the same as that of Asian American.
- In terms of gender, the overall percentage of female students varies between 12.5% and 24.5%, with an average value of 18.2%. In spring 2022, the overall percentage of female students is 24.6%. The percentage of domestic female students is 10.1%.

The above data clearly shows the percentage of traditional URM students in our Ph.D. program is low. It has been between 0 and 2% in the last decade.

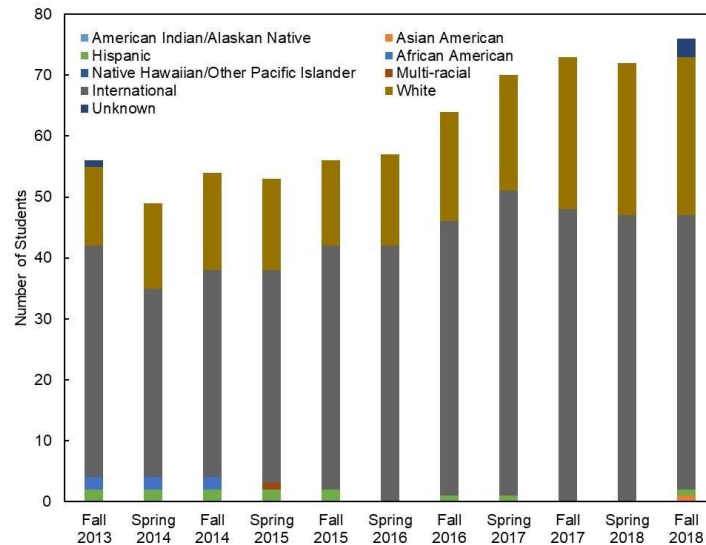


Figure 1. Number of Enrolled Ph.D. Students Disaggregated By Race

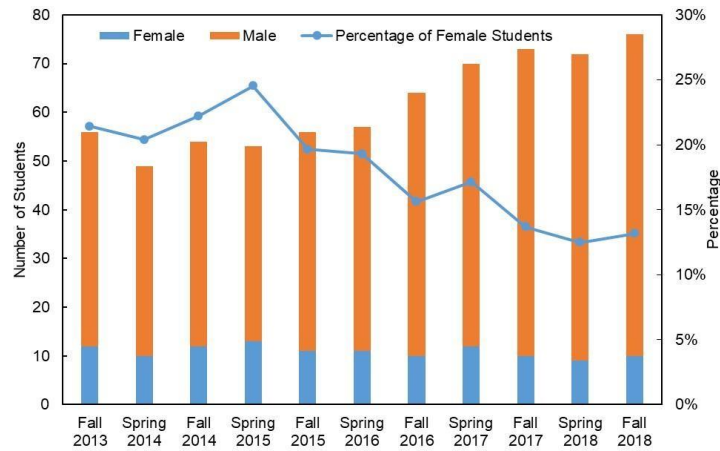


Figure 2. Number of Enrolled Ph.D. Students Disaggregated by Gender

To get the Ph.D. degree from our program, a student needs to complete at least 72 credit hours beyond the baccalaureate degree, including at least 45 credit hours of graduate coursework, and 21 credit hours of research. To meet the degree requirements, the following milestones need to be reached, including the completion of coursework, pass of the written qualifying exams, appointment of a dissertation committee, pass of the proposal defense to get admission to candidacy, and successful defense of the Ph.D. dissertation. Students are expected to spend 4-6 years to complete the degree study. Table 1 shows the fifth-year and sixth-year graduation rate. Except for students who joined in AY12/13 and AY 14/15, ~50% students could not graduate and obtain their degrees in six years. However, it is encouraging to see 77.8% students who joined in AY14/15 were able to graduate in five years.

Table 1. Representative Retention and Graduation Rates

Cohort Year	Fifth-Year Graduation Rates	Sixth-Year Graduation Rate
AY 09/10	25%	50%
AY 10/11	27.3%	27.3%
AY 11/12	20%	20%
AY 12/13	53.8%	84.6%
AY 13/14	35.7%	50%
AY 14/15	77.8%	Data not available
AY 15/16 and after	Data not available	Data not available

Our Ph.D. students are highly competitive in the job market. They have been hired by Fortune 500 companies (e.g., Apple, Intel, Qualcomm, Caterpillar, Raytheon Technologies, Ford Motor, Nikes,

General Electrics etc.), and National Labs (e.g., Los Alamos National Laboratory, Lawrence Livermore National Laboratory, etc.). However, there are only a few students who become faculty after graduation. And they are all international students who are currently working in their home countries. More detailed examples of students' post-graduation job placement can be found in Appendix C.

In summary, analyzing available data shows:

- The percentage of traditional URM students in our program is very low.
- In average, there are 50% Ph.D. students cannot graduate within five years.
- 95% of our students are not working in the academic field.

Thus, our program needs a plan to improve the overall learning experience not just for the URM students, but for ALL students.

B. ASSESSMENT OF OBSTACLES

In the last three years, multiple faculty meetings were held to discuss how to improve the learning experience for students, and the overall quality of our program. More specifically, the following issues were discussed.

- How to increase the enrollment? How to effectively recruit students with background other than mechanical engineering? How to recruit URM students?

During the pandemic, our enrollment number has been hit hard due to the lack of international students joining us. We need to be more aggressive in terms of recruiting domestic students.

Previously, we requested prospective students without mechanical engineering background to take up to eight post-baccalaureate courses before applying to our program. It will take 1-3 semesters for those students who can eventually be admitted into the program. Is there a way to shorten the time?

URM students always look for role models. Without having URM faculty members, it is hard for us to recruit URM students.

- How to improve the fifth-year graduation rate?

As discussed in section A, there are five milestones in our program. The second one is to pass the written qualifying exam. It is expected that a student needs to take (and pass) the exam in their third semester after joining the program. However, not all students follow the instruction due to (1) the lack of awareness of the policy, and (2) no “push” from the dissertation advisor. Even among those students who took the exam on time, up to 50% students could fail in their first attempts. And 10% students could fail twice and eventually left the program. Are the contents and formats of our current qualifying exam helping us to keep good students?

- How to have our alumni “give back”?

Our program has graduated lots of outstanding PhD students who are currently working in leading industrial companies and government labs. Although some of them are still in touch with their dissertation advisors, there has been no department-level efforts to stay connected with them. We need a person who has experience in building the alumni network, and have them “give back” to the program (*e.g.*, offer round-table discussion to current students, donate back to the program, etc.).

- How to provide special trainings to students who are interested in academic jobs?

Our program had a few students who are interested in becoming professors. They were eager to get teaching/mentoring experience. However, sometimes they were not supported by their dissertation advisors. The advisors want the students to spend more time in research. How to pursue those advisors to support the students?

C. RECOMMENDATIONS

After consulting with faculty, staff and students, we have the following recommendations in terms of recruitment, retention/graduation, and alumni engagement for the Ph.D. program.

For recruitment of high quality Ph.D. students, we have the following recommendations.

- Offer competitive graduate assistantships.
- Review the possibility to waive the GRE requirement and application fee to increase the number of applicants.
- Promote the Ph.D. program within our bachelor students, early entry master’s students and master students. Explore the resources offered by the Office of Undergraduate Research (OUR) to provide research experience to undergraduate students and then recruit them into graduate programs.
- Utilize the networks of current faculty, students and alumni to establish recruitment pipelines in certain international countries (*e.g.*, China, India, and Bangladesh) and local industrial companies.
- Design and keep an up-to-date program website and program brochure to provide comprehensive information of our programs.
- Recruit faculty members from the URM group. We need role models to convince URM students to join our program.

For retention and graduation of Ph.D. students, we have the following recommendations.

- Review the contents and formats of our qualifying exams. The exams shall not only test a student’s academic background but also their research potential.
- Coordinate with the Graduate School and other organizations to provide mentor training to faculty.
- Launch a new initiative to help students to establish Individual Development Plans (IDP).

- Develop a Ph.D. student guide to provide one-stop information (e.g., degree requirements, enrollment requirements, how to form dissertation committee, etc.) to students.
- Organize mid-semester events (e.g., information session, alumni career panel) to remind students degree requirements, and help them prepared for future careers.
- Survey students on a yearly basis to better understand their concerns and needs.

For **alumni engagement**, we have the following recommendations.

- Establish a department-level Outstanding Alumni Awards.
- Launch an alumni newsletter.
- Develop effective strategies for alumni fundraising and launch campaigns.

For **assessment**, we have the following recommendations.

- Conduct anonymous survey to collect students' comments on qualifying exams, financial support, mentor/mentee relationship, etc. The collected information will be discussed in the faculty meeting. The program will then respond and take action accordingly.

D. CONTINUING EFFORTS (INCLUDING NEW ACTIVITIES SINCE FALL 2022)

For some recommendations discussed in Section C, we have already taken actions and will continue our efforts. In this revised document, some recent activates since fall 2022 are added in. For example,

In terms of **recruitment**:

- In academic year 2021/2022, the stipend of graduate assistantship was increased from \$15,300 to \$18,500 per academic year. We are currently planning to further increase the stipend to \$20,000.
 - Since 2022, the stipend has been increased every year. For the coming academic year 2024/2025, the stipend amount is expected to be at least \$22,500.
- We have waived the GRE requirement for 2021, 2022 and 2023. Currently we are collecting data to make the final decision on whether permanently remove the GRE requirement.
 - GRE is still being waived till spring 2025. After that, we will analyze the data collected in five years to understand (1) whether requiring GRE score creates a true obstacle for students to apply to our graduate programs, and (2) the relation between GRE scores and academic performance.
- We have been actively promoting our early-entry master's program by discussing this opportunity in courses with large enrollments (e.g., MEGR 3152 which usually has 100 juniors each semester). We also initiated an annual information session for students who are interested in learning more about the early-entry program. In the future, we plan to continue the efforts by providing the information session on a semester-base, record "story-

telling” videos from students who are in or graduated from the early-entry MS program, and develop a dedicated website.

- Since fall 2022, during the academic year, monthly information sessions have been conducted to promote our graduate programs. All information sessions have been conducted in a panel discussion format, during which current student panelists shared their education experience and answered any questions the prospective students may have. Students with diverse background were selected to serve in the panel. Thanks for the advanced technology, all information sessions have been simulcasted, which allowed the prospective international students attend the event virtually and local students attend it in person at the same time. The information sessions have been very helpful in terms of recruitment of Ph.D. students. For example, (1) For fall 2023, 74 applications were received and 19 students joined our program. (2) For fall 2024, so far 83 applications have been received and 29 students have been admitted. The information sessions have also been very effective in recruiting early-entry master’s students. Since fall 2022, 10-12 early-entry master’s students were recruited in each semester. Among those students, 6 are URM students. Some early-entry master’s students have been supported by research projects funded by OUR. One student became a thesis master’s student. One female student became a Ph.D. student.
- Our department has hired an African American teaching faculty member in summer 2021. So far, she has involved in the recruitment of undergraduate students. In the future, we would like to invite her to be more engaged in the recruitment and advising of graduate students.

In terms of the **retention and graduation**:

- In responding to faculty’s concerns, we have decided to change the format of math qualifying exam, allowing students to answer four out of five questions. The new policy will be effective in fall 2022. We are also in the discussion to change the format of some topical exams from written exam to oral exam.
 - Since fall 2022, feedback from students have been collected after each qualifying exam. Those feedback were shared and discussed thoroughly in faculty meetings. As responses, (1) The exams are no longer on three consecutive days. Instead, there is a day between each exam. (2) The website for qualifying exams has been updated with clearer guidance and more sample exams.
- Our program has been short of staffs in the last year. Particularly, the academic advisor who helps the graduate program left the program in January 2022. Luckily we hired a new one in April 2022. We also secured a new position to hire one more academic advisors. With those people on board, we will work on preparing the IDP document, and a new program guide.
- In the last three years, our Graduate Program Director individually met students in the first month they joined the program. During the meeting, she learned the students’ future career

goals. For those who are interested in the academic jobs after graduation, she assigned them to serve as lab TAs, nominated them to serve as Instructor of Records (IOR), and encouraged them to apply for the Graduate School Teaching Fellowship. In other words, special customized training opportunities are being and will continue to be provided to those future professors.

- One female student who served as an IOR and received the Graduate School Teaching Fellowship joined Wingate University in spring 2024.
- In spring 2023, to get students more engaged in our programs, a student mixer social event was initiated. Since then, about 60 students each semester attended the event, during which they got to know new friends, meet with professors working in different research fields, and receive small give away gifts.

In terms of the **alumni engagement**:

- Although we have not done much to engage alumni, we expect the new academic advisor who joined us in April 2022 will lead this effort. She has extensive experience on building “alumni trees” in her old institution. The Graduate Program Director has already had initial discussion with her.
 - A few alumni have been invited to serve in the Industry Advisory Board (IAB). In spring 2024, an IAB meeting was conducted. The alumni offered suggestions on how to improve our curricula to provide better learning experience to both undergraduate and graduate students. We will continue to seek their inputs.

In summary, our program believes that by continuing the proposed work described above, we will increase our enrollment, provide a better learning experience to all students, and start to produce alumni who will work as professors in other institutions.

