Chemical Engineering MS

College of Engineering, Department of Chemical Engineering

Dr. Robby Sanders

The Department of Chemical Engineering at Tennessee Technological University strives to develop the 21st Century Renaissance Engineer through development and implementation of novel learning environments anchored by the award-winning Renaissance Foundry Model. The foundation of this platform is rooted in the guidelines provided by the National Academy of Engineering's Vision for the Engineer of 2020. Educational protocols within the department are consistent with the mission and vision statements given below:

The Mission of the Department of Chemical Engineering is to prepare relevant and adaptive chemical engineers in state-of-the-art areas by emphasizing real world problem solving and critical thinking skills.

The Vision of the Department of Chemical Engineering is to be a recognized leader in chemical engineering education through excellence in teaching, research, and se6mic 1 e.

The Department of Chemical Engineering at Tennessee Tech blends scholarship and research with advanced course work, providing excellent opportunities to graduate students to work towards solving some of the many global challenges faced by society. Our program offers an MS in Chemical Engineering. The relatively small size of the program and friendly campus atmosphere promote close interaction among students and faculty. Research is sponsored by federal agencies (such as NSF) as well as state and private sources among others. Faculty members work closely with colleagues in Electrical and Computer Engineering, Civil and Environmental Engineering, Mechanical Engineering, Chemistry, Biology, and Manufacturing and Engineering Technology at TTU, as well as maintain strong collaboration with TTU's Centers of Excellence and other leading institutions and national laboratories to build a unique and effective environment for graduate student research, learning, and well-rounded training.

These activities are consistent with the TTU mission and vision which are posted at the following website (https://www.tntech.edu/about/mission.php)

Fall 2022 census for the MS-CHE program and departmental data for the PhD program, the program shows 48% (10 students) of CHE graduate students are enrolled at the MS level and 52% (11 students) at the PhD level, the latter of which reflects three students who completed their thesis-based MS-CHE degree at TTU and are enrolled in the PhD program and another two students who completed their BS in CHE at TTU and are enrolled in the direct-admit PhD program. Total enrollments in the MS-CHE and PhD (CHE concentration) programs over the last two decades are provided in the figure below which illustrates a cyclical nature of enrollment (particularly in the MS program) that is aligned with a similar pattern for the department's BS program enrollment as well as national trends in CHE enrollment.

Research funding: To complement on-campus sources of graduate student support and to further increase the amount of external funding, several faculty in the department and others across campus prepared a $3 million grant proposal that was funded (after three previous attempts) in July 2022 by the NSF's National Research Traineeship (NRT) program. Dr. Pedro Arce (Professor of CHE) is the PI of this grant which is expected to run for five years, covering fees and providing stipends to 20 graduate students (12 MS and 8 PhD) with a projected nine of these trainees being graduate students in the CHE department. The efforts will center on the expansion and

research projects at the food-energy-water nexus. Graduate students will be periodically "immersed" in various communities throughout Appalachia and in Native American communities (particularly, Cherokee) where they will work with community stakeholders to identify problems in those communities. Such problems will serve as the basis for research projects completed by students in the program. An extensive evaluation plan will be implemented to inform the decision-making process and ensure that program deliverables are met. Such is expected to guide new and ongoing research efforts in the department and support the department in growing its graduate enrollment.

The College continues to increase its activities to recruit graduate students, and the department will be actively engaging in recruitment efforts during the 2023-2024 academic year with plans for the Chair to attend the American Institute of Chemical Engineers annual meeting in November of 2023 where a table will be reserved for the department's participation at the Recruitment Fair. Both the department and College continue to increase communications to current students at the university who might be interested in the BS/MS Fast-Track programs. Recruitment of students directly from the department's CHE-BS program to join the CHE graduate program as either an MS student or a direct-admit PhD student has had a very positive impact. Building on a successful first-year recruitment effort, an increased emphasis will be made to recruit chemical engineering students as well as students in other project-related disciplines for participation in the NSF-funded NRT project.

Maintain a diverse graduate student body consisting of domestic and foreign students including minorities and individuals of underrepresented groups.

1. CHE Department Graduate Student Admissions and Success Database: These databases are maintained in Excel spreadsheets that are located on a shared drive accessible by the Graduate Program Coordinator and CHE office staff. The department is also leveraging Microsoft Teams for sharing and archiving information related to the program. These spreadsheets include a collection of applicant data (e.g., GRE Scores, BS GPA, TOEFL scores, BS Institution, etc.) for all students applying for admission to the program as well as decisions made by the CHE graduate committee. Upon admission and entry to the graduate program, a separate spreadsheet is used to track each student's entry time, projected graduation date, research advisor, funding status, completion of required courses, and other measures of student success. Data are entered upon entrance of a student into the program and periodically updated.

1. CHE Department Graduate Student Admissions and Success Database: These databases

provided the opportunity to be involved in development of manuscripts for submission for peer-reviewed conference proceedings and journal articles and to present at conferences and the on-campus Student Research and Creative Inquiry Day event.

a. End of the student's program and presentations at Student Research Day

1. CHE Department Graduate Student Admissions and Success Database: Documentation of students admitted and progress towards degree.
2. Periodic Review of Graduate Coursework and Curriculum: Courses provide relevant training in advanced chemical engineering concepts. Required courses offered at a frequency to support timely progression towards degree completion. In general, these courses should be offered annually. 77.16nn15 792
3. Th

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Optimize graduate student time to graduation by providing courses and advising that facilitates student completion of the MS degree within a desired two-year window.

1. External and Internal Funding Generated/Obtained: Reports are periodically requested from the TTU Office of Research (or obtained from its website) to provide details on external funding to faculty in the department. In addition, the department maintains a summary of funding status of graduate students in the program and frequently re-assesses this information in efforts to ensure that as many graduate students as possible are supported.
2. Periodic Review of Graduate Coursework and Curriculum: Progress made towards completion of required and elective courses is assessed using a variety of approaches. All graduate students are expected to file a program of study not later than the end of the semester in which they will have earned 15 credits towards their degree, and generally they are not allowed to register for subsequent semesters if this is not done. Additionally, a review of graduate courses and the curriculum is periodically completed through meetings between the Department Chair and the Graduate Program Coordinator to ensure that courses are offered in a time frame consistent with the program goal for time to graduation. Faculty advisors meet routinely with their advisees to discuss progress in courses and plans for follow-up courses. The Graduate Program Coordinator meets with all new students in the program to discuss courses, the program, and other critical matters. Additions, deletions, and/or changes to the graduate curriculum are first approved via the CHE Graduate Committee and subsequently via the College of Engineering’s Graduate Executive Committee (of which the CHE Graduate Program Coordinator is a member), and then the Graduate School Executive Committee.

1. External and Internal Funding Generated/Obtained: Documentation of internal/external grant funding that is used to support faculty research and graduate students.
2. Periodic Review of Graduate Coursework and Curriculum: Courses provide relevant training in advanced chemical engineering concepts. Required courses offered at a frequency to support timely progression towards degree completion. In general, these courses should be offered annually.

As mentioned above, for the 2022-2023 reporting period, four externally-funded grants with CHE faculty as PI or co-PI had funds allocated for CHE graduate student support. In addition, other graduate students are supported as teaching assistants or research assistants from a number of other sources on-campus including through the department, Centers of Excellence, the College, and university.

Course offerings are routinely evaluated, and courses are offered at a frequency that provides the possibility for students to graduate in-line with the stated goal for time to graduation. Each student is assigned an advisor who routinely meets with the student. The average time to graduation for g12 792 0 612 to

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2. Thesis Presentation and Defense, Publications, and Other Presentations: All students in the thesis-based MS program are required to complete a thesis presentation and defense. The presentation is completed in a public, seminar-type format at the end of the students' program with the student's thesis committee and others in attendance. Upon completion of the presentation, a question/answer session ensues, and then, with the audience dismissed, the committee discusses the presentation and defense and the student's overall performance in the program and decides whether the student has "passed." As the comprehensive exam is integrated with the thesis defense for MS students, questions may also be asked regarding coursework completed and student knowledge in his/her area. A non-thesis MS degree is also possible for students who desire a more course work intensive graduate degree and for students who are directly admitted to the PHD program. During their program, students are encouraged and provided the opportunity to be involved in development of manuscripts for submission for peer-reviewed conference proceedings and journal articles and to present at conferences and the on-campus Student Research and Creative Inquiry Day event.

1. Periodic Review of Graduate Coursework and Curriculum: Courses provide relevant training in advanced chemical engineering concepts. Required courses offered at a frequency to support timely progression towards degree completion. In general, these courses should be offered annually.
2. Thesis Presentation and Defense: Thesis documents are published in the ProQuest Dissertations & Theses database. MS-thesis-based students are encouraged to submit a manuscript to a peer-reviewed journal though such submission is not required for

advisees to discuss progress in courses and plans for follow-up courses. The Graduate Program Coordinator meets with all new students in the program to discuss courses, the program, and other critical matters. Additions, deletions, and/or changes to the graduate curriculum are first

during departmental meetings and via discussions between the Faculty Advisor, CHE Department Chair and/or Graduate Program Coordinator occur periodically. CEGRA activities help create a culture for growing professional and other ethical behaviors.
2. CHE 6920 is a focused course offered each year. It includes research ethics, research methods, and professionalism in scholarly activities in addition to preparing students for proposal writing and presentations. It is required for students in the non-thesis-based MS program and an optional (often-taken) course for thesis-based MS students.
3. Thesis committee members provide input and guidance to students in class and research settings.

1. Chemical Engineering Graduate Research Association (CEGRA): CEGRA maintains an active group of officers who lead regularly-scheduled meetings and social events.
2. CHE 6920: Topics related to ethics and safety are covered in this course.
3. Guidance of thesis committee members: Students meet routinely with graduate research advisors and make satisfactory progress towards degree objectives.

All students must show knowledge and applied proficiency of ethics in research approaches. A focused course (CHE 6920) is offered each year to help students with these aspects, and it includes research ethics, research methods, and professionalism in scholarly activities in addition to preparing students for proposal writing and presentations. The vast majority of graduate students in the program take this course. Further, input and guidance from thesis committee members to students in class and research settings provide additional points for ensuring ethical behaviors.

3. Non-thesis binders contain both original work and resources leveraged.
4. Chemical Engineering Graduate Research Association (CEGRA) provides opportunities for students to see the breadth and depth of knowledge associated with their discipline through participation in conferences and increased familiarity with other researchers' work.

1. Research Seminar Series: Graduate student and faculty participation in on-campus seminars.
2. Student Thesis and Non-Thesis Committees: Programs of study are submitted and approved by student's committee. Changes are likewise reviewed and approved.
3. Non-thesis binders: Binders are received and held by student's faculty advisor.
4. Chemical Engineering Graduate Research Association (CEGRA): CEGRA maintains an active group of officers who lead regularly-scheduled meetings and social events. The CEGRA leadership also facilitates the process for obtaining funding to support graduate student travel to and presentation at conferences.

All students must show knowledge of current and relevant areas of research (or other forms of inquiry for the non-thesis option) and must demonstrate a commitment to the process of lifelong learning. The Department offers a “Research Seminars Series” to broaden student exposure about current topics of relevance for the profession. This seminar series is conducted each semester. In addition, though the Chair of the student’s thesis (or non-thesis) committee must be a graduate faculty in CHE at TTU, many graduate students have other thesis committee members who are from outside the department and in many cases outside of the College of Engineering. “Certificates of Approval” which are required to be signed by the thesis committee and included in the record for each student’s thesis reflect this composition. Further, for students pursuing the non-thesis option, a binder containing content (both original work and resources that students reviewed during their project such as copies of peer-reviewed literature) must be submitted by the student for review and approval.

An increased emphasis is being placed this year on MS-CHE students presenting at the Student Research and Creative Inquiry Day event.

All thesis-based MS-CHE students are encouraged to have submitted, at the time of thesis defense, at least one manuscript based on his/her thesis project to a peer-reviewed journal. Graduate students also often author or co-author abstracts and conference proceedings. Further, MS-CHE (thesis-based) students are required to submit a thesis approved by their

thesis advisory committee and the College of Graduate Studies. Non-thesis MS-CHE students submit a binder containing original material including (for example) written work, computer codes, presentation materials, copies of peer-reviewed literature, etc.

1. Thesis Presentation and Defense, Publications, and Other Presentations: All students in the thesis-based MS program are required to complete a thesis presentation and defense. The presentation is completed in a public, seminar-type format at the end of the students' pro

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Appendix 1: Curriculum Map Chemical Engineering MS