Institutional Effectiveness
2024-2025

Program: Mechanical Engineering MSME
College and Department: College of Engineering, Mechanical Engineering
Contact: Mohan D Rao
Mission:

The Mechanical Engineering (ME) Department, within a regional and global context, will prepare its students for productive career in a competitive, dynamic, technologically based society; will advance the knowledge of mechanical engineering principles and applications; and will serve the public.

The Mechanical Engineering M.S. program at Tennessee Tech provides students advanced engineering skills and state-of-the-art knowledge in selected areas for positions in industry or pursuing a PhD. Students focus their programs on specific interests among several areas:

- Acoustics and Vibrations
- Design / Mechanical Systems
- Energy Harvesting / Smart Materials
- Energy Storage / Fuel Cells / Battery
- Smart Materials / Sensors
- Material Characterization and Modeling
- Robotics / Mechatronics / Controls
- Thermal Science / Fluid Mechanics

The program is research oriented and includes both thesis and non-thesis options for M.S. students. Graduate faculty work with students in advanced and in-depth studies on topics of mutual interest; provide guidance in fundamental and applied research; help develop powers of analysis, synthesis and critical thinking; and prepare students to follow academic and research careers through doctoral-level studies. The master's degree program consists of 30 hours for a thesis option and 33 hours for a non-thesis option.

Attach Curriculum Map (Educational Programs Only):
Attached Files: See Appendix 1

PG 1: Recruit and mentor very talented, research active faculty who will excel in teaching, research and scholarly activities and enhance the reputation of the Department of Mechanical Engineering at both regional and national levels.

Define Outcome:

PG 1: Recruit and mentor very talented, research active faculty who will excel in teaching, research and scholarly activities and enhance the reputation of the Department of Mechanical Engineering at both regional and national levels.

Assessment Methods:

Faculty Dossiers and Publications: Journal and conference publication rates per faculty member with graduate students serve as a measure of ongoing professional development and scholarly output. Faculty development is supported through various funding sources for instruction and research-related activities.

Research Funding: Average number of externally funded projects per faculty, compiled biennially, reflects faculty research activity and program growth.

Criteria for Success (Thresholds for Assessment Methods):

The ME department has adopted a holistic approach to measuring the success of its MS program, recognizing that setting thresholds for each assessment metric, while useful, is not the best way to assess overall effectiveness. This new approach is detailed in our 2023 Self-Study Report, part of the THEC 5-year MS Program Evaluation Review. The overall effectiveness of the MSME program is now assessed through various metrics, including student placement and employability, student exit surveys, and thesis evaluation data. Our goal is to achieve 100% employability for our graduates, ensuring they thrive in their jobs and advance in their careers.

Results and Analysis:

Program Goal 1: Recruitment and Retention of Faculty

Faculty Overview – AY 2024–25

During the 2024–25 academic year, the Mechanical Engineering (ME) Department at Tennessee Tech University had 19 full-time faculty and one half-time adjunct. This included Dr. Zhang, Director of the Center for Manufacturing Research (CMR); Dr. Jeff King, founding Director of the new Nuclear Engineering program; and Dr. Rao, ME Department Chair.

Of the tenure and tenure-track faculty, seven were full professors, five associate professors, and two assistant professors, in addition to four lecturers. The department had two vacant faculty lines resulting from a resignation and a retirement in the prior year. Despite rigorous search efforts, both positions remained unfilled due to last-minute candidate withdrawals tied to spousal employment constraints. However, the

department successfully hired a temporary instructor to support the large incoming freshman class of 320 students in Fall 2024.

The ME faculty represent a broad range of academic and research expertise, reflecting the interdisciplinary nature of the field. All faculty are actively engaged in teaching, research, advising, and service. Despite strong retention of all tenured and tenure-track faculty, the department continues to operate with two fewer faculty members than in previous years. This shortfall has been brought to the attention of the Dean of Engineering, and discussions are ongoing to authorize the hiring of replacements for the vacant positions.

Use of Results to Improve Outcomes:
The ME Department continues to make significant progress in recruiting and retaining high-quality faculty and graduate students. This is reflected in the marked increase in research productivity described above. However, there remains room for growth in MS student recruitment. The recent launch of the online, non-thesis MS program is a positive step toward addressing this challenge.

Looking ahead, the department plans to actively promote the online MS program, particularly targeting professionals in local industry to boost enrollment. The degree requirement for this non-thesis program has been reduced from 33 to 31 to make the program more attractive and competitive with peer programs. Additionally, efforts to fill two vacant faculty positions have been successful. We are pleased to announce that two new tenure-track faculty members will be joining the department in August 2025.

PG 2: Increase the number and quality of MS and PhD graduates until they are about 10% of the undergraduate population. The goal is to have a thriving graduate program with quality students.

Define Outcome:
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Assessment Methods:
MS Student Enrollment

Criteria for Success (Thresholds for Assessment Methods):
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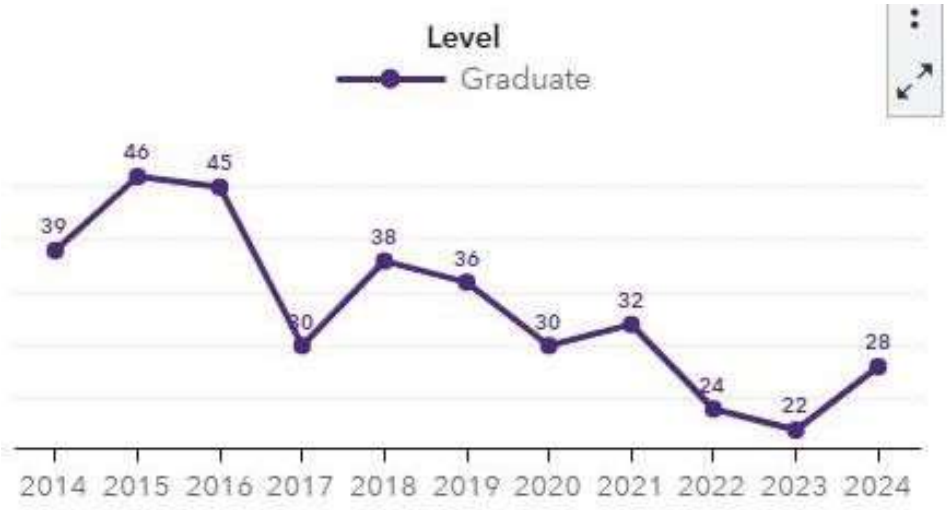
Results and Analysis:

Program Goal 2: Increase Number of MS Students per Year

MS Student Enrollment – AY 2024–25

During the 2024–25 academic year, the Mechanical Engineering Department experienced a decline in applications to the MS program, particularly among international students due to factors such as visa delays and restrictions. However, there were encouraging developments on the domestic front: several of our own undergraduate students applied to and joined the MS program, and over a dozen enrolled in the department's fast-track MS option.

As of Fall 2024, MS enrollment stood at 28 students, up from 22 in the previous year. The chart below, sourced from the Institutional Research website, illustrates the MS enrollment trend in recent years. The decline in MS enrollment over the past ten years is partly attributed to the department's increased focus on recruiting PhD-level graduate students.



Despite the reduction in MS numbers, overall graduate student enrollment (MS + PhD) in Mechanical Engineering has seen an increase and stable at approximately 70 students over the past four years.

As part of its proactive efforts to boost MS enrollment, the ME Department hosts an information session each semester for prospective graduate students. These sessions are organized by the ME Department's Graduate Student Committee and supported by the ME Graduate Committee.

In AY 2024–25, sessions were held during both the Fall and Spring semesters, attracting over 60 interested students. Research-active faculty presented their ongoing projects to engage and inspire potential applicants. The sessions also included information about the Fast-Track MS program, which allows qualified undergraduates to begin graduate coursework early.

These sessions have proven highly effective in recruiting high-quality undergraduate students into the MS program, especially the MS-Fast track.

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PG 3: Increase externally funded research activation, proposals and journals submitted, and conference publications of the Department of Mechanical Engineering faculty per year.

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Assessment Methods:

Faculty Publications: Journal and conference publication rates per faculty member with graduate students serve as a measure of ongoing professional development and scholarly output. Faculty development is supported through various funding sources for instruction and research-related activities.

Research Funding: Average number of externally funded projects per faculty, compiled biennially, reflects faculty research activity and program growth.

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Results and Analysis:

Program Goal 3: Increase Research and Scholarship Activities

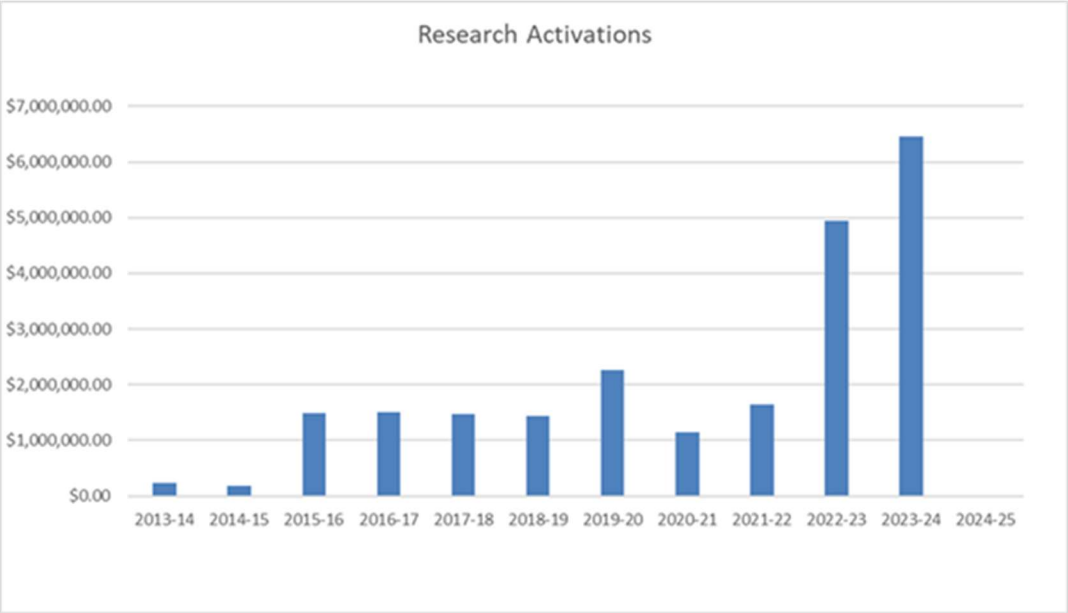
MS Research – AY 2024–25

The ME Department faculty are actively engaged in externally funded research supported by major agencies such as the National Science Foundation, Department of Defense, Department of Energy, Office of Naval Research, NASA, Air Force Office of Scientific Research, the State of Tennessee, and industry partners including Cummins and Northrop, among others. These sponsored projects enhance research and scholarship, contributing significantly to the intellectual development of both MS and Ph.D. programs through student-involved research and the generation of new knowledge.

Over the past five years, external funding secured by ME faculty has grown steadily— from approximately $600,000 to a record $6.5 million in AY 2024–25—largely driven by major federal grants from the Department of Energy and NASA.

All faculty members actively pursue professional development to strengthen their teaching, research, and service. These activities include attending workshops, training sessions, and conferences; reviewing technical papers and proposals; publishing in journals and conference proceedings; organizing academic events; and participating in professional societies.

During AY 2024–25, ME graduate faculty published more than 21 journal articles and 19 conference papers, many of which were co-authored by MS students—demonstrating strong student involvement in faculty-led research. The graph below illustrates the department's research expenditure trend over the past five years.



It is seen that the research productivity including the external funds received far exceeded our expectations during the last two years and the ME department leads the college of engineering in this area and has become a role model for other departments in the College of Engineering and the University.

Use of Results to Improve Outcomes:

The ME Department continues to make significant progress in recruiting and retaining high-quality faculty and graduate students. This is reflected in the marked increase in research productivity described above. However, there remains room for growth in MS student recruitment. The recent launch of the online, non-thesis MS program is a positive step toward addressing this challenge.

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SLO 1: Improve communication skills of Mechanical Engineering graduate students through mastery in both verbal and written communication skills.

Define Outcome:

SLO 1: Improve communication skills of Mechanical Engineering graduate students through mastery in both verbal and written communication skills.

Assessment Methods:

MS Thesis Assessment Data: Graduate students are required to make oral presentations of their thesis. Evaluation feedback for these oral presentations is provided to the students, which helps them to improve their technical communication skills.

Criteria for Success (Thresholds for Assessment Methods):

The ME department has adopted a holistic approach to measuring the success of its MS program, recognizing that setting thresholds for each assessment metric, while useful, is not the best way to assess overall effectiveness. This new approach is detailed in our 2023 Self-Study Report, part of the THEC 5-year MS Program Evaluation Review. The overall effectiveness of the MSME program is now assessed through various metrics, including student placement and employability, student exit surveys, and thesis evaluation data. Our goal is to achieve 100% employability for our graduates, ensuring they thrive in their jobs and advance in their careers.

Results and Analysis:

SLO 1: *Communication in Area of Specialization*

Graduate students are required to make oral presentations of their thesis. Evaluation feedback for these oral presentations is provided to the students, which helps them to improve their technical communication skills. Many of the core courses also require oral presentations that are evaluated as part of the course grades. Evidence of achievement in technical writing is provided through the accomplishment of written theses that are reviewed and approved by the student's advisory committee. The results of the oral and thesis assessment for 2024-25 are shown below. It can be seen that all the data presented are above the threshold of 3.0 set by the program.

MS Thesis Assessment Data- Communication Skills

Evaluation of Oral Presentation	**Results on a scale of 1-4**
Visual Aids	3.83
Presenter	3.96
Presentation mechanics	3.76
Quality of English	4
Technical Content	4
Technical Writing	3.18

Use of Results to Improve Outcomes:

One consistent concern among graduate students from the exit survey is the limited range of courses available to them. This limitation stems from faculty availability, which has recently been strained by several factors, including increased enrollment in our undergraduate programs and the retirement or departure of two key graduate faculty members. Furthermore, our focus on research and Ph.D. programs has restricted our capacity to expand course offerings. To effectively address this issue, the ME Department graduate committee examined the current graduate course offerings and streamlined the course offerings as detailed in the attached presentations. This proposal will be implemented from AY 25-26. In addition, the hiring two new faculty for AY 25-26 will help alleviate some of this issue.

Finally, to support the growth of the MS program, the Mechanical Engineering Department is revising the non-thesis MS degree requirements effective Fall 2025. This change replaces the current 3-credit independent project with a 1-credit course, ME 6910 – *Introduction to Graduate Research*, thereby reducing the total credit requirement from 33 to 31. This aligns the program with peer institutions and offers a more flexible path for working professionals and online students. By maintaining academic rigor while streamlining the degree, this revision is expected to boost enrollment in the non-thesis track and strengthen the overall MS program.

SLO 2: Demonstrate the ability to conduct basic theoretical and/or applied research (MSME Thesis Option) or independent study (MSME Non-thesis Option).

Define Outcome:

SLO 2: Demonstrate the ability to conduct basic theoretical and/or applied research (MSME Thesis Option) or independent study (MSME Non-thesis Option).

Assessment Methods:

Graduate advisors and committee review:

Criteria for Success (Thresholds for Assessment Methods):

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Results and Analysis:

SLO 2: *Demonstration of Research or Independent Study*

Graduate advisors and committees play a vital role in guiding students through research

methods and overseeing their academic progress. The successful completion of a thesis or project report demonstrates a student's readiness for advanced study. Each advisory committee is responsible for reviewing and approving the student's final work.

In AY 2024–25, thirteen students earned their MS degrees—five in Fall 2024 and eight in Spring 2025—marking an increase of two over the previous year. Notably, there were no student withdrawals from the program.

Graduate students are strongly encouraged to present their work at the university's annual Research and Creative Inquiry Day held each April. This year, eleven ME students participated in the event, showcasing their research through poster presentations.

Use of Results to Improve Outcomes:

One consistent concern among graduate students from the exit survey is the limited range of courses available to them. This limitation stems from faculty availability, which has recently been strained by several factors, including increased enrollment in our undergraduate programs

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SLO 3: Students will give professional presentations or write scholarly manuscripts worthy of publication in conferences and/or peer reviewed journals.

Define Outcome:

SLO 3: Students will give professional presentations or write scholarly manuscripts worthy of publication in conferences and/or peer reviewed journals.

Assessment Methods:

Graduate Student Exit Interviews: A written and oral survey evaluates program quality, learning

outcomes, and resource adequacy. Results are reviewed biennially.

Criteria for Success (Thresholds for Assessment Methods):
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Results and Analysis:
SLO 3: Give professional presentations or write scholarly manuscripts

Several conference and journal papers were authored by the MS students; these data are currently being compiled and will be presented at the Fall 2025 retreat. Furthermore, two of our MS students won prestigious awards at a NA SA symposium in Oct. 2024, details below:

The 17th annual vonBraun Space Exploration Symposium, hosted by the American Astronautical Society, took place October28–30,2024, at the University of Alabama in Huntsville, under the theme **"Expanding Exploration: From Vision to Reality."** A key highlight was the Student Poster Contest, which drew submissions from undergraduates and graduates nationwide. Out of many entries, only 40 posters—representing approximately 30 universities—were selected for in-person presentation.
In the Graduate Engineering category, two of our MS students shined:

- Won **first prize** in Graduate Engineering, and
- Took **first place** in Liberal Science.

Both awards came from Tennessee Tech, underscoring our program's growing impact in aerospace research and education.

Use of Results to Improve Outcomes:
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Summative Evaluation:

The analysis of both the thesis defense evaluations, exit survey data, IDEA evaluations and other metrics paints a comprehensive picture of a highly satisfactory academic environment for ME graduate students. The thesis defense evaluations from 2023 through 2025 show consistent high performance, indicating strong support and effective guidance in academic and presentation skills. Similarly, the exit survey data reveal a predominantly positive sentiment, with students expressing high satisfaction with academic advising, course availability, and faculty communication. Together, these findings highlight the strengths of the academic programs and support systems, while also pointing out areas for continuous improvement to maintain and enhance the quality of the student experience.

The MS Program went through a comprehensive external review in 2023 as part of 5- year THEC Program Review. The review was very successful with no weakness or concerns identified. The final report by the external evaluator on our MSME program highlighted its robust curriculum, aligned with regional and national standards and offering both thesis and non-thesis tracks. The reviewer praised our assessment methods, data collection, analysis of results and existing continuous improvement plan.

However, the report also identified challenges such as the need for more tenure-track faculty to accommodate potential growth in the non-thesis and distance learning options, and to enhance the research and publication outputs. Several of these were addressed during the AY 24-25 including revamping the core graduate course offerings, restructuring of the non-thesis MS program and promoting the Fast track MS program to attract domestic students. In addition, faculty search was successful in recruiting two tenure track Assistant Professors to the department from August 1, 2025.

Assessment Plan Changes:

The ME Graduate committee will meet during the Fall 2025 faculty retreat scheduled for August 15, 2025, to discuss the assessment results and any plans for change for the following years.

List of Appendices:

Appendix 1: Curriculum Map

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Curriculum Map of M.S. Program in Mechanical Engineering			
	Student Learning Outcomes		
Courses & Degree Requirements	**Demonstrate an enhanced expertise in their area of specialization in Mechanical Engineering.**	**Conduct basic, applied and/or empirical research and/or design.**	**Give professional presentations or write scholarly manuscripts worthy of publication in conferences and or peer reviewed journals.**
Graduate Level Coursework. * (Minimum 21 credit hours for thesis Option; 30 credit hours for non-thesis). A maximum of 9 credit hours can be at the 5000 level.	X		
ME 6990- Research and Thesis (6 to 8 credit hours for thesis option).	X	X	X
ME 6960- Independent Project Course (3 credit hours for non-thesis option).	X	X	X
ME 6910-1 credit. Introduction to Graduate Research		X	X