Mechanical Engineering MS

Definition of Unit

Providing Department:
Mechanical Engineering MS

Department/Unit Contact:
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Mission/Vision Statement:

The Mechanical Engineering M.S. (MSME) 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
- Vehicle Systems

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.

The graduate program in Mechanical Engineering contributes directly to the missions of the Department, College, and University by preparing advanced level graduates consistent with the following mission statements:

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.

COLLEGE OF ENGINEERING MISSION: To graduate innovative engineers who solve technological challenges to meet societal needs.

VISION: The Mechanical Engineering Department at Tennessee Tech aspires to be recognized globally for outstanding education and research, leading to well-qualified engineers who are adaptive professionals, inquisitive, entrepreneurial and successful in engineering practice, research, and public service.

PROGRAM EDUCATIONAL OBJECTIVES:

In the years after their graduation, the MSME graduates will have the ability to:
• Conduct basic and/or applied research
• Engage in advanced engineering design
• Assume leadership roles in their career and profession
• Pursue additional graduate studies
• Be engaged in life-long learning

Goal 1: Recruitment and Retention of Faculty

Define Goal:

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.

Intended Outcomes / Objectives:

The ME Department at TTU has 17 full-time, tenure-track and tenured faculty positions, three lecturers, and one adjunct faculty. This includes the Dean, Associate Dean for Research and Innovation, Director of CMR, Interim Chair of MET, Department Chair and Associate Chair positions. Of the tenure and tenure-track ranks, 10 faculty members hold the rank of full professor; three are associate professors and four are assistant professors. Given the breadth of the mechanical engineering field and the technical background required to contribute to the advancement of the state-of-the-art, the ME faculty body is diverse in academic background and research. Departmental faculty members are all expected to contribute to the instructional, research, advising, and service activities of the department.

During the 2019-20 AY, the ME department was successful in recruiting two outstanding faculty -- Dr. Rory Roberts was hired as tenured Associate Professor and Dr. Arman Sargholzaei as tenure track Assistant Professor.

Goal 2: Increase Number of MS Students per Year

Define Goal:

Increase the number 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.

Intended Outcomes / Objectives:

Enhance the reputation of the Department of Mechanical Engineering at both regional and national levels.

Over the period from 2012-2017, a total of 715 complete student applications to the MSME program were received. Two hundred and eighty four applications (40%) were granted admission (including provisional standing). A total of 165 actually enrolled during this time. Sixty one MS degrees have been awarded during this period. These data are a reflection of the high standards related to retention and quality control of MS graduates that is implicit in the MSME program.

We have had some decrease in both applications and student enrollment of MS students during AY 219-21, particularly from international students due to COVID-19 concerns. We are not sure if this trend will continue into the next year or not at this point. The good news is that we have had a number of our own domestic UG students apply and join our program. In addition, we have also ha d over a dozen of our own UG students sign up to our fast-track MS program.

Goal 3: Increase Research and Scholarship Activities

Define Goal:

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

Intended Outcomes / Objectives:

Enhance the reputation of the Department of Mechanical Engineering at both regional and national levels to attract high quality faculty and graduate students.

The ME department faculty members engage in regular professional development that enhances their teaching, scholarship and practice. These include but are not limited to the participation in workshops, training courses, and conferences, technical paper and proposal reviews, journal and conference publications, conference and symposium organization, and professional society activities.

More than 120 journal papers and 80 conference proceedings were published by the ME graduate faculty during 2012-2019, translating into an average number of scholarly articles published in journals by the collective ME faculty of approximately 21 journal papers per year. Several of the published papers were lead-authored or co-authored by MS students.

The ME department faculty also engage in externally funded research projects/grants from agencies such as the National Science Foundation, Department of Defense, Department of Energy, Office of Naval Research, NASA, Air Force Office of Scientific Research, ASHRAE, MIT Lincoln Labs, State of TN, and industries such as Cummins and Bristol Compressors, among others. Sponsored projects facilitate research and scholarship, which consequently help build intellectual capital for the MS and Ph.D. programs through student-involved research activity and the possible creation of knowledge in the process. Funds generated from externally sponsored projects and proposals submitted by the ME faculty during the past five years have increased from about $600k to $1.7 million.

Student Outcome 1: Communication in Area of Specialization

Define Goal:

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

Intended Outcomes / Objectives:

Mechanical Engineering students should be well prepared to have a productive career, advancing the knowledge of mechanical engineering principles and applications serving the public.

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. Additional evidence of achievement comes from scholarly manuscripts that were submitted and accepted, and presentations given at regional and national meetings.

Student Outcome 2: Demonstration of Research or Independent Study

Define Goal:

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

Intended Outcomes / Objectives:

Mechanical Engineering students should be well prepared to have a productive career, advancing the knowledge of mechanical engineering principles and applications serving the public.

Graduate students are encouraged to participate in the annual Research and Creative Inquiry Day held during the month of April to present posters on their research. In the past, several ME students have won awards in the competition.

Student Outcome 3: Give professional presentations or write scholarly manuscripts

Define Goal:

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

Intended Outcomes / Objectives:

Mechanical Engineering students should be well prepared to have a productive career, advancing the knowledge of mechanical engineering principles and applications serving the public.

Advisors and graduate committees provide guidance and training to students in research methods. Successful completion of the thesis requirement provides evidence of the ability for further study.

Each student's advisory committee has an opportunity to evaluate and approve the student's thesis or project report. After the completion of his or her research work, each MS candidate undergoes a thesis defense, in which the results of the candidate's research are presented to the advisory committee. During this examination and thesis defense, the committee may ask any questions in regards to the thesis research and/or the candidate's academic coursework and preparation.

Assessment Tool 1: Graduate Student Exit Interviews

Goal/ Outcome/ Objective:
Student Outcome: 1, 2, 3

Type of Tool:
Survey

Frequency of Assessment:
Prior to graduation

Rationale:
Written survey and oral discussion with students are targeted toward determining the quality of the program, attainment of selected learning outcomes, and the adequacy of resources and facilities to achieve these. See Graduate Student Exit Interview Form for the survey questions included.

Assessment Tool 2: Percentage of MSME Students Employed or Attending Graduate School in another university

Goal/ Outcome/ Objective:
Student Outcome: 2

Type of Tool:
Survey

Frequency of Assessment:
Annually

Rationale:

The ME Department, along with the Centers of Excellence, perform exit interviews with graduating students and collect data on their next placement, feedback to the program, and level of their success. The data is collected, compiled and analyzed by the Centers and departments as a tool to improve the quality and environment of the graduate program.

Percentage of MSME students who are employed upon graduation or who have been admitted to PhD programs is a good indicator of the quality of our graduate program.

The data for AY 19-20 will be updated next year as this survey is conducted once in two years.

Assessment Tool 3: Co-Op Employer Surveys

Goal/ Outcome/ Objective:
Student Outcome: 1, 2, 3

Type of Tool:
Survey

Frequency of Assessment:
Each Semester

Rationale:

Administered by the Office of Career Services to employers of students participating in the Co-Op program. Employers provide feedback regarding (1) individual student performance, and (2) more general assessment-related questions regarding performance of the M.E. program.

The survey data will be updated next year.

Assessment Tool 4: Alumni Surveys

Goal/ Outcome/ Objective:
Student Outcome: 1,2,3

Type of Tool:
Survey

Frequency of Assessment:
Once in 2-3 years

Rationale:

One way of evaluating the effectiveness of the graduate program is to track the placement and performance of MS graduates either in their places of employment or doctoral programs in which they are enrolled. Results of such surveys help identify any weaknesses in the program for appropriate remedial measures to be crafted and implemented. They also help determine the strengths of the program. The MS alumni survey responses indicate that 97% of graduates felt the M.S. program provided them with the technical knowledge required to be successful in their field. The same number of the respondents indicated that the program gave them the ability to undertake technical work independently. The surveys also indicated that 97% of the respondents felt technically competent to pursue life-long learning as a result of the M.S. program; therefore, a survey of graduate student alumni is an indicator of the success of our graduate students in their professional careers.

Assessment Tool 5: Employer Surveys

Type of Tool:
Survey

Frequency of Assessment:
Once every 2-3 years

Rationale:

A survey of employers is an indicator of our graduate students in their professional careers. This is no longer a true assessment tool. This tool is now only used only for information purposes.

Assessment Tool 6: ME External Advisory Board Feedback

Goal/ Outcome/ Objective:
Student Outcome: 1,2, Goal 2 and 3

Type of Tool:
Advisory Board,Focus Group

Frequency of Assessment:
Bi-Annually

Rationale:

Feedback from the ME External Advisory Board is an important source of program improvement, guidance, and supporting evidence regarding the performance of students who are graduates of the MSME program. The Advisory Board contains representatives of several key constituency groups of the program, i.e., employers, alumni, and the professional community at large.

As a response to student and EAB feedback--in order to improve the communication skills of graduate students, the CoE has begun offering a 3 credit hour course entitled Technical Communication for Engineers (ENGR 5250) whose primary objective is to strengthen the communication skills of graduate students in engineering.

Assessment Tool 7: IDEA Teaching Evaluations

Goal/ Outcome/ Objective:
Goal 1

Type of Tool:
Survey

Frequency of Assessment:
Fall and Spring Semester

Rationale:

IDEA evaluations are a university required tool for assessment of teaching of graduate faculty.

The average IDEA ratings on Progress on Relevant Course Learning Objectives, Teaching Effectiveness, and Usefulness of the Course since the 2012-2013 academic years are presented in the attached. The IDEA survey instrument makes provision for students to provide comments on each course. Some students use this as a vehicle to provide feedback on course topics and course requirements. On average, all ratings (on a scale of 1-5) fell within the “similar” comparison category, demonstrating the ME graduate curriculum success.

Assessment Tool 8: Average Number of Funded Research Projects

Goal/ Outcome/ Objective:
Goal 3

Type of Tool:
Tracking Spreadsheet

Frequency of Assessment:
Annually

Rationale:

A summary of external funds generated by the M.E. department using data provided by the Office of Research (per year per ME Faculty Member) is an indicator of the growth of external research provided by the faculty.

Data is compiled for proposals and activations by the College of Engineering.

Assessment Tool 9: Average Journal and Conference Publications per faculty per Year

Goal/ Outcome/ Objective:
Goals 1, 2, and 3

Type of Tool:
Tracking Spreadsheet

Frequency of Assessment:
Annually

Rationale:

All faculty members engage in regular professional development that enhances their teaching, scholarship and practice. These include but are not limited to the participation in workshops, training courses, and conferences, technical paper and proposal reviews, journal and conference publications, conference and symposium organization, and professional society activities.

Support for faculty development is provided for faculty to attend workshops, training courses, and conferences. If the activity is primarily instruction-related, the department's Student Course Fees fund can be used. For more research-related activities, such as conferences, Center funds, indirect cost returns, and/or project funds are typically used. Additional opportunity for development is provided through the hosting of seminars on a frequent basis by a variety of sources including CoE departments, CMR, CESR, WR, CITL, student groups, and individual faculty.