The University of Tennessee Chattanooga
Academic Program Review 2022
Engineering Graduate Master's Program
Final Report, March 28, 2022

Overview

A program review was conducted virtually March 21 -22, 2022 of the Engineering Graduate Master's Program at the University of Tennessee Chattanooga. In preparation for the review, the program prepared a self-study "Academic Program Review Engineering Graduate Master's Program Self-Study Report Academic Years Fall 2016 - Summer 2021." The review was conducted using guidelines provided in the University of Tennessee Chattanooga 2020 – 2025 Academic Program Review Graduate Program On-Site Visit Packet. This is the final report supporting the review. Informational extracts provided within the self-study, results from interviews, and follow-up requested documentation was used to prepare this final report.

PART 1 – Learning Outcomes

How would you rank this program with similar ones in the state, region, and nation? The last review of the MS Engineering program at the University of Tennessee, Chattanooga (UTC) was conducted in 2016. Two main recommendations were made to improve the program: enrollment and research growth. A number of steps have been taken over the years after the last MS Engineering program review to support existing efforts to increase the capacity for distance learning (DL) .   The program is graduating students who are in demand by industry and also Ph.D. graduate programs. The program enjoys stable enrollment but has not achieved desired growth goals despite multiple measures to attract additional students.

Are the intended program and learning outcomes clearly identified? The desired learning outcomes of the MS Engineering program graduates are as follows:

- Effective Oral Communication Skills: Prepare and deliver an effective presentation
- Engineering Fundamentals: Understand and apply engineering fundamentals
- Effective Technical Writing Skills: Write an effective thesis or project report

An additional student learning outcome covering ethics has been added this year and will be assessed for the first time in next academic year (2022-23).

Has the department specified program mission, vision, and goal statements? Do these statements clearly identify intended program and student learning outcomes? Are they appropriate for the program level (graduate) and for UTC? Yes, these items are clearly articulated in the "Academic Program Review Engineering Graduate Master's Program Self-Study Report."

What goals should the department establish regarding its curriculum? In particular, what advice should be offered to the department developing goals regarding the following aspects.
- **Student opportunities for research/involvement in faculty research** – None. There are ample opportunities available for students to participate in discipline specific research.
- **Student opportunities for practical/field experiences** – None. There are ample opportunities available for students to participate in practical/field experience with regional industries.

- **Student placement in the workforce related to the field of study** – None. Students indicated there are ample opportunities for employment with regional industries and also national laboratories. Faculty indicated students are in great demand by regional employers.

What goals should the department establish regarding its teaching? Faculty qualifications? Faculty development? None. Faculty are well qualified via education and professional experience to develop and deliver coursework for the program. Faculty are provided ample opportunity for continuing professional development. Most importantly, the faculty are highly motivated and dedicated to student success.

What criteria does the department use to evaluate sufficient achievement of intended program outcomes? Are the criteria appropriate for such evaluation and/or for the program? How?
Does the department make use of evaluation information and/or information obtained from student, alumni, and employer surveys and/or data from institutional research to strengthen and improve the program? The University of Tennessee at Chattanooga has an institutional assessment process whereby outcomes are assessed. *Anthology-Planning* is used as a repository for student learning outcomes, service outcomes, program outcomes, assessment results, follow up actions planned, and strategic plans. By using the information captured in Anthology-Planning, UTC is able to provide evidence of outcomes being assessed and those results being used for continuous improvement. The College of Engineering and Computer Science completes a MS Engineering Program assessment that is performed as a composite of the outcomes from the different concentrations based on the student learning outcomes (SLOs) of the program. Students' learning performance is assessed based on the three learning outcomes.

Does the program fit/align within the institutional mission? Yes. Table 4, page 11 of the self-study clearly describes the alignment with UTC's mission, vision, and values.

PART 2 – Curriculum

Is the current curriculum appropriate to the level and purpose of a graduate program? Is the program more advanced in academic content when compared to related undergraduate programs? How has the program designed a process by which students can be assured of making timely progress in the degree program? How is it determined that courses are offered? Is there a set schedule for course offerings upon which the student can rely? Does the department clearly outline program requirements and offer courses regularly to ensure timely completion of the program? As described in the self-study, the MS Engineering curriculum has been revised multiple times in the last five years to appropriately address the needs of current students and attract new students. Specifically:
- Additional graduate courses are now available online;
- New graduate courses have been added to enhance student learning and preparation for real world; and
- An additional student learning outcome covering ethics has been added this year and will be assessed for the first time in next academic year (2022-23).

To increase the flexibility of the MS Engineering Program and to target working professionals, an online MS Engineering program has been created to allow students to complete their MS Engineering degree

fully online. New graduate courses have also been added to the MS Engineering program to reflect the changing landscape and the demand of current and emerging industries.

The curriculum has been designed to be flexible and convenient with courses offered regularly, enabling students to make timely progress towards their degrees. Students can finish their master's degrees in engineering in two years by taking two courses per semester (including summers). At least two core courses and two elective courses are offered each fall and spring semester, in addition to the "Special Topics in Engineering" and "Thesis/Project" courses.

Does the curriculum align with the program learning outcomes? How is mastery assured through the curriculum? How is the content reviewed on a regular basis with results used to determine actions to take to improve the curriculum? Does the department regularly review and revise curriculum content and organization to ensure that it is appropriate and that it prepares students to meet the specified learning outcomes? Is the curriculum adequate to enable students to develop the skills and attain the outcomes? Figure 2, page 17 of the self-study clearly demonstrates curriculum alignment with the learning outcomes.   The College of Engineering and Computer Science has a Graduate Curriculum Committee with representation from each department, which reviews and makes necessary changes in the graduate curriculum every year based on student evaluations and assessment results.

Will the department need to update the curriculum and/or develop new or alternative offerings in the near future? Yes. Despite considerable recruiting efforts, employment of an external marketing team, and outreach to regional industries by the Dean; the MS Engineering Program has not reached a point of sustainability. The Dean has taken a wise and pragmatic approach to balance the needs of supporting an evolving program while ensuring the judicial stewardship of precious resources.   Several suggestions are recommended to mitigate this situation.

- Strictly enforce course enrollment minimums,
- Offer dual listed coursework at the 4000/5000 level consistent with regional accreditor guidelines to increase course enrollment,
- Restrict new enrollment to under subscribed programs (e.g. Industrial, Mechanical: Mechanics, etc.)
- Consider strategic combinations of existing programs (e.g. Mechatronics),
- Consider a common core of coursework shared by all MS Engineering program students followed by specificity within a given discipline,
- Encourage and support Dean to continue to develop relationships and applied engineering coursework to support regional industry,
- Seek additional agreements with regional employers such as the existing MOU with the Tennessee Valley Authority (TVA), and
- Pursue military graduate students and advertise UTC programs via the DoD AI Portal.

Are opportunities available to students that allow them to engage in research, professional practice or training experiences? How are those opportunities communicated to students? As documented in the program self-study, the MS Engineering program engages students in professional practices and training experiences by offering a variety of seminars, local internship opportunities, and job fairs throughout the year. Students are informed of these via email, social media, bulletin boards, and e-boards. In addition, theses and projects also act as professional practice resources where students get to engage in solving real-world industrial problems as an integral step in their professional preparation towards providing cutting-edge technological solutions.

Is the program offered through distance education or online? If so, how are those offerings assessed compared to on ground programming? Are appropriate pedagogical and/or technological innovations included that enhance student learning? Are the department's instructional practices consistent with the standards of the discipline? The MS Engineering curriculum has been revised multiple times in the last five years to appropriately address the needs of current students and attract new students. Specifically:

- Additional graduate courses are now available online,
- New graduate courses have been added to enhance student learning and preparation for real world, and
- An additional student learning outcome covering ethics has been added this year and will be assessed for the first time in next academic year (2022-23).

To increase the flexibility of the MS Engineering Program and to target working professionals, an online MS Engineering program has been created to allow students to complete their MS Engineering degree fully online. New graduate courses have also been added to the MS Engineering program to reflect the changing landscape and the demand of current and emerging industries.

All MS engineering courses in the Electrical Engineering concentration area, and several courses in the concentration areas of Chemical, Civil and Mechanical Engineering are offered online. Students in these courses are monitored and evaluated actively through the Canvas Learning Management System (LMS) to ensure progress and that their achievements are on-par with students attending the same courses on campus. Online students are required to participate in discussion forums regularly to fulfil their class participation goals and make sure they keep up with the lectures. Normally, both in-class and online students share assignments and exams.

Graduate courses are usually offered in the evenings or late afternoons to accommodate working students. Each course uses the Canvas LMS to display class materials, create discussion boards, and post assignments. This system helps students keep up with coursework if they are unable to attend class due to work or illness. Online offerings are supported by virtual platforms such as Mediasite, Studio, and Camtasia to record and store lectures both synchronously and asynchronously. UTC has technical support personnel who are responsible for maintaining these platforms. Such virtual platforms offer the opportunities to embed modern instructional methods and pedagogical approaches such as blended learning, synchronous and asynchronous delivery, learner-centric delivery, simulations, flipped-classroom learning, etc.

Do the instructional practices provide adequate opportunities for student interactions with one another, faculty, and professionals? Does the department make adequate efforts to include students in the life of the program (e.g., seeking student advice in reviewing the curriculum/course schedules/teaching methods, etc.)? The MS Engineering program provides adequate professional development opportunities through membership in professional associations such as Tau Beta Pi, Associated General Contractors (AGC), Graduate Student Association (GSA), American Society of Civil Engineers (ASCE), American Society of Mechanical Engineers (ASME), National Society of Black Engineers (NSBE), and the Society of Woman Engineers (SWE). These organizations encourage students to attend conferences and workshops, help students network and find jobs, and provide students with opportunities for publication.

To provide adequate enrichment opportunities, the MS Engineering program hosts a variety of seminars conducted by local professional speakers from the Tennessee Valley Authority (TVA), Volkswagen (VW),

Coca Cola, etc. These seminars, offered free and situated conveniently in UTC auditoriums, create an environment that facilitates student engagement with local industries and enriches students' education. It also provides opportunities for students to learn multi/inter-disciplinary approaches to problem-solving in various industries.

In support of teaching, research and service missions, the College continues the Speaker Series. The presentations in the Speaker Series provide opportunities for sharing both cutting-edge information from noted researchers in various fields as well as experience and timely insights from community leaders.

PART 3 – Student Experience

Does the program have enough students to allow an appropriate group of peers as they participate in the program? Yes. Figure 3, page 32 of the self-study provides longitudinal graduate engineering program enrollment data provides Fall enrollment for the past years. Enrollment has remained steady and level at approximately 50 students per year.

Are students offered the opportunity to evaluate both the curriculum and the faculty? How? Are these methods effective in getting feedback about the program and teaching effectiveness?
The College of Engineering and Computer Science has a Graduate Curriculum Committee with representation from each department, which reviews and makes necessary changes in the graduate curriculum every year based on student evaluations and assessment results (Section 1.2, B), as shown in Figure 1 of the self-study.

Are there appropriate curricular and co-curricular offerings to enhance student experiences? Does the program provide adequate opportunities for student professional development? To what extent does the program encourage membership in professional organizations, support participation in conferences and workshops, and/or promote opportunities for student publication? Does the program provide students with enrichment opportunities, such as lecture series, student organizations, etc.? Are such opportunities adequate to promote a scholarly environment? Does the program provide adequate opportunities for student internships, practica, and/or field experiences? Are diverse perspectives and experiences provided for the students both through the curriculum and through extracurricular activities? The MS Engineering program provides adequate professional development opportunities through membership in professional associations such as Tau Beta Pi, Associated General Contractors (AGC), Graduate Student Association (GSA), American Society of Civil Engineers (ASCE), American Society of Mechanical Engineers (ASME), National Society of Black Engineers (NSBE), and the Society of Woman Engineers (SWE). These organizations encourage students to attend conferences and workshops, help students network and find jobs, and provide students with opportunities for publication.

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Are students provided with appropriate academic support services? What services are offered? Do students use the services? How well do they meet the needs of the students?
Students have a wide range of resources available to them including:

- The College of Engineering and Computer Science regularly evaluates its facilities and equipment and makes improvements where necessary. For example, the College is committed to creating an environment that places personal safety and health of the students and faculty first by regularly evaluating laboratories.
- Learning and Information Resources. Students and faculty have access to information resources to support teaching and learning primarily through the UTC library. Additionally, the Walker Center for Teaching and Learning supports faculty by offering development sessions and other teaching resources
- The availability of instructional resources has improved with the opening of the new library building in January 2015. The UTC Library is well-equipped to support the program with a broad collection of diverse materials including 600,000 print and eBooks, over 30,000 digital journals available, 150+ indexes and databases, and interlibrary loan service.
- The program's instructional equipment and facilities within the College of Engineering and Computer Science are adequate and continually upgraded. CECS maintains a budget for regular upgrade of instructional and laboratory equipment.
- Graduate students also have a study room on the second floor, EMCS 241, which provides a quiet study environment.
- Technical support is provided by technical   personnel staffed by the College of Engineering and Computer Science, along with graduate assistants.
- Other academic support services, within the College, that are available to graduate students are Advising, Career Development, Event resources, Peer Tutoring, and Clubs and Organizations. Some support services available through UTC include the Disability Resource Center, Counseling Center, and the Writing Center.

PART 4 – Graduate Faculty Quality

Are the faculty competencies/qualifications those needed by the program and by UTC? Do all graduate faculty meet the standards set by the program and expected SACSCOC faculty credentials? Do faculty hold terminal degrees in the appropriate discipline? Do faculty specialties correspond to program needs and to the concentrations in which they teach? If faculty need additional/different competencies/qualifications, how might these needs be addressed? The College of Engineering and Computer Science has 56 tenured and tenure- track faculty and 32 non-tenured faculty members. Of those, 31 faculty members (tenured & tenure-track) are distributed across the three Engineering departments within the MS Engineering program concentrations. They are all qualified to teach graduate level courses and advise graduate students.

Each department has a graduate coordinator who is responsible for the graduate concentration in his/her discipline. The main responsibilities of graduate coordinators are to advise graduate students, review all prospective graduate students' applications, recruit graduate students to their concentrations, write and propose curriculum changes, and teach graduate level courses.

All full-time and part-time faculty meet the high credential standards set by the program and SACSCOC guidelines.

Are faculty teaching loads sufficiently reasonable and equitable to accommodate the highly individualized nature of a graduate program, especially the direction of theses or dissertations? Most graduate level courses, on-campus and online, are taught by full-time graduate faculty in the College. For the MS Engineering program, faculty teaching loads are aligned with the highly individualized nature of graduate instruction. In the case of graduation projects and dissertations, specialized professors are assigned to guide the student on an individual basis. Figure 5 of the self-study shows the average Student Credit Hour (SCH) per Total Faculty FTE generated by a university faculty member, a college faculty member, and the engineering program faculty member for each fall semester for four years starting in 2016.

With respect to ethnicity, gender, and academic background, is faculty diversity appropriate for the program? Does the program student and faculty diversity mirror the demographics of the discipline? Students enrolled in the MS Engineering Program are increasingly diverse. Studies have shown the importance of faculty diversity to enrolling and retaining students from diverse backgrounds. College faculty members have demonstrated a positive impact in shaping campus culture and encouraging students from multiple groups of minorities and genders to enroll and persist through graduation. The diversity of faculty and graduate major enrollment are presented in Appendix F of the self-study.

Do the faculty have regular opportunities for professional development such as travel and participation in professional organizations, workshops, and other learning experiences? Do faculty take advantage of the opportunities provided? The MS Engineering faculty strive for continuous professional development, which can advance teaching methods, scholarship and practice. Ongoing, current and past research projects led by faculty members draw external funds such as grants and awards. Annual conferences, workshops, expos, meetings, and a multitude of organizational gatherings are regularly attended by faculty.

Are faculty engaged in the planning, assessment, and improvement processes that measure and advance student success? Does the program use assessment data, etc. to improve teaching, scholarship and creative activity and service? How does this work? Are the processes effective? The faculty actively engages in regular planning, evaluation, and improvement activities that measure and advance student success. To enrich and improve the curriculum, which is maintained at the department level, faculty members may propose changes including curriculum, program goals, and an overall assessment process based on feedback from students and input during departmental meetings. The department reviews the proposal and, if approved, submits it to the graduate coordinator committee. The committee then reviews and approves the proposed changes. Once approved, the university implements the changes in the following academic year.

PART 5 – Learning Resources

Does the program regularly evaluate its equipment and facilities and pursue necessary improvements? Has the program requested/encouraged necessary improvements of its equipment and facilities through appropriate internal mechanisms? Through appropriate external mechanisms? Reference Part 3 – Student Experience above.

Does it appear that the program's resources are appropriate within the context of overall college resources? How should needs of the program be prioritized? Could savings be realized from current program operations to fund any new budgetary needs? As mentioned previously in this report, despite considerable recruiting efforts, employment of an external marketing team, and outreach to regional industries by the Dean; the MS Engineering Program has not reached a point of sustainability. The Dean has taken a wise and pragmatic approach to balance the needs of supporting an evolving program while ensuring the judicial stewardship of precious resources.   Several suggestions are recommended to mitigate this situation.

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Are library holdings and other learning and information resources current and adequate to support the teaching and learning needs of the discipline? Are there resources adequate to support the research and publication needs of the faculty and staff? Reference Part 3 – Student Experience above.

PART 6 – Support

Is the program's operating budget consistent with the needs of the program? Considering current budget constraints, what are the most pressing resource needs of the program? Could these needs be met in ways without requiring additional budgetary resources, such as savings from current program operations? How should the needs of the program be prioritized? Could savings be realized from current program operations in order to fund any new budgetary needs? Does the program have a history of enrollment and graduation rates sufficient to sustain high quality and cost effectiveness? The MS Engineering program's internal and external support are consistent with the budget needs of the program. Table 10 of the self-study shows the internal awards/grants received by the faculty in the department. Appendix E of the self-study provides the operating budget for the College.

Is the program responsive to local, state, regional and national needs of the discipline?
The MS Engineering program is responsive to changing local, state, regional and national needs. The curriculum contents are reviewed regularly, partly to respond to changing regional needs. With growing interests in the areas of renewable energy, sustainable infrastructure, data analytics, artificial intelligence, smart transportation, environmental sustainability, biomedical devices, etc., in the region, state, and nationally, the college has the capacity to grow its MS program offerings in response to these needs by providing the relevant education and training through new programs and/or modification to existing programs to support workforce demands in these areas.

Does the program regularly and systematically collect data related to the success of its graduates, including placement? Do they also incorporate the results of that data to inform program improvements? Graduate students are connected to the College's LinkedIn page (https://www.linkedin.com/groups/6715787) upon graduation. The LinkedIn page helps the College stay connected with alumni and where they currently work. Since 2015, the College has also completed an Annual Review, which is distributed to all alumni in addition to the local and regional businesses. Appendix K of the self-study provides Employment and Placement from University, College, and Department/Program graduates.

Are the program policies reviewed on a regular basis to ensure alignment with institutional policies and mission? The MS Engineering program's procedures are regularly reviewed to ensure alignment to institutional policies and mission. This is done every year to comply with and maintain the standards contained in the guidelines of the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC).
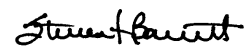
Considering current budget constraints, what are the most pressing resource needs of the program? Does the program have acceptable completion rates? If unacceptable, what are possible contributing factors? How is this information used toward program revision? As mentioned in several p[laces within this report, the most pressing need of the program is the recruitment of additional students so the program can become self-sustaining.   There are no issues with the program completion rates.

PART 7 – Summary Recommendations

Overall, what are your impressions of the program? What are the major strengths of the program? What are the major weaknesses of the program? What goals would you suggest the program set for the next five years? Please list goals in order of priority (i.e., the most important goal first, followed by the second most important goal, etc.) How can the program work to achieve these goals over the next five years? Considering current budget constraints, what are the most realistic strategies the program can use to achieve the highest priority goals? What goals would require additional resources? What level of resources would these goals require? How might the program secure these resources? Thank you for the honor and opportunity to conduct a program review of the MS Engineering Program. As documented throughout the report the program enjoys strong leadership from the Dean, faculty, and staff. The program is doing all of the right activities and assessments to ensure student success, regional prominence, and serving industrial constituents. The only pressing challenge is attracting additional students to the program.   I encourage the program to continue the initiatives in process and also consider some of the recommendations made within the report.

Respectfully submitted,

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