Annual Graduate Program Report

Mechanical Engineering Department (MEEG)
University of Arkansas
Fayetteville, AR

Degree Programs:
Mechanical Engineering (MSME, thesis option)
Master of Science in Mechanical Engineering (MSME, non-thesis option), and
Doctor of Philosophy (PhD) in Engineering.

Period of Interest
AY2022-2023

Date:
12 September 2023

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MEEG Staff Support

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PROGRAM GOALS

The Mechanical Engineering Department (MEEG) developed a departmental strategic plan that aligns with both the COE and UA's priorities. The plan was completed, and faculty approved during on 9/18/2017 during the Fall faculty meeting. In the new strategic plan, the vision statement is "We seek to serve society by preparing high quality mechanical engineers and performing impactful scholarly work that advances the well-being of Arkansas and beyond". The strategic goals are:

1. Graduate diverse, fully qualified mechanical engineers
2. Enhance research in core and emerging mechanical engineering areas
3. Expand doctoral graduate program and PhD's granted
4. Reduce student-to-faculty ratio
5. Expand and improve infrastructure for educational and research activities
6. Strengthen hands-on educational experiences

MEEG STUDENT LEARNING OUTCOMES (SLOS)

MEEG Student Learning Outcomes are defined in terms of the knowledge, skills, and abilities that students will know and be able to do as a result of completing a program (either MSME or PhD). These student learning outcomes are directly linked to the accomplishment of the program goals listed above. They are:

MSME SLOs:

1. Students will gain advanced knowledge in mechanical engineering.
2. a. Thesis: Students will gain a necessary understanding of their research field.
   b. Non-thesis: Students will apply advanced coursework to an engineering problem.
3. a. Thesis: Students will contribute new knowledge of fundamental or applied importance.
   b. Non-thesis: Students will demonstrate important application(s) of existing knowledge.
4. Students will be able to communicate effectively during oral presentations.
5. Students will be able to communicate effectively in writing.

PhD SLOs:

1. Students will gain advanced knowledge in mechanical engineering.
2. Students will show proficiency in the foundational topics of mechanical engineering.
3. Students will gain an understanding of their research field to contribute new knowledge.
4. Students will contribute new knowledge of fundamental or applied importance.
5. Students will be able to communicate effectively during oral presentations.
6. Students will be able to communicate effectively in writing.

PROCESS FOR ASSESSING STUDENT LEARNING OUTCOMES (SLOS)

The graduate faculty approved a new academic assessment plan in August 2015, which became effective the Fall 2015 semester. This new assessment plan has been providing better program assessment and feedback for continuous improvement. In addition to defining the MEEG graduate

program goals and student learning outcomes (SLOs), detailed performance surveys are being used to supplement existing assessment measures. The surveys are periodically completed by graduate students, their major advisors, and their faculty advisory committee members throughout a student's program period. In particular, these performance surveys explore beyond the previous annual 'satisfactory or unsatisfactory progress' check. Each survey asks about overall student progress, interactions with the student's peers and major advisor/committee member, level of effort, and oral/written communication skills.

For the new assessment process, the assessment measures (see Tables 1 and 2) are matched with their related SLOs. Samples of standard forms (i.e., annual graduate student academic review, graduate student performance survey (self-assessment and advisor) are available upon request. All data are collected by the Assistant to the Graduate Program Coordinator and recorded in a spreadsheet for analysis. Data are to be reviewed annually by the MEEG Graduate Studies Committee and results reported to the Dean of the College of Engineering (COE) by the Chair of the MEEG Graduate Studies Committee. Future plans are for the data to be entered into an Access Database of Graduate Student Progress which will allow for improved analysis and access to historical data.

Table 1. Means of assessment for MSME (thesis/non-thesis) students.

Student Learning Outcome	Assessment Measure
1. Academic Progress Toward Gaining Advanced Knowledge	Cumulative GPA. Annual Graduate Student Academic Review.
2a. Understanding of Field	Student self-assessment in Graduate Student Performance Survey. Thesis defense, Graduate Student Performance Survey.
2b. Applying Coursework	Student self-assessment in Graduate Student Performance Survey. Project presentation, Graduate Student Performance Survey.
3. Contribute New Knowledge	Student self-assessment in Graduate Student Performance Survey. Thesis defense / project presentation, Graduate Student Performance Survey.
4. Communicate Orally	Graduate Seminar, Student self-assessment in Performance Survey. Thesis defense / project presentation, Graduate Student Performance Survey.
5. Communicate in Writing	Student self-assessment in Graduate Student Performance Survey. Thesis / project report, Graduate Student Performance Survey.

Table 2. Means of assessment for PhD students.

Student Learning Outcome	Assessment Measure
1. Academic Progress Toward Gaining Advanced Knowledge	Cumulative GPA. Annual Graduate Student Academic Review.
2. Foundational Proficiency	Cumulative GPA. Ph.D. Candidacy exam
3. Understanding of Field	Student self-assessment in Graduate Student Performance Survey. Candidacy exam, Dissertation, Graduate Student Performance Survey.
4. Contribute New Knowledge	Student self-assessment in Graduate Student Performance Survey. Candidacy exam (PhD proposal), Dissertation, Graduate Student Performance Survey.
5. Communicate Orally	Graduate Seminar, Student self-assessment in Performance Survey.

	Candidacy exam, Dissertation defense.
6. Communicate in Writing	Student self-assessment in Graduate Student Performance Survey. Candidacy exam, Dissertation.

PROGRAM ASSESSMENT RESULTS

MEEG utilize eight assessment measures:

1. Cumulative GPA
2. Annual graduate student academic review
3. Graduate student performance survey
4. Participation in graduate seminar
5. PhD Candidacy exam
6. Oral defense of MS thesis, MS project, or PhD dissertation
7. Written MS thesis, MS project, or PhD dissertation

Results for AY2022-2023 are given below and discussed with regard to SLOs.

Cumulative GPA
MS SLOs: #1 – Gain advanced knowledge (i.e., academic progress)
PhD SLOs: #1 – Gain advanced knowledge (i.e., academic progress)
#2 – Foundational proficiency

Table 3 provides the cumulative GPA for MEEG graduates. These results show that students are proficient and making good progress in their course work at the graduate level.

Table 3. Cumulative GPA for MEEG graduate students.

Acad Plan	Name	Cumulative GPA AY22-23
MEEGPH	Abe, Adedoyin Ayomide	4.000
MEEGPH	Bennett, William Basore	4.000
MEEGPH	Dunlap, Christy Lela	4.000
MEEGMS	Ghufran, Muhammad	4.000
MEEGMS	Hoskins, Julia K.	4.000
MEEGMS	Nanayakkara Ratnayake, Charith Oshadi	4.000
MEEGPH	Sangsefidi Sr, Milad	4.000
MEEGPH	Scott, Daniel	4.000
MEEGPH	Shen, Bo	4.000
MEEGMS	Stubbs, Najee Ian	4.000
MEEGMS	Viljoen, Daniel Christoffel	4.000
MEEGPH	Jack, Justin Tamico	3.929
MEEGPH	Musa, Mishek Jair	3.917
MEEGMS	Vinson, Whit Miller	3.917
MEEGPH	Eaton, Abigail Louise	3.909
MEEGPH	Sui, Chao	3.893
MEEGPH	Ashmore, Mason Thomas	3.857
MEEGPH	Harris, Nathaniel Quinn	3.857
MEEGPH	Kasitz, Joshua Michael	3.846
MEEGPH	Pandey, Hari	3.846

MEEGPH	Meyer, Jeremy William	3.786
MEEGPH	Tushar, Nahid Hasan	3.769
MEEGPH	Mohammad Nafis, Bakhtiyar	3.643
MEEGPH	Ruby, Collin N	3.625
MEEGMS	Whitt, Reece Landon	3.571
MEEGPH	K C, Navin	3.500
MEEGPH	Harris, John R	3.385
MEEGPH	Velasquez Carballo, Kevin Eduardo	3.333
MEEGPH	Medina Garcia, Alicia	3.286
MEEGPH	Tunon, Bryan Ernesto	3.286
MEEGPH	Wu, Rencheng	3.250

Annual Graduate Student Academic Review

MS SLOs: #1 – Gain advanced knowledge (i.e., academic progress)
PhD SLOs: #1 – Gain advanced knowledge (i.e., academic progress)

Table 4 below provides the results the annual graduate student academic review forms (received each spring semester). Students are required to annually obtain feedback from their major advisor with regard to their progress toward graduation. The forms allow for only a rating of satisfactory or unsatisfactory. A review of the historical and this year's annual review data show that students are generally making satisfactory progress.

Table 4. Annual graduate student academic reviews.

Academic Year	Number Satisfactory	Number Unsatisfactory
2020-2021	31	0

Graduate Student Performance Surveys

MS SLOs: #2a – Understanding of field
#2b – Applying coursework
#3 – Contribute to new knowledge
#4 – Communicate orally
#5 – Communicate in writing
PhD SLOs: #3 – Understanding of field
#4 – Contribute to new knowledge
#5 – Communicate orally
#6 – Communicate in writing

Tables 5 and 6 below show the results of the graduate student performance surveys. Please note that these surveys were created in an effort to better assess the SLOs from several different perspectives. The surveys are required prior to enrolling each semester by the student and student's major advisor. The surveys are also required after the oral defense (i.e., MS thesis/project or PhD dissertation) by the student, major advisor, and all thesis/project/dissertation committee members. At this time, there are no obvious issues.

Table 5. Statistics from student self-assessment in graduate student performance surveys (2022-2023 Academic Year).

Question	Fall 22 (36 Respondents)	Spring 23 (31 Respondents)
Overall Academic Progress	4.24	4.34
Overall Research Progress	3.71	3.87
Quantity of Interaction with Prof.	4.25	4.25
Quality of Interaction with Prof.	4.39	4.41
Quantity of Interaction with Peers	4.06	4.34
Quality of Interaction with Peers	4.33	4.30
Time Spent in Lab/Office	4.02	4.26
Effort Level on Research	4.11	4.31
Oral Communication	4.21	4.18
Written Communication	4.20	4.24

Table 6. Statistics from major advisor or committee member graduate student performance surveys. (22022-2023 Academic Year).

Question	Fall 22 (36 Respondents)	Spring 23 (31 Respondents)
Overall Academic Progress	4.18	4.30
Overall Research Progress	3.88	4.18
Quantity of Interaction with Prof.	4.37	4.48
Quality of Interaction with Prof.	4.36	4.39
Quantity of Interaction with Peers	4.48	4.51
Quality of Interaction with Peers	4.51	4.48
Time Spent in Lab/Office	4.25	4.46
Effort Level on Research	4.22	4.42
Oral Communication	4.16	4.22
Written Communication	4.06	4.15

Participation in Graduate Seminar
MS SLOs: #4 – Communicate orally
PhD SLOs: #5 – Communicate orally

All graduate students are required to enroll in MEEG 6800 Graduate Seminar each semester. Students are also required to give a presentation on their research topic once per year. Most MS students give one to two presentations prior to graduation. For PhD students, they give an average of about 3 presentations.

Recent action: Based on a review of recent attendance records, it was apparent that an increasing number of graduate students have failed to register and attend the graduate seminar. After consultation with the department chair and members of the graduate studies committee, a

department staff was put in charge to register the seminar class on behalf of the students. In addition, students' presentations and attendance are closely monitored. In order to be excused from individual seminars, students are now required to submit official requests with approval from their academic advisors.

PhD Qualifying and Candidacy Exam

MS SLOs: n/a
PhD SLOs: #2 – Proficiency in foundational topics
#3 – Understanding of research field

In Fall 2021, MEEG faculty developed and approved a new qualifying exam format. The primary reason for the change was to better reflect the increasing multidisciplinary nature of both the students' academic background and the research projects they are involved in. The new format essentially combines the PhD qualifying and candidacy exams into a single exam consisting of two different phases. In Phase I, the students demonstrate proficiency in fundamental mechanical engineering principles through graduate level coursework and the submission of an abstract describing the foundational principles of proposed research. In Phase II, the students submit a detailed writeup of proposed research and pass an oral defense.

Table 8 below provides a list of PhD candidates who passed their qualifying and candidacy exams from Fall 2022 to Spring 2023. Based on comments from the faculty members that served on the exam committees, there appears to be no obvious issues or concerns of the new exam format.

Table 8. PhD candidacy exam completed from Fall 2022 to Summer 2023.

Student Name	Term	Candidacy Exam Status
Whitt, Reece	Fall 2022	Pass
Eaton, Abigail	Spring 2023	Pass

Oral Defense of MS Thesis, MS Project, or PhD Dissertation

MS SLOs: #4 – Communicate orally
PhD SLOs: #5 – Communicate orally

and

Written MS Thesis, MS Project, or PhD Dissertation

MS SLOs: #5 – Communicate in writing
PhD SLOs: #6 – Communicate in writing

The last two steps in a student's work prior to graduating include writing and orally defending their MS thesis/project or PhD dissertation. Verification of progress or success in this area is partially assessed by the fact the student graduated. Table 9 provides a list of recent graduates during this academic year. There appears to be no obvious issues or concerns.

Table 9. List of degree and graduation dates for MEEG graduates.

Semester	Year	Degree	Name	Advisor

Fall	2022	MSME	Abe, Adedoyin Ayomide	Zou
Fall	2022	PHD	Afshar Mohajer, Mahyar	Zou
Fall	2022	PHD	Iradukunda, Ange Christian	Huitink
Spring	2023	PHD	Miller, Charles Richey	Zou
Spring	2023	MSME	Moritz, John Alan	Wejinya
Spring	2023	MSME	Romero Melgar, Sergio Esteban	Huitink
Spring	2023	PHD	Simpson, Joseph Patrick	Leylek
Spring	2023	PHD	Soltani Kordshuli, Firuze	Zou
Fall	2022	PHD	Wang, Xin	Meng

Conclusions

Based on the given assessment measures, it appears that all the student learning outcomes (SLOs) are being met by the MEEG graduate program at both the MS and PhD levels. As future survey assessment data become available, changes are expected to be identified which will strengthen the graduate program. Thus far, none has been identified.

External Review

In Fall 2022, MEEG underwent an external review of our graduate program. The following are the areas of concern provided by the reviewers, and the responses from the department.

- The department should continue to hire high quality faculty to strengthen the existing research areas and increase the number of PhD students.

Department Response:
Faculty hiring: We have good news related to hiring new faculty. The department has been given approval to hire three new faculty starting fall 2023: two assistant and one associate professors. The faculty research areas are in design/manufacturing, robotics/controls/automation, and transportation. Each of these areas are vital to the growth and direction of mechanical engineering of today. Due to both the continued demand for NIEEG graduates and our relatively high student-to-faculty ratio, the COE Dean's Office continues to be supportive of MEEG faculty growth. In the long-term (the following 2-5 years), we anticipate adding faculty to our core strength areas and to cover any attrition which may occur.

PhD students: In the near-term, we are increasing our efforts to recruit high-achieving students, especially UA MEEG undergraduate honors students, many who are eligible to apply for the Distinguished Doctoral Fellowships (DDF) and Doctoral Academy Fellowships (DAF). Also, we will work closely with Ms. Petra Martin, COE's new Assistant Director of Graduate Recruitment, to identify and recruit high quality PhD students external and internal to the UA. In the following 2-5 years, in addition to the activities described above, our current and incoming new faculty will actively recruit PhD students through private communications with their colleagues at other universities and direct contact with students from information provided by the Graduate Recruitment Office. Finally, our department head and other faculty are working to develop new and/or better relationships with universities within a 200-mile radius of the UA. We believe students choosing to pursue a graduate degree from these institutions are much more likely to consider our graduate program.

- The University should develop retention strategies, such as named professorships for junior faculty.

Department Response:
The COE's Development office is well aware that endowed professorships and chairs would greatly benefit MEEG faculty. They (and the department leadership) are seeking to find donors who have interests that align with this type of gift. Historically, the department has targeted the 4 endowed positions to faculty who could leverage them the most (i.e., greatest expected long-term impact/productivity). And, in the past, junior faculty (tenure-track) have competed and received professorships. To use as a retention strategy, the department would need several more funded professorships. As a note, the COE has historically offered two types of retention incentives for the top performing faculty — a) allowed departments to identify top performing faculty/staff and offer a significant pay raise well above the average; and b) offered both pay raises and research related incentive packages for those who recently received NSF CAREER Awards (or similar).

- During our tour of the labs, we identified a need for additional space that is necessary for existing faculty to further grow the research program.

Department Response:
Space limitations are real within MEEG and are a long-term concern that could inhibit departmental growth and productivity. Right now, we are seeking to fully utilize our current space as existing faculty are willing to share their temporarily unused space with their colleagues. However, it is expected we will need more ENRC research lab and graduate student space very soon — as a part of start-up packages for incoming new faculty (fall 2023). Noteworthy, the COE recently added more graduate student 'bullpen' space (which is helpful).

- The large undergraduate student body imposes a heavy teaching load to the research active faculty. Reduced teaching load should be given to enable them to attract additional funding.

Department Response:
The department is sensitive to the significant load that teaching large classes can create, especially for research active faculty. MEEG's typical load for research active faculty is 3 courses per year. And, in response to this issue, we currently have a buy-out rate which is the lowest in the COE (10% of 9-month salary per class). In fact, the most research-active faculty have routinely bought out of one class per year. And, on occasion, the department head has given release time for faculty who are leading work on large multi-institution and multi-million-dollar proposals/projects. Related, the availability of TA support for research active faculty is essential (see #6 below).

- The established minimum rate for graduate student stipend by the university is very low compared to peer institutions and should be raised.

Department Response:
The department has to make more progress in this area. That said, we have recently increased our minimum PhD stipend to $20k per year; however, $24k/year would be more competitive. As supplements to base stipends, some of our top students have received DDF/DAF fellowships. These DDF/DAF fellowships have undoubtedly allowed MEEG to hire graduate students we wouldn't have otherwise attracted. Beyond that, small scholarships (from Foundation monies) have been used to target other potential graduate students. So, more departmental graduate-student scholarships are another need. Furthermore, the departmental faculty are aware that we are not as competitive as needed. So, research faculty are budgeting higher stipends in their current and future research proposals.

- The number of TAs is low given the size of the undergraduate student body and the planned growth of the ME graduate program.

Department Response:
This stems from two problems — the availability of resources and availability of graduate student applicants. As stated above (#1), we are increasing our recruiting efforts. There is no doubt that faculty/N'1EEG productivity would increase if our number of TAs was more in line with our peers. From a funding standpoint, the level of funding is well below our monthly stipend minimums. And current funding provides TA stipend/tuition for only 9 months (when 12 months is more realistic).

Our aspirational goal is to at least match the number of TAs with that of the faculty (i.e., I : I ratio) and more in line with our ME department peers at RI institutions.

- The Department should encourage faculty/students to aggressively pursue prestigious fellowships such as NSF GRFP, NDSEG, NASA fellowships, etc., and provide additional incentives for such awards.

Department response:
In the near-term, the department will identify a faculty-in-charge or organize a committee to formulate a plan to effectively guide new graduate students to apply for national level fellowships. In the following 2-5 years, the department will implement the plan and based on the results, continue to improve on it.

- In our meeting with the graduate students, they indicated that there is a need for additional 5000 level courses in many of the areas in the department. In some areas, the choices of courses are extremely limited. The faculty expressed the same when we met with them.

Department Response:
In the near-term, we will actively encourage our faculty to develop new 5000 level courses. We also expect the new faculty that will start in Fall 2023 to offer a more diversified range of new 5000 level courses. In the following 2-5 years, we expect the number of 5000 level courses to continue to increase following the increase in the number of new faculty.

- We recommend senior level/graduate level courses (4000/5000) that become excellent tools to recruit graduate students.

Department Response:
In the near-term, we plan to encourage our faculty to develop a 5000-level section to their 4000level elective courses. In the following 2-5 years, we expect all our 4000-level elective courses to have a 5000-level section. Related, this also aligns with our new accelerated MSN,'E program which will start Fall 2023. This program is expected to increase our graduate student population; increase our number of PhD students as some 'continue on' after completing their MS; and increase enrollment in our graduate courses.

- The success of the honors program in recruiting undergraduate students should be extended to the broader undergraduate student body.

Department Response:
NIEEG believes this largely already occurs, but we should insure all UGs are aware and have the same opportunities. The typical path for our undergraduates (UG) to pursue research is through faculty announcements and discussion within their classes. Students identify professors with common interests (e.g., CFD modeling, . . .) discussions lead to research opportunities, whether the student is in the UG Honor Program or not. Faculty do provide our UG Honors coordinator with project descriptions, but these are the same projects mentioned in the scenario above. A step improvement, which will begin Spring 2023, will be to publicize (via web or email) written UG research project descriptions to the entire NIEEG student body.

- In assessing the SLOs, metrics such as journal/conference publications, conference attendance and presentations should be included.

Department Response:
In the near-term, we will ask our faculty to document this information. In the following 2-5 years, we expect the information to become a standard SLO item in our self-study report.