# Annual Graduate Program Report

Biomedical Engineering Department (BMEG)
University of Arkansas

**Degree Programs:**
Biomedical Engineering (MSBME, non-thesis)
Biomedical Engineering (MSBME, Healthcare Entrepreneurship, non-thesis)
Biomedical Engineering (MSBME, thesis)
Doctor of Philosophy (PhD) in Engineering

**Report Period**
May 16, 2022 – May 15, 2023
Summer 2022, Fall 2022, and Spring 2023

**Date**
Approved by BMEG Graduate Committee: 9/12/2023
Approved by BMEG Department Head: 9/12/2023

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## PROGRAM GOALS FOR BMEG MS. AND PHD PROGRAMS

Program goals are broad general statements of what the program intends to accomplish and describes what a student will be able to do after completing the program. The program goals are linked to the mission of the university and the new strategic plan[1] of the College of Engineering (COE).

Accordingly, the program goals of the MS and PhD programs in Biomedical Engineering at the University of Arkansas, Fayetteville are to produce graduates that are capable of:

1. Succeeding in practice at the interface between life science and engineering, or in other professional activities, or in post-master's or Ph.D. studies.
2. Utilizing their advanced engineering education in creating new knowledge or enabling technologies for improvement of human health and healthcare.
3. Continuously upgrading their knowledge in their chosen specialty by initiating self-directed learning.

## STUDENT LEARNING OUTCOMES

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. These student learning outcomes are directly linked to the accomplishment of the program goals.

The graduates of the MS and PhD programs in Biomedical Engineering will either be capable of the following or possess the following attributes:

1. Conceiving, designing, analyzing, and implementing systems, processes and experiments related to improving human health and healthcare.
2. Functioning in multidisciplinary teams to find effective solutions to complex technical problems and/or the design of new products and processes to improve human health and health care.
3. Using modern analytical, simulation, and diagnostic tools and techniques used in healthcare industry.
4. In-depth and up-to-date knowledge within a specialized field in Biomedical Engineering.
5. An understanding of ethical and professional responsibility
6. To effectively communicate their findings/ideas to a technical and non-technical audience

The prescribed outcomes are met through the curriculum followed by the students.

[1] https://engineering.uark.edu/about-us/strategic-plan

## PROCESS FOR ASSESSING STUDENT LEARNING OUTCOMES

A process must be defined and documented to regularly assess student learning and achievement of student learning outcomes. The results of the assessment must be utilized as input for the improvement of the program.

The process for assessing student outcomes (MS and PhD) are outlined in **Table 1**. The specific outcomes that each assessment measures are also listed.

**Table 1.** Student outcomes assessment matrix.

| | **Outcome 1:** Conceiving, designing, analyzing, and implementing systems, processes and experiments related to improving human health and healthcare. | **Outcome 2:** Functioning in multidisciplinary teams to find effective solutions to complex technical problems and/or the design of new products and processes to improve human health and health care. | **Outcome 3:** Using modern analytical, simulation, and diagnostic tools and techniques used in healthcare industry. | **Outcome 4:** In-depth and up-to-date knowledge within a specialized field in Biomedical Engineering. | **Outcome 5:** An understanding of ethical and professional responsibility | **Outcome 6:** To effectively communicate their findings/ideas to a technical and non-technical audience |
|---|---|---|---|---|---|---|
| Graduating student cumulative GPA | | | | x | | |
| Annual student academic review | | | | x | | |
| Assessment of student performance in core graduate classes: **BMEG 5103** Design and Analysis of Experiments in Biomedical Research | x | | x | | | |
| Participation in graduate seminar | | | | | x | x |
| Comprehensive examination (MS non-thesis), Thesis (MS) Candidacy Exam (PhD) and Dissertation defense (PhD) | All outcomes | | | | | |
| Exit interviews | All outcomes | | | | | |
| Employment data | All outcomes | | | | | |

## PROGRAM ASSESSMENT RESULTS

### *1. Graduating student cumulative GPA (cGPA) – Outcome 4*

**Table 2** provides the results from all students graduating with a MS or PhD degree in the 2022-2023 academic year. The metric for success is for 100% of students to achieve at least a 3.0 cGPA. Based on the data below, we have achieved the stated criterion.

**Table 2.** Cumulative GPA for graduating BMEG students in AY2022-2023.

| Degree | Student Name | Graduating Term | cGPA |
|---|---|---|---|
| MS | Jacob Scluns | 1229 | 3.483 |
| MS (thesis) | Kathryn Priest | 1229 | 3.897 |
| MS (non-thesis) | Hailey Dirrigl | 1233 | 3.900 |
| MS (thesis) | Mackenzie Lewis | 1233 | 4.000 |
| MS (thesis) | Eric Ledieu | 1233 | 3.368 |
| PhD | Tai Huynh | 1233 | 3.870 |
| MS (thesis) | Sam Stephens | 1233 | 3.625 |

### *2. Annual student academic review – Outcome 4*

**Table 3** provides the results from the 2020-21 annual academic review. Students are required to annually get feedback from their major advisor with regard to their progress toward graduation. The graduate school form provides for a rating of satisfactory or unsatisfactory. The metric for success is for 90% of students to achieve at least a "satisfactory" outcome. Review of this year's data shows that all students are making satisfactory progress.

**Table 3.** Annual student academic reviews

| Academic Year | Number Satisfactory | Number Unsatisfactory |
|---|---|---|
| 2022-2023 | 42 | 0 |

### *3. Assessment of student performance in core graduate classes*

Student performance in the Core Graduate Classes as listed in Table 1 will be used to measure success in this particular assessment criterion. Each core class will be assessed via a specific assessment rubric compiled in **Appendix A** of this report.

### *3.1 BMEG 5103: Design and Analysis of Experiments in Biomedical Research – Outcome 1*

A single exam or homework problem was identified which requires the student to conceive, design, analyze and implement systems relating to human healthcare. The criteria for success in this metric was for 90% of the students to achieve a score of 70% or more. As per the results detailed in **Appendix A.1**, we have achieved this metric. Representative student reports for this specific metric are on file in the BMEG Department and can be made available upon request.

### *3.2 BMEG 5103: Design and Analysis of Experiments in Biomedical Research – Outcome 3*

A single exam or homework problem was identified which requires the student to use modern analytical, simulation, and diagnostic tools and techniques used in the healthcare industry. The criteria for success in this metric was for 90% of the students to achieve a score of 70% or more. As per the results detailed in **Appendix A.2**, we have not achieved this metric this year. Representative student reports for this specific metric are on file in the BMEG Department and can be made available upon request.

### *4. Participation in graduate seminar – Outcomes 5 and 6*

All BMEG graduate students are required to enroll in the BMEG5800/01 (Fall) and BMEG5810/11 (Spring) Graduate Seminar classes each semester, excluding the summer semester. Students are also required to give either a research presentation or a chalk-talk seminar once per academic year. This will ensure that MS students give at least 2 presentations, and PhD students will give at least 4 presentations prior to their graduation. In the 2022-2023 academic year, all graduate students have enrolled for the seminar class and have presented in-class at least once during the period of assessment.

### *5. Comprehensive examination (MS non-thesis), Thesis defense (MS thesis), Candidacy examination (PhD) and Dissertation defense (PhD) – All Outcomes*

The comprehensive exam (MS), candidacy exam (PhD) and dissertation defense (PhD) are key assessment metrics for a graduate student in the BMEG program. Students will graduate only if they pass these assessment points. These examinations are meant to test achievement of the student in all the Outcomes listed in **Table 1**. The MS thesis defense, PhD qualifying exam and PhD dissertation defense are assessed using grading rubrics available on file in the BMEG Department, and on the BMEG website.[2]

### *5.1 MS Comprehensive Examinations (Non-Thesis and Thesis)*

All students in the BMEG MS Program must pass a comprehensive examination. Students may retake a failed comprehensive exam once upon the approval of the student's Thesis Committee (for Thesis option) or Advisory Committee (for Non-thesis option). A student who fails the comprehensive examination twice will be terminated from the program. Under no circumstances will a student be allowed to take the comprehensive examination more than twice.

#### *5.1.1 MS Non-Thesis Comprehensive Examinations*

For the Non-thesis option, the comprehensive examination is an extensive written test of knowledge comprised of topics covered by the Biomedical Engineering Graduate Core courses. The comprehensive examination for the non-thesis option is administered by the Program Advisory Committee. **Table 4** compiles the list of students who have completed their MS Non-Thesis Comprehensive Exams.

**Table 4.** MS Non-Thesis Comprehensive Exam Results.

| Student Name | Term | Status |
|---|---|---|
| Hailey Dirrigl | 1233 | Pass |

[2] http://biomedical-engineering.uark.edu/academics/student-resources.php

### *5.1.2 MS Thesis Defense*

For the Thesis option, the comprehensive examination is an oral defense of the Master's thesis. The student is expected to demonstrate technical competence in the field directly related to the thesis research as well as a broader understanding of biomedical engineering research and the scientific method. The oral defense also assesses the student's ability to respond to questions in a rational, knowledgeable manner. The comprehensive examination for the Thesis option is administered by the Thesis Committee, and success of this metric is determined via an evaluation form. **Table 5** compiles the list of students who have completed their MS Thesis Defense.

**Table 5.** MS Thesis Defense Results.

| Student Name | Term | Status |
|---|---|---|
| Jacob Schluns | 1229 | Pass |
| Kathryn Priest | 1229 | Pass |
| Mackenzie Lewis | 1233 | Pass |
| Eric Ledieu | 1233 | Pass |

### *5.2 PhD Candidacy Examination*

The candidacy examination/dissertation proposal is the first step in meeting the dissertation requirement. The Ph.D. candidacy examination consists of both written and oral components not only covering general didactic knowledge in biomedical engineering but also measuring the student's potential preparedness in a narrowly focused area sufficient to propose a rigorous research plan. The written component is a proposal encompassing the student's dissertation research. The oral component is a presentation of the written proposal. The candidacy exam assesses the student's understanding of the proposed research area, and why the proposed research plan is the most appropriate and practical approach given the current state of scientific understanding and the available resources. The Advisory Committee will assess the student's preparedness for continuation in the doctoral program. Final approval of the proposal is given by the student's Program Advisory Committee. **Table 6** below gives a list of the PhD candidates who passed their candidacy exams this reporting year.

**Table 6.** PhD Candidacy Examination Results.

| Student Name | Term | Candidacy Status |
|---|---|---|
| April Jules | 1233 | Pass |
| Shelby Bess | 1233 | Pass |
| Tommaso Benigni | 1233 | Pass |
| Kaitlyn Elmer | 1233 | Pass |
| Angeline Rodriguez | 1229 | Pass |
| Wenbo Xu | 1229 | Pass |
| Emory Gregory | 1226 | Pass |

### *5.3 PhD Dissertation Defense*

The PhD Dissertation Defense is a written and oral presentation of the dissertation to the Dissertation Committee. The candidate is tasked with constructing a convincing scientific

argument which demonstrates: 1) the ability to clearly define a biomedical engineering research problem; 2) technical competency within his/her field; and 3) an understanding of the impact of the project relative to a broader scientific field. Success in this metric is determined by an evaluation form. **Table 7** below gives a list of the PhD candidates who passed their dissertation defense this reporting year.

**Table 7.** PhD Dissertation Defense Results.

| **Student Name** | **Term** | **Status** |
|---|---|---|
| Tai Huynh | 1233 | Pass |

### *6. Exit interviews – All Outcomes*

Exit interviews are typically conducted by the BMEG Department Head the semester of graduation. Exit interview data was not available for the graduating students.

### *7. Employment Data – All Outcomes*

Employment data for all students obtaining employment in this reporting period is compiled below. All but one of our graduating students were able to obtain gainful employment or continuation in professional/advanced degree programs within one month of graduation.

**Table 8.** Employment data for graduating students.

| Degree | Student Name | Graduating Term | Current Position, Employer |
|---|---|---|---|
| MS (non-thesis) | Hailey Dirrigl | 1233 | Engineering Intern, Lineus Medical |
| MS (thesis) | Sam Stephens | 1233 | Instructor, UARK |
| MS (thesis) | Jacob Schluns | 1233 | Quality Manager, Epic |
| MS (thesis) | Mackenzie Lewis | 1233 | BPD Rotational Associate Scientist, AstraZeneca |
| MS (thesis) | Kathryn Priest | 1229 | Sustaining Engineer, Exactech |
| PhD | Tai Huynh | 1233 | Post-Doc, US Army Institute of Surgical Research |
| PhD | Alan Woessner | 1223 | Imaging and Spectroscopy Core Manager; Microscopist, Arkansas Integrative Metabolic Research Center |
| PhD | Ishita Tandon | 1223 | Post-Doc, UARK |

# APPENDIX A.1 – BMEG 5103 ASSESSMENT RUBRIC (Outcome 1)

| BMEG Graduate Program Assessment | | | |
|---|---|---|---|
| ***Outcome: (1) Conceiving, designing, analyzing, and implementing systems, processes and experiments related to improving human health and healthcare.*** | | | |
| **Course Information** | | | |
| **Course Number** | **Course Title** | **Semester** | **Enrollment** |
| BMEG 5103 | Design and Analysis of Experiments | Spring 2023 | 10 |
| **Direct Measure of Student Achievement [Only BMEG graduate students]** | A course project was identified which requires the student to conceive, design, analyze and implement systems relating to human healthcare.<br><br>***Question (30pts):*** The purpose of this assignment is to analyze the types of statistical analyses that were performed during biomedical experiments using a review of published biomedical research. Namely, students identified a peer reviewed manuscript and described two different experiments with two different statistical analyses. The student then needed to design an experiment in the form of a homework problem that would utilize one of the statistical analyses presented and provide a solution (Assignment description and grading rubric attached) | | |

| Assessment | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Student** | **Score** | | **Student** | **Score** | | **Student** | **Score** |
| **1** | 28 | | | | | | |
| **2** | 29 | | | | | | |
| **3** | 28 | | | | | | |
| **4** | 30 | | | | | | |
| **5** | 30 | | | | | | |
| **6** | 27 | | | | | | |
| **7** | 27 | | | | | | |
| **8** | 27 | | | | | | |
| **9** | 27 | | | | | | |
| **10** | 29 | | | | | | |
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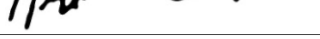
|---|---|---|---|
| ***Number obtaining 70% or more of total points*** | **10** | **Percent of students meeting criteria *(target: 90%)*** | **100%** |
| **Instructor:** | **Jeff Wolchok** |  | |
| | | *Signature* | |

## APPENDIX A.2 – BMEG 5103 ASSESSMENT RUBRIC (Outcome 2)

| BMEG Graduate Program Assessment | | | | | | | |
|---|---|---|---|---|---|---|---|
| ***Outcome: (3) Using modern analytical, simulation, and diagnostic tools and techniques used in healthcare industry.*** | | | | | | | |
| **Course Information** | | | | | | | |
| **Course Number** | **Course Title** | | | **Semester** | | **Enrollment** | |
| BMEG 5103 | Design and Analysis of Experiments | | | Spring 2023 | | 10 | |
| **Direct Measure of Student Achievement [Only BMEG graduate students]** | A homework assignment will be identified which requires the student to use modern analytical, simulation, and diagnostic tools and techniques used in the healthcare industry. (See attached homework – students use the statistical software package jmp to analyze the data) | | | | | | |
| **Assessment** | | | | | | | |
| **Student** | **Score (out of 10)** | | **Student** | **Score** | | **Student** | **Score** |
| **1** | 10 | | | | | | |
| **2** | 10 | | | | | | |
| **3** | 7 | | | | | | |
| **4** | 10 | | | | | | |
| **5** | 9 | | | | | | |
| **6** | 7 | | | | | | |
| **7** | 6 | | | | | | |
| **8** | 0 | | | | | | |
| **9** | 10 | | | | | | |
| **10** | 8 | | | | | | |
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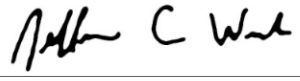
| ***Number obtaining 70% or more of total points*** | | **8** | | **Percent of students meeting criteria *(target: 90%)*** | | **80%** | |
| **Instructor:** | | Jeff Wolchok | |  | | | |
| | | | | *Signature* | | | |