Academic Assessment Plan

(M.S., Ph.D. / Microelectronics-Photonics)

Submitted by Rick Wise, Program Director
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Program Goals

1. Provide students with interdisciplinary education and training in engineering and science to meet the needs of emerging technology industries.

2. Place students in interdisciplinary groups performing rigorous and challenging research to prepare them for careers in industrial research teams, national labs, and academic positions.

3. Prepare students to be effective in technology management and entrepreneurship.

Student Learning Outcomes

1. Conduct independent investigations (M.S.) or define and explore new areas of research (Ph.D.) in an interdisciplinary environment, expanding the breadth and depth of state-of-the-art knowledge in the field of micro to nanoscale materials, processing, and devices.

2. Master knowledge, practices, and skills from traditional graduate level programs in Physics, Chemistry, Electrical Engineering, Chemical Engineering, Mechanical Engineering, Biological Engineering, and Biomedical Engineering, regardless of prior traditional educational background.

3. Communicate effectively deep level knowledge of their work to persons well-versed in their field, detailed technical concepts to persons with strong technical backgrounds outside of their field, and general concepts and applications to the general public.

4. Work efficiently in interdisciplinary team environments, fully supporting team goals through active membership or through team leadership as appropriate.

5. Implement intellectual property management and research commercialization processes, encouraging migration of ideas from formulation to societal benefit during their professional careers.

6. Execute duties found in entry-level professional positions with the operational skills equivalent to at least one year's experience in that position.

7. Embrace the role of citizen-scientist in both their professional and societal communities, utilizing their sound ethical and analytical backgrounds, to lead the discussions that will be needed to balance what can be done with what should be done.

Process for Assessing each Student Learning Outcome

1. **Ph.D. Candidacy Exam Process (Direct): This process addresses the Ph.D. level knowledge portion of outcomes 1 and 2, communications requirements of outcome 3, IP and the commercialization aspects of outcome 5, and professional behaviors found in outcomes 6 and 7. Assessment of the report year will begin on January 15th of the following year and results will be reported by May 1st.**

   The MicroEP Ph.D. candidacy process is in two parts which may be taken in either order. One part is a formal written research proposal 15 pages in length that is similar in nature to a NSF proposal. It is written in strong collaboration with the major professor, and must be presented and approved by the student's Ph.D. committee at the end of the formative stage of the research definition but well before the student is deep into the execution stage of the research. It is designed to assure that the field of the research is well understood by the student, that the proposed research topic has sufficient depth and breadth to demonstrate Ph.D. level professional work, and that the research has a reasonable chance of completion within four years after being accepted as a Ph.D. student after completion of a MS degree.

   The second part is a written exam with oral discussion taken by the student during prior to the start of the spring semester. This exam is a combination of a NSF solicitation and a Request for Quotation received by a technology-based company. Students are allowed access to any written information they wish to use, but they may not discuss the exam scenario or their work with any person. The student is limited to 15 pages, and the written document and the oral discussion are both evaluated by the same faculty panel. A student who fails the exam may take it one additional time during the same time the following year. This document is almost always the first complex problem assessment and development proposal written by the student, and provides very good information on how the student will perform in the types of assignments typically given in a professional position where a Ph.D. is the minimum education requirement for being hired. The exam is given to the students the week before the start of the spring semester.

2. **Curriculum and career advising each semester at pre-registration (Indirect): This process addresses outcomes 2, 4, and 6. Assessment of the report year will begin on January 15th of the following year and results will be reported by May 1st.**

This formal advising process gives an opportunity to discuss with the student such things as their academic performance in the prior semester, how they are working with their professor and their research group members, and what is affecting their ability to make satisfactory progress on their research. All students are advised by the MicroEP program director and co-advised by their major professor.

3. **Small Group Student Meetings (peer assessment and mentoring) (Indirect): This process addresses outcomes 3, 4, 6, and 7. Assessment of the report year will begin on January 15th of the following year and results will be reported by May 1st.**

   These peer mentoring groups are led by senior MicroEP students, and participation is required for all MicroEP students during their first two years in the program. The groups meet six times each fall and spring semester and focus on how to effectively communicate to other students that are not already familiar with the work. In this way, they practice communicating with young professionals unfamiliar with their field, and also have an opportunity to discuss operational problems with their peers and receive feedback on their way of handling the problems. They are also taught the use of MS Project.

4. **Use of Microsoft Project software (Indirect): This software usage addresses outcomes 4 and 6. Assessment of the report year will begin on January 15th of the following year and results will be reported by May 1st.**

   One large predictor of professional success is the ability to plan your work such that you have no downtime during the day. All students in their first two years must use Microsoft Project software for their research planning to help them learn the time management and project management practices they will need in their early careers.

5. **Research Communications Seminars (Indirect): This process addresses outcomes 3, 4, 6, and 7. Assessment of the report year will begin on January 15th of the following year and results will be reported by May 1st.**

   Monthly seminars are held to update the students on the MicroEP announcements, news, events, and recognition. Students in the first two years of the MicroEP program also present their research to their peers at these seminars. These one hour and 15 min seminars are held the first Monday evening of each month during the spring and fall semester. Attendance is required for all MS students in their first three semesters and all PhD students in their first five semesters.

6. **Small Group Leader meetings (Indirect): This process addresses outcomes 4, 6, and 7. Assessment of the report year will begin on January 15th of the following year and results will be reported by May 1st.**

   Senior MicroEP students that lead these small groups experience their first taste of administrative responsibility, performance assessment and feedback, and management team discussions as they

find common issues of concern from the different Small Groups. They have the responsibility to not only assess and prioritize common issues and the responsibility to propose and help implement program changes needed to address the issues. These meetings are facilitated by a MicroEP program associate director.

7. **Annual student performance reviews (Indirect): This process addresses outcomes 1, 2, 3, 4, and 6. Assessment of the report year will begin on January 15th of the following year and results will be reported by May 1st.**

An annual review process was established by the Graduate School several years ago that is designed to tell the student if they are making satisfactory research and academic progress toward their degree, or if they are not. The MicroEP grad program expanded the feedback forms significantly to allow the major professor to separately address the quantity and quality of a student's work in many different performance attributes including academic progress, interaction with professor, interaction with other students, laboratory work, research documentation, thesis/dissertation progress, and research planning. The student fills out a self-assessment and then brings that document with him/her to the meeting with the major professor, which gives the student practice in how to align their self-assessment of their work to their direct supervisor's assessment. All review forms are then reviewed by a MicroEP program associate director to both create a program wide composite view and to identify any students that need further program level performance review before the forms are forwarded to the Graduate School.

8. **Formal Exit Interviews with all graduates (Indirect): This process addresses all outcomes. Assessment of the report year will begin on January 15th of the following year and results will be reported by May 1st.**

While the MicroEP program receives student feedback through many channels, as a result of feedback from external reviewers during the first program review a formal exit interview policy was implemented and a script was created to help guide the interview. A MicroEP program associate director performs these exit interviews; then the forms are scanned and stored in both hardcopy and electronic forms.

9. **M.S. and early stage Ph.D. Research Document (Direct): This process addresses outcomes 1 and 3. Assessment of the report year will begin on January 15th of the following year and results will be reported by May 1st.**

All early stage MicroEP students are required to create a research description document to both help them fully understand their proposed research and to assist in communicating the goals and limits of their proposed research with their committee members. It is updated each semester with progress made and current issues hampering progress. When a Ph.D. student completes the Ph.D. Candidacy Research Proposal, this document is no longer required.

10. **Research Commercialization course MEPH 5383 (Indirect): This course addresses outcomes 3, 4, 5, and 7. Assessment of the report year will begin on January 15th of the following year and results will be reported by May 1st.**

This course, taught by the MicroEP program director, is a core requirement of both the MicroEP M.S. and Ph.D. curricula, and leads the student through the full process of commercialization of research. It is a team based course that requires development of a commercialization plan for an on-campus professor's research and extensive presentations on that work to the class.

11. **Operations Management seminar courses MEPH 5811/5911/6811/6911 and Proposal Writing course MEPH 5832 (Indirect): This five semester course sequence addresses outcomes 6 and 7. Assessment of the report year will begin on January 15th of the following year and results will be reported by May 1st.**

This is a required core course sequence for every MicroEP student, and is designed to introduce aspects of management of a technical group in a high tech workplace.

12. **Ethics course MEPH 5821 (Indirect): This course addresses outcome 7. Assessment of the report year will begin on January 15th of the following year and results will be reported by May 1st.**

This is a required core course, taught by the MicroEP program directo, for every MicroEP student, and is designed to prepare MicroEP graduates with discussions of alternative actions that may be taken in many typical ethically uncomfortable positions that may arise in the technology workplace.

13. **M.S. Thesis preparation and defense (Direct): This process addresses outcomes 1, 2, 3, and 5. Assessment of the report year will begin on January 15th of the following year and results will be reported by May 1st.**

The M.S. thesis work and documentation demonstrates both a student's skills and knowledge, and is often the first major professional work done by the student where he/she has the responsibility to both guide the work and overcome whatever obstacles arise. We see this as the demonstration vehicle of the student demonstrating through achievement that they are now professionals. The MicroEP program requires all Ph.D. path students that enter the MicroEP program after the B.S. degree to complete a thesis based M.S. MicroEP degree before being admitted as a Ph.D. student. The thesis is first used to assess a student's capability for independent work and analysis and then used as a career guidance tool. In this sense the M.S. thesis is part of the Ph.D. candidacy process as well.

14. **Ph.D. Dissertation preparation and defense (Direct): This process addresses outcomes 1, 2, 3, 4, 5, and 7. Assessment of the report year will begin on January 15th of the following year and results will be reported by May 1st.**

A student completing a Ph.D. dissertation has a responsibility to have created a new field of investigation, performed a meaningful investigation, performed analysis to tie current work to prior theory, examined the societal and commercial potential of their work, and found a way to communicate deep level knowledge in an understandable fashion to their committee and public.

15. **Industrial Advisory Board (IAB) (Indirect): This board meets annually and addresses outcomes 2, 3, and 7. Assessment of the report year will begin on January 15th of the following year and results will be reported by May 1st.**

The IAB is comprised of proven professionals in companies that have a strong interest in the MicroEP fields of research, including several early graduates from the MicroEP program. During its annual meeting it reviews program attributes and gives feedback on proposed changes, as well as having the authority to propose changes to the program from their own intuitions or observations. During the annual meeting selected students present their research in progress to the IAB and discuss the societal implications of their work with this group of outside professionals.

Timeline for Data Collection and Analysis

Collection, Analysis, and Reporting of Assessment Data	**(Program Director)**	**May 1**
Document Key Findings		**May 1**

Use of Results

- **Actions for MicroEP Management Team Approval**	**June 30**
- **Actions for MicroEP Graduate Studies Committee Approval**	**July 31**
- **Actions for MicroEP Graduate Faculty Approval**	**September 15**
- **Program review with Industrial Advisory Board**	**November 15**

In addition to the actions taken by these groups in response to the Academic Assessment report, other issues will be addressed as appropriate in a timely manner.