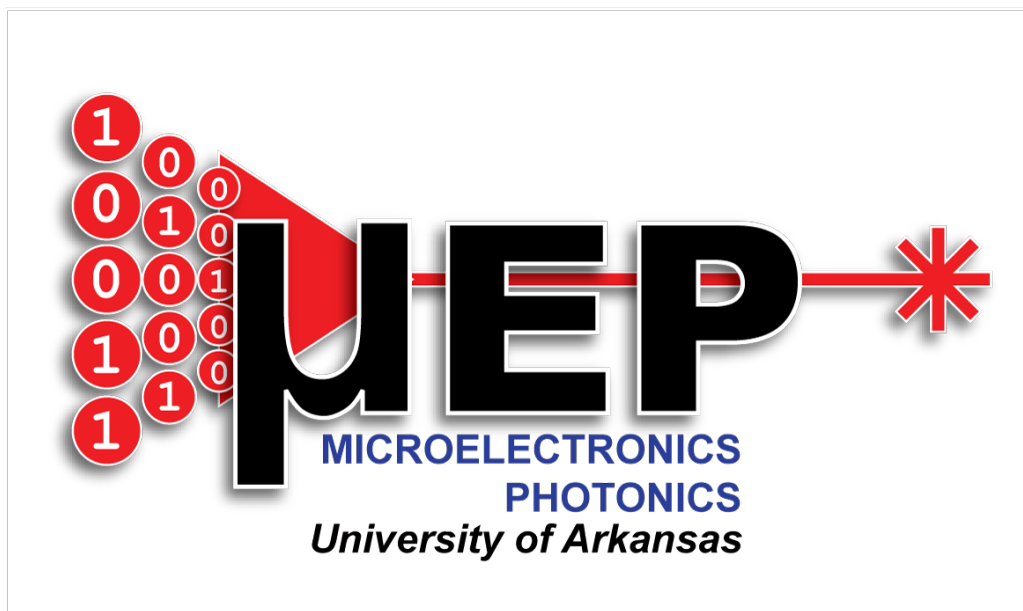


MICROELECTRONICS-PHOTONICS GRADUATE PROGRAM

GRADUATE STUDENT HANDBOOK

2017-2018

AUGUST 1, 2017



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INTRODUCTION

WELCOME

It is our sincere pleasure to welcome you to the Microelectronics-Photonics (μ EP) Graduate Program at the University of Arkansas. It is our goal to provide you with both state of the art academic instruction, and the organizational skills to fully utilize that instruction, that will allow you to excel in your professional career. We are your partner and take a personal responsibility to make your experience at the University one that you will not soon forget.

MISSION

The Microelectronics-Photonics program at the University of Arkansas, Fayetteville, is an interdisciplinary graduate program designed to expand a student's knowledge beyond the boundaries of traditional departmental based graduate programs. Students in the Microelectronics-Photonics program participate in cross-departmental research, take applications-intensive classes from multiple engineering and science departments, and develop workplace productivity skills in a simulated industrial environment.

The outcomes of our students' graduate education in this interdisciplinary environment are a better understanding of micro and nano scale materials and processing that result in high-performance, miniaturized devices; of the combination of these materials and devices into electronic, photonic, and chemical/biological systems; and the economics that affect successful introduction of these devices and systems into industry and the community.

PHILOSOPHY

The Microelectronics-Photonics program reports directly to Dean of the Graduate School of the University of Arkansas, but closely aligns its policies with the policies of both the Fulbright College of Arts and Sciences and the College of Engineering. The Arkansas Department of Higher Education approved the M.S. μ EP degree on July 23, 1999 for fall semester 1999 implementation, and the Ph.D. μ EP degree on July 26, 2000 for implementation in the Fall 2000 semester.

Traditional students in the M.S. μ EP program are required to complete an interdisciplinary research-thesis based degree, an external technical organization based research-project degree, or a non-research degree. The two research based degrees provide the base to continue toward the Ph.D., and the non-research is intended primarily to support non-traditional students with professional experience or students on career paths that do not directly involve research. All three degree paths require a mixture of physics/chemistry, engineering, technical elective, and business management classes; resulting in a degree that is highly marketable to career opportunities in the development and manufacturing of high tech materials and devices.

The program's faculty and post-doc staff voluntarily associate themselves with μ EP to better coordinate research and educational efforts in this field. The μ EP faculty members' home appointments are in the departments of Biological and Agricultural Engineering, Biology, BioMed Engineering, Chemical Engineering, Chemistry, Civil Engineering, Computer Systems Engineering, Electrical Engineering, Industrial Engineering, Management, Mechanical Engineering, and Physics. It is expected that students accepted into the μ EP program will begin working with the staff in their research laboratories shortly after their arrival at the University of Arkansas, Fayetteville.

UA GRADUATE SCHOOL CATALOG

This graduate handbook is designed to supplement the material found in the Catalog of the Graduate School of the University of Arkansas. The material found in this handbook is indicative of the current philosophy of the program, and may include changes that are being submitted into the UA approval cycle for publication in the next year's Graduate Catalog.

STUDENT RESPONSIBILITIES

Students wishing to enter the μ EP graduate program must first accept the responsibilities of becoming part of this student and faculty team. This mirrors the life one will face after graduation, when all privileges and benefits are firmly tied to different types of responsibilities that one must accept in order to gain the privileges.

In the case of the μ EP program, our students must first accept the types of responsibilities that are common to all graduate programs here at the University of Arkansas. These include such responsibilities as

- committing as much time to studies as are necessary to learn the academic materials presented to you,
- exceeding the minimum moral and ethical behaviors defined by the University,
- maintaining the minimum requirements on cumulative grade point average (CGPA),
- giving your employer (whether working as teaching assistant, graduate assistant, work study, or outside the University) a full measure of work for every hour you are paid, and
- treating all others you contact with the respect and professionalism that you desire from others toward yourself.

In addition, the μ EP program requires our students to accept additional responsibilities in return for the extra resources and training this program provides them. These μ EP specific responsibilities include

- enthusiastically participating in all non-academic training events scheduled by the μ EP graduate program,
- actively learning about your μ EP colleagues not only as classmates but also as people,
- embracing the concept that none of us are successful in our academic endeavors unless all of our colleagues also reach their full academic potential,
- providing tutoring and other support to your colleagues as needed,
- trusting your colleagues enough to ask for help if you are facing trouble in an academic arena,
- providing the μ EP management with constructive criticism toward improving the program, and
- adding your energy to define and implement needed program changes.

The μ EP program does not exist just to provide you with a series of courses to increase your knowledge. The μ EP program exists to help you mature into a highly skilled professional, one who will have not only an extensive knowledge set upon graduation but also the organizational skills needed to effectively utilize this knowledge set early in your career.

STUDENT OBLIGATIONS

Communications requirements:

1. Attend weekly μ EP operations seminar meetings (MEPH 5811/5911/6811/6911)
2. Attend μ EP student public presentations prior to their thesis/dissertation defense
3. Attend μ EP summer camp the week before start of classes in the fall
4. Attend μ EP supplemental training activities as scheduled
5. Check "name"@uark.edu email once per day for program communications
6. Empty mailbox in μ EP office once per week
7. Attend and present research summaries at small project group meetings (approximately six per semester)
8. Attend all μ EP monthly Research Communication Seminars (MEPH 5611/6611).

Proficiency to be demonstrated in following software packages:

1. Microsoft Project
2. Microsoft Word for Windows
3. Microsoft Excel
4. Microsoft PowerPoint (to be used for all student presentations unless another software product is required by a specific course instructor)

μ EP Documentation requirements:

1. Required for MEPH 5811, 5911, 6811, and 6911 enrolled students, highly recommended for all students:
 - a) One page resume with attached list of all publications published, submitted and planned and all conferences attended (updated first full week of September and February). PhD students who have completed candidacy should submit a full CV.
 - b) Research document between student, major professor, and μ EP assistant director (updated first full week of September and February. Not required during the first semester of a degree program.) See an outline at <http://microep.uark.edu/>.
 - c) Research path defined in Microsoft Project (updated monthly as described in project document. Not required during the first full month of a degree program.)
2. Required for all MEPH students:
 - a) Curriculum/degree plan (updated each semester as part of advising cycle, and required before enrollment for the following semester).
 - b) The degree plan must be reviewed with, and signed by, your major professor and returned to the μ EP office as well as any other required documents in order for your advising hold to be released.
 - c) Research Quad Slide summarizing your MS or PhD research updated each fall/spring semester beginning with your second semester in the program. The slide will be posted to the μ EP website and must be approved by your major professor. The format must strictly follow the template provided by the μ EP program. An example quad slide may be found at the end of this handbook.

Graduate School Documentation requirements:

The Graduate School requires different forms as spelled out in the Graduate School Handbook.

Typing skills:

Technology based careers involve intense written communication in order to be effective. The μ EP program strongly encourages all of its students to quickly increase their level of typing to the level of at least 45 words per minute, using any of the free typing tutorial programs available through the internet.

MICROELECTRONICS-PHOTONICS GRIEVANCE PROCEDURES

The Graduate School handbook defines grievance procedures for students. An academic grievance means a dispute concerning some aspect of academic involvement arising from an administrative or faculty decision which the graduate student claims is unjust or is in violation of his or her rights.

In the event of a disagreement, μ EP students are requested to follow an orderly procedure with the goal of timely and efficient problem resolution. Disagreements or issues should first be openly discussed with the faculty member or administrative person whom the student believes has caused an unjust act. It is anticipated that most problems can be resolved by open communication guided by mutual respect.

In the event that a problem cannot be resolved between the student and the person or persons at the source of the disagreement, the student should discuss the matter with the Director of the μ EP graduate program. If the problem still cannot be resolved at this level, the student should request that the matter be reviewed and considered by the Graduate Studies Committee of the μ EP Graduate Program (GSCMEP).

If the problem or disagreement is with the Director of the μ EP program, the student may choose to meet with the academic dean or the Graduate dean for a possible informal resolution of the matter.

A student has the right to file a formal grievance as defined in the Graduate School catalog at any time, and the program fully supports the use of this formal process by our students. However, μ EP students should recognize that the informal approach described above is aligned with the formal grievance procedure's initial steps.

In addition, μ EP Graduate Students may contact the University of Arkansas Office of Student Mediation and Conflict Resolution for advice on any issue that is negatively affecting their academic success. The web site for this office is <http://ethics.uark.edu>, and the telephone number is (479) 575-5170.

ACADEMIC HONESTY AND PLAGIARISM

Honesty in all things is a core value of the μ EP Graduate Program. All μ EP students are not only expected to display the highest level of personal honesty in their own actions, but also to stop - by whatever means necessary - any dishonesty they observe in the University environment.

Any act of academic dishonesty of any kind by a μ EP student ***may result in immediate expulsion from the μ EP Graduate Program.*** There is no tolerance on this issue, so do not put yourself in the position of trying to explain why you did something that you know is clearly wrong.

UA overview from the office of the Provost:

As a core part of its mission, the University of Arkansas provides students with the opportunity to further their educational goals through programs of study and research in an environment that promotes freedom of inquiry and academic responsibility. Accomplishing this mission is only possible when intellectual honesty and individual integrity prevail.

Each University of Arkansas student is required to be familiar with and abide by the University's 'Academic Integrity Policy' which may be found at honesty.uark.edu/policy. Students with questions about how these policies apply to a particular course or assignment should immediately contact their instructor.

The μ EP program fully supports this policy enforcement. You should read all the information in the link as these policies define what will happen in any case of academic dishonesty.

It is the responsibility of every μ EP Graduate Student to fully familiarize themselves with these documents. **Lack of knowledge of these policies will not be grounds for appeal of any sanction imposed as the result of violations of these policies.**

The μ EP Graduate Program does consider any kind of copyright infringement to be no different than theft, and as serious as cheating or plagiarism. This includes (but is not limited to) the use of pirated software to meet your academic assignments and the copying of textbooks (except in very rare and very limited special circumstances).

PLAGIARISM

It has been noted that incoming students may believe that portions of another person's work can be pasted into a document and sufficiently modified to make it non-plagiarized. This shows up most often in the first chapter of theses and dissertations when prior work and current state of the art are being discussed.

Please be clear on one point – each person writes in their own voice, which includes the choice of words and the manner in which words are placed. **YOU CANNOT MODIFY PRIOR WRITTEN TEXT ENOUGH TO MAKE IT NON-PLAGIARIZED!**

The advice of the μ EP Graduate Program is to always start from a blank page to write down the knowledge you have gained from reading other sources. These sources will be cited as your references attached to that section of your work.

If you feel that you must use someone else's exact words, either for clarity or because the original author's words may be used to emphasize a point, then use the following format:

"You will note that the quotation is separated into a stand-alone paragraph that is not only contained in quotation marks, but is also indented a quarter inch more on both sides and put into italics. The reference

*number after the quotes is bogus in this case, but if this handbook contained reference footnotes it would say
Private Communication from Rick Wise.”¹*

ACADEMIC HONESTY AND PLAGIARISM (CONTINUED)

All μEP students working on a candidacy exam, thesis, or dissertation will be given access to self-submit their document to the web site <http://www.turnitin.com/> if they wish to confirm that their document does not contain inadvertent plagiarism. The final submitted document will also be submitted by the μEP program to this or other plagiarism sites before being accepted for its intended academic purpose.

It should be noted that any and/or all documents submitted by μEP students as part of their academic work may be submitted to plagiarism sites for review without prior notification beyond that of this handbook. Any work submitted will be edited to protect the identity of the student whose work is being submitted per UA policies and procedures.

Any document found to contain plagiarized material will be reported per the UA Academic Honesty Policy and the defined response under the Sanctions Rubric will be fully implemented.

ANNUAL ACADEMIC REVIEW POLICY

Microelectronics-Photonics graduate students are required to participate in an annual review of academic progress. Such review will be conducted as a face-to-face interview between the student and the Major Professor. At a minimum, the review will cover progress in completing courses with an adequate grade point, in completing all required examinations, in completing the thesis/dissertation/project requirements, and towards completing any other requirements for the degree as listed in the handbook. Reviews will be completed in February of each year, reflecting performance over the prior calendar year, but no more than thirteen (13) months may lapse between successive reviews. Any student that fails to arrange for and complete an annual review will not be allowed to enroll in courses in the following semester. μ EP students who begin their graduate program in January will complete their first annual review the following February.

It is the student's responsibility to self-assess their performance using the third page of the μ EP annual review form prior to meeting with the Major Professor. Any significant differences between the student's self-assessment and the professor's assessment should be the focus of the discussion during the review.

Both the graduate student and the Major Professor will sign the documented outcome of the annual review. This document will then be submitted to the Microelectronics-Photonics review coordinator for approval. If the student is judged to be making neither ordinary nor adequate progress toward the degree, then a written explanation will be included with the documentation, along with planned corrective actions. The μ EP Program Director is required to review and approve any identified corrective actions. In the event that planned corrective actions are not deemed to be adequate, then the student will be removed from the program.

MICROELECTRONICS-PHOTONICS PROGRAM FEEDBACK

All students of the μ EP Graduate Program may be asked to voluntarily participate in an evaluation process to better understand the effectiveness of the training provided to μ EP students. All μ EP students are asked to supply demographic and personal information that is used for external reporting requests to appropriate state and federal agencies.

Student privacy is maintained during any evaluation process by the work being conducted by educational researchers outside of the μ EP graduate faculty. Prior researchers include Dr. Ronna Turner of the College of Education and Health Professions (Office of Research, Measurement, and Evaluation) and Dr. Douglas Adams of the Fulbright College of Arts and Sciences (Sociology)

Any participant's results are provided to the student for their benefit, allowing them to better understand their learning styles and how these styles can affect their academic success. The results also help students better understand their personality type and their style of interaction with other students and faculty. The μ EP program management and faculty receive only composite scores from the educational researchers (no specific information concerning a current student participating in any voluntary study is provided).

Participation in any evaluation process or demographic/personal data accumulation is completely voluntary and does not affect in any way students' standing in the program or their academic careers. The μ EP program management team does deeply appreciate each student that participates in these efforts, as this data supply the program with the quickest feedback on how the μ EP educational elements are affecting our students.

Any student wishing further information on any μ EP data request or evaluation process management is encouraged to contact one of the educational researchers through any of the following channels:

Dr. Doug Adams
Dr. Patricia Koski

(479) 575-7440
(479) 575-4401

djadams@uark.edu
pkoski@uark.edu

FUNDING OPPORTUNITIES – GRADUATE ASSISTANTSHIPS

There are two types of Graduate Assistantships, Teaching and Research. If you are on a 50% appointment (requiring 20 hours per week of work) then you are considered an in-state student for purposes of tuition assessment, and the fund that pays your stipend will also pay that in-state. If you are on 25% appointment (10 hours per week of work), you are considered an in-state student for purposes of tuition assessment, which you will pay from your own funds.

Regardless of the type of Graduate Assistantship that you may receive, all students must pay all supplemental fees themselves.

Teaching Assistantships require that a student be competent in both written and spoken English. Students who graduate from an undergraduate institution where English was not the language of instruction must demonstrate competency in written and spoken English before they can be considered for positions requiring live instruction (such as being an undergraduate lab class instructor). See the Graduate Catalog for methods to prove this written and spoken English competency.

The μ EP Graduate Program is very entrepreneurial in working with our admitted students to help them identify and then compete successfully to win funding opportunities. Over 95% of our students have secured funding for their degrees within a year of their arrival on campus, but the μ EP program cannot guarantee funding for any student. That is because selections to new positions most strongly depend on the reputation you build as a student in our classes and on your research skills you display in working on your research project. Most of our students who are selected for Teaching Assistantships win those positions because they have taken the financial risk to come here for their education and proven themselves, and the positions most frequently open in the last three weeks before the start of the next semester. μ EP graduate students have worked as TAs for Physics, Chemistry, EE, ChE, and μ EP, depending on the background of the individual student. TAs are generally paid about \$1000 - \$1700 per month, depending on the department in which the TA is located.

Individual professors, through research grants that they win in the highly competitive marketplace, directly fund Research Assistantships. Students are selected directly by these professors to work on the specific research projects supported by these funded grants. A student hired by a professor in a RA position is expected to align his or her own research (in support of their thesis or dissertation) with the research of their hiring Professor. In a typical workweek, the student would do 20 hours of work directed by his or her major professor and then do additional research in the professor's laboratory in support of their thesis/dissertation. In this way, both the professor and the student make progress toward their common research goal in a shorter calendar period than would otherwise be possible.

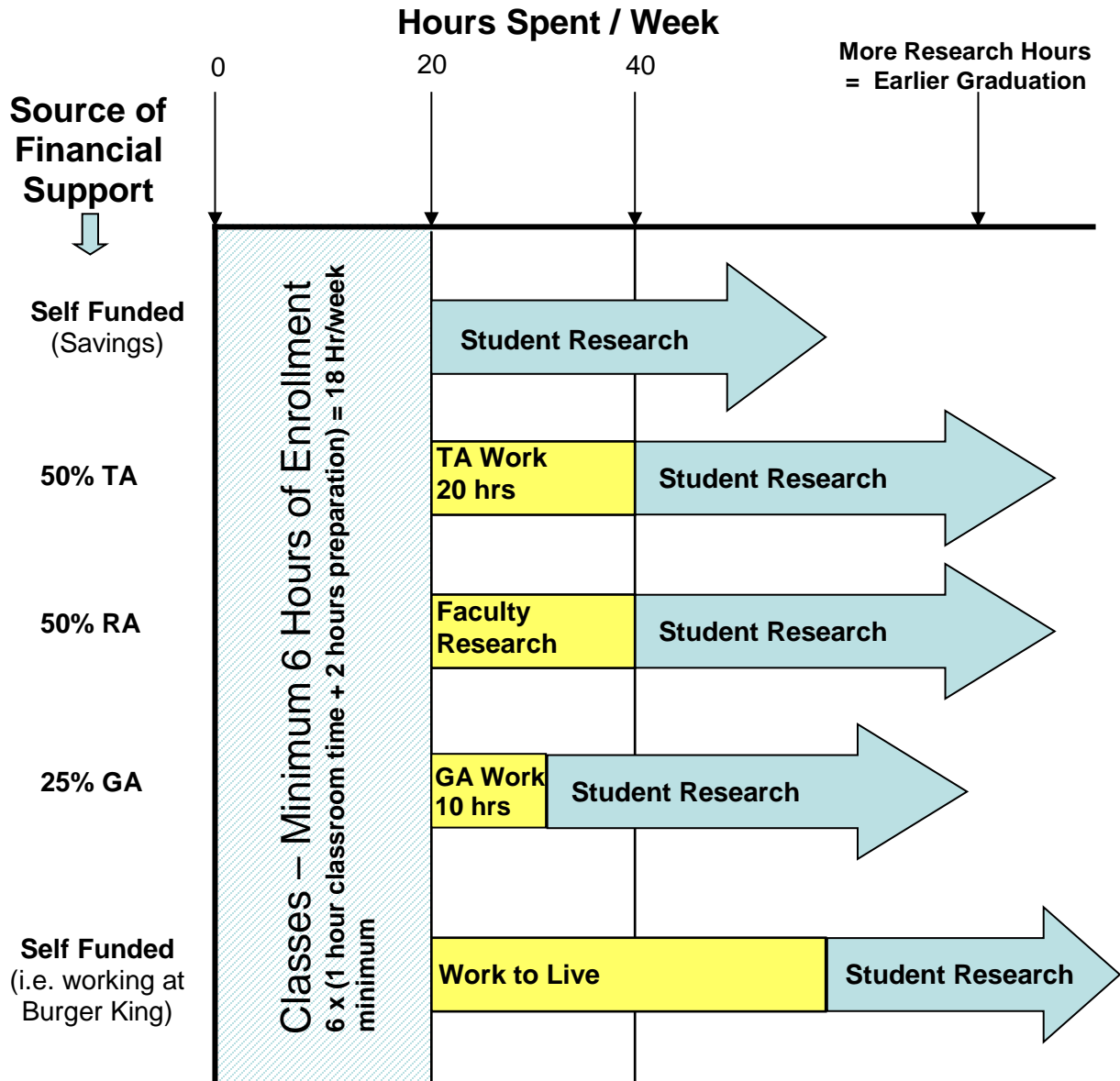
Research Assistantships generally pay about the same as a TA in that professor's department, although individual researchers may budget higher stipends in their proposals in an attempt to attract top graduate students.

The μ EP Graduate Program acts as an agent for μ EP students to match their talents and interests with RA and TA positions as they become available. TA positions most often are open for the fall semester, although some TA positions become open in the spring and summer semesters as students move into RA positions. RA positions may open at any time, both from current students graduating and from new research grants being approved for funding.

As an agent for both μ EP students and faculty, the μ EP director uses knowledge of both the open positions' requirements and μ EP students' skills to quickly arrange job interviews that seem likely to produce strong partnerships. It must be noted that these interviews are very similar to job interviews after graduation – they are only opportunities to compete, not guarantees of being given the new funded position. For a μ EP student to win an appointment, the student must convince the hiring supervisor that they can together form an effective partnership that will result in the goals of both parties being met.

FUNDING OPPORTUNITIES GRADUATE ASSISTANTSHIPS (CONTINUED)

Students can win funded TA or RA positions before arriving on campus on the basis of such things as their academic record, their GRE scores, their record of prior research, and strong recommendations from faculty. However, the chances of a new student competing successfully for new positions are much higher if the new student is already on our campus, taking UA graduate classes and volunteering in a research laboratory under a professor whose research matches their own interests. The fact that UA professors can directly observe the work ethic and academic capabilities of an on-campus student gives that student a distinct advantage over off-campus students who are represented only by paperwork.



Funding for your graduate work is a job, not a gift. The μ EP program expects its students to set the standard in providing value far in excess of the salary received.

FUNDING OPPORTUNITIES – FELLOWSHIPS

Fellowships are grants to a student to support their educational process. These types of grants typically are not tied to a particular professor, and may or may not have specific task requirements associated with them. As an example, one Fellowship may require specific work hours partnered with a teacher in a 6th grade classroom but a Distinguished Doctoral Fellowship has no specific tasks assigned outside of academic and research excellence.

Fellowship checks are issued at the start of an academic period, either monthly or by semester.

University of Arkansas Fellowships:

<http://graduate-recruitment.uark.edu/funding-degree/fellowships.php>

The μ EP web site contains links to many different sources of Fellowships and Assistantships. Students are encouraged to take an entrepreneurial approach to both competing for existing funded positions as well as to work with faculty to write new research proposals that contain new RA positions for their continued educational support.

FACULTY OF THE MICROEP GRADUATE PROGRAM

Faculty of the μ EP graduate program are appointed to traditional departments, but have chosen to self-associate with other faculty pursuing research and education in the field of microelectronic and photonic materials and devices.

New faculty members can be added to the μ EP faculty list upon their request if they (1) agree to support a μ EP graduate student as a research professor, (2) support a μ EP graduate student as a member of an advisory or research committee, or (3) agree to actively participate in normal academic responsibilities associated with the management of a degree granting program at the University of Arkansas. Current faculty members of the μ EP Graduate Program are:

Biological and Agricultural Engineering	Jin-Woo Kim Yanbin Li	
Biomedical Engineering	Morten Jensen	Timothy Muldoon
Chemical Engineering	Robert Beitle Jamie Hestekin Keith Roper Shannon Servoss	
Chemistry and Biochemistry	Jingyi Chen Robert Coridan Ingrid Fritsch Member, GSCMEP Colin Heyes Mahmoud Moradi Julie Stenken Zhengrong (Ryan) Tian Jie Xiao	
Civil Engineering	Paneer Selvam	GSCMEP, Asst. Director, μ EP
Computer Science	Jia Di	
Electrical Engineering	Simon Ang Juan Balda Zhong Chen Magda El-Shenawee David Huitink Omar Manasreh Alan Mantooth	Roy McCann Hameed Naseem Errol Porter Morgan Ware Fisher Yu
Industrial Engineering	Ed Pohl	
Mechanical Engineering	Adam Huang Ajay Malshe Paul Millett Arun K Nair Steve Tung Member, GSCMEP	Uche Wejinya Wenchao Zhou Min Zou
Microelectronics-Photonics	Russell DePriest Alex Lostetter (adjunct)	GSCMEP, Adj. Asst. Director, μ EP
Nano Institute	Mourad Benamara	Yuriy Mazur
Physics	Radwan Al-Faouri Laurent Bellaiche Hugh Churchill Huaxiang Fu Bill Harter Joe Herzog Pradeep Kumar Jiali Li Lin Oliver Member, GSCMEP Rick Wise Director, μ EP	Salvador Barraza-Lopez Bothina Manasreh Greg Salamo Woodrow Shew Surendra Singh Ken Vickers (adjunct) Yong Wang Min Xiao

MICROELECTRONICS-PHOTONICS CURRICULUM OVERVIEW

OVERVIEW

The definition of a μ EP student's curriculum can vary dramatically within the μ EP field. Analogies of this are obvious in most traditional engineering and science departments, where students all receive a "department" degree despite significant differences in educational content of the graduate degree plan.

The Graduate Studies Committee of the Microelectronics-Photonics program (GSCMEP) believes that significant organizational and student career preparation benefits arise by requiring students to create an integrated materials/fabrication knowledge base in an application area of interest. The curriculum plan described below is designed to help the students achieve this goal.

Courses that have previously been accepted as appropriate in prior μ EP students' curricula are found in the course listing section. Each course was placed in the curriculum type that appears to be most appropriate for the course material.

Please note that this listing is included for illustrative purposes and is not meant to exclude any course considered appropriate by a student's graduate committee. However, courses not included in the list may not be allowed for use to meet the curricula content guidelines below unless specifically approved during the advising process.

CURRICULUM CONTENT

The program is built on the proposition that μ EP students must have an academic exposure to a wide variety of subjects at both the M.S. and Ph.D. level, while building deep level knowledge in an area supportive of their career objectives. Each student is expected to build a curriculum that creates a deeper area of knowledge in a technology area, including courses in materials, fabrication theory, fabrication practice, and management of technology.

The minimum number of courses needed to meet μ EP program requirements for diversity among areas of emphasis is summarized in the following list:

1. Semiconductor device theory (ELEG 5203 SC Devices required for all students)
2. Materials at the micro and nano scale (One course from that course list required for all students)
3. Micro or nano scale fabrication theory (One course from that course list required for all students)
4. Micro or nano scale fabrication practice (One course from that course list recommended for all students)
5. Management skills in technology based careers (MEPH 5811/5911/6811/6911/5821/5832 required for all students).
6. Intra/entrepreneurial skills in high technology environments (MEPH 5383 Commercialization of Research required for all students)
7. Research Communication Seminar, MEPH 5611 at the M.S. level or MEPH 6611 at the Ph.D. level. A Student will register for this seminar course during his or her third semester as a M.S. student, or during the fifth semester if a Ph.D. student. However, the seminar grading accumulates from the first semester of the M.S. or Ph.D. program enrollment.

Each M.S. student must take at least two appropriate courses from the Fulbright College of Arts and Sciences, one management of technology course, and at least three courses from the College of Engineering.

MICROELECTRONICS-PHOTONICS CURRICULUM OVERVIEW (CONTINUED)

All μ EP students must enroll in a MEPH one semester-hour course each semester as part of the program emphasis on organizational training during the first two years of their enrollment. The enrollment sequence is as follows:

1 st Fall	MEPH 5811	Op Mgmt: Infrastructure Mgmt	2 nd Fall	MEPH 6811	Op Mgmt: Mgmt and Leadership I
1 st Spring	MEPH 5911	Op Mgmt: Personnel Mgmt	2 nd Spring	MEPH 6911	Op Mgmt: Mgmt and Leadership II
1 st Summer	MEPH 5821	Ethics	2 nd Summer	MEPH 5832	Proposal Writing

Students who begin their graduate studies at the University of Arkansas during the spring semester will be required to take MEPH 5811 in the fall semester following their completion of MEPH 6911 or to take MEPH 5811 concurrently with MEPH 6811.

Ph.D. μ EP students must achieve in their M.S./Ph.D. total curriculum plan the same level of academic diversity and other skills required of M.S. μ EP graduates. The curriculum for both M.S. and Ph.D. degrees are fully described in following sections of this handbook.

A minimum cumulative GPA of 2.85 is required to remain enrolled in the Graduate School. At this time the μ EP Graduate Program has no additional requirements on minimum GPA.

FURTHER DETAIL ON RESEARCH COMMUNICATIONS SEMINAR (MEPH 5611/6611)

One of the foundations of the μ EP program is that students form a partnership with each other and with the μ EP faculty that benefits all parties. As part of this collaboration building process, the program has established a monthly (usually 9 meetings per academic year) seminar that allows a student who is nearing completion of a degree to present both the status of the research and demonstrate how the project planning built into the μ EP curriculum has helped to minimize downtime and maximize research productivity. The participation of all μ EP students in this seminar has the following benefits:

- Students are exposed to the research activities occurring around them.
- Faculty members that advise the presenters are provided with a forum for “cross pollination” of research ideas between the groups that make up the μ EP center.
- Student presenters are given an opportunity to utilize public speaking and presentation skills that will be vital in the workplace.

The format of the monthly presentations is determined by the leaders of the small project groups, with each month’s presentations made by the members of one small project group.

Research Communications Seminar (MEPH 5611/6611) is a PASS/FAIL course that has the following requirement: 100% attendance of the monthly seminars will result in a course grade of “A”, while anything less will be given a course grade of “F”. In the event a student cannot attain a 100% attendance, here are the remediation opportunities available to the student:

- For an absence with prior approval, the student must attend **1** public presentation or defense for a MicroEP student.
- For an absence without prior approval, the student must attend **2** public presentations or defenses for a MicroEP student.

MICROELECTRONICS-PHOTONICS CURRICULUM OVERVIEW (CONTINUED)

It is the hope of the program management team that these monthly presentations foster additional collaborations between research groups. In addition, public speaking in a “friendly” atmosphere can reduce the stress that a student may feel during a thesis/dissertation defense that will be occurring shortly after his or her monthly seminar. Special Note: Non-Traditional students who are working in full time jobs are encouraged, but not required, to attend these seminars.

FURTHER DETAIL ON RESEARCH SUMMARIES DURING SMALL PROJECT GROUP MEETINGS

At the beginning of each academic year (Fall semester), the μ EP management team will divide the “early career” cohorts into small groups that will function as workgroups or project teams. Each of the workgroups will be under the leadership of an experienced μ EP student. Typically, these leaders are M.S. or Ph.D. candidates nearing the completion of their research and degree requirements. Early in each semester, the group leaders will schedule approximately six meetings that will take place during the semester. Attendance at these scheduled meetings is mandatory and is part of the course requirements for MEPH 5811/5911/6811/6911 (further details are found in the syllabi for these courses).

The μ EP management team views the structure of these workgroups as analogous to a diverse team in industry comprised of technologists and project leaders reporting to a single technical section manager. The focus of these meetings is to provide peer review and feedback on each group member’s research plan (as shown using Microsoft Project) and the execution of the research to that plan.

MICROELECTRONICS-PHOTONICS LISTING OF TYPICAL COURSES

MATERIALS (REQUIRED TO PICK AT LEAST ONE COURSE FROM LIST)

ELEG	5363	Semiconductor Material and Device Characterization
ELEG	5323	Semiconductor Nanostructures I
MEEG	4023	Composite Materials-Analysis and Design (Irregular)
MEEG	4303	Materials Laboratory (Irregular)
MEEG	5263	Intro to MEMS
MEEG	5333	Intro to Tribology
MEPH	5713	Advanced Nanomaterial Chemistry
PHYS	5413	Quantum Mechanics I
PHYS	5713	Condensed Matter Physics I
PHYS	5723	Physics at the Nanoscale
PHYS	5734	Laser Physics
PHYS	5753	Applied Nonlinear Optics
PHYS	5773	Introduction to Optical Properties of Materials
PHYS	6613	Quantum Optics
PHYS	6713	Condensed Matter Physics II
BMEG	5313	Advanced Biomaterials and Biocompatibility

FABRICATION THEORY (REQUIRED TO PICK AT LEAST ONE COURSE FROM LIST)

ELEG	5213	Integrated Circuit Fabrication Technology
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ELEG	5273	Electronic Packaging
MEEG	5273	

FABRICATION PRACTICE (RECOMMENDED TO PICK AT LEAST ONE COURSE FROM LIST)

ELEG	5223	Design and Processing of Solar Cells
ELEG	5293L	Integrated Circuit Fabrication Laboratory
ELEG	5243L	Microelectronic Fabrication Techniques and Procedures (HiDEC)
MEPH	5733L	Fabrication at the Nanoscale

GRADUATE COURSES OF INTEREST FOR ENGLISH AS SECOND LANGUAGE STUDENTS

ELAC 5050 International Graduate Teaching Assistants Training

Course Description: To prepare international graduate assistants to assist or teach in U.S. university classes. The course focuses on enhancing teaching and communication skills, and cultural knowledge. Students are non-native speakers of English who currently have a teaching assistantship or plan to obtain one in the following semester. Not for degree credit.

ELAC 2053 Academic Presentations

Course Description: For advanced non-native speakers of English to build skills and strategies for delivering effective, clear presentations in academic and professional settings. Students learn about organization, best use of visual aids, connecting with an audience, facilitating questions and answers, and intercultural issues that affect perception and comprehensibility.

ELAC 2012 English Phonology for Non-Native Speakers

Course Description: In this course students study the basic principles of phonetics and phonology of English in order to develop their ability to produce the standard American accents

MICROELECTRONICS-PHOTONICS LISTING OF TYPICAL COURSES

APPLICATIONS

BENG	4123	Biosensors and Bioinstrumentation
BENG	5743	Biotechnology Engineering

BENG	5253	Bio-MEMS
MEEG	5253	

CHEM	5283	Energy Conversion and Storage
ELEG	4213	MEMS and Microsensors
ELEG	4253	Nanotechnology (Irregular)
ELEG	4303	Introduction to Nanomaterials and Devices (Irregular)
ELEG	5203	Semiconductor Devices (Required)
ELEG	5313	Power Semiconductor Devices
ELEG	5333	Semiconductor Nanostructures II
ELEG	5353	Semiconductor Optoelectronic Devices
ELEG	5923	Introduction to Integrated Circuit Design
ELEG	5993	Mixed-Signal Modeling & Simulation
ELEG	5703	RF and Microwave Design
ELEG	5723	Advanced Microwave Design
ELEG	5773	Electronic Response of Biological Tissues
PHYS	5763	Experimental Methods for Nanoscience
MEPH	5742	Transmission Electron Microscopy Theory and Operation

MANAGEMENT OF TECHNOLOGY AREA OF EMPHASIS

NOTE: See Graduate Catalog for Graduate Certificates in Entrepreneurship and in Management

CHEG	5033	Technical Administration
INEG	4423	Advanced Engineering Economy
INEG	4433	System Engineering Management
MEEG	591(3)	Nano Manufacturing Innovation
MEPH	5253	Emerging Technologies In Industry
MEPH	626(V)	Emerging Technologies In Industry Practicum
MEPH	5393	Product Development Process (Non-Thesis MS Only)
**MEPH	5383	Research Commercialization and Product Development
*GRSD	5033	The Professoriate: Research and Service
*GRSD	5003	The Professor's Role in Higher Education

* May be substituted for other required courses with permission if career focus is a professorial position.

** Not required if Graduate Certificate in Entrepreneurship in approved degree plan.

MICROELECTRONICS-PHOTONICS LISTING OF TYPICAL COURSES

OPERATIONS MANAGEMENT:

MEPH	5811	Operations Management: Infrastructure Management – 1 st year fall semester (Required of all μ EP students)
MEPH	5911	Operations Management: Personnel Management – 1 st year spring semester (Required of all μ EP students)
MEPH	6811	Operations Management: Management and Leadership I – 2 nd year fall semester (Required of all μ EP students)
MEPH	6911	Operations Management: Management and Leadership II – 2 nd year spring semester (Required of all μ EP students)
MEPH	5611	Research Communications Seminar (third semester of M.S. program)
MEPH	6611	Research Communications Seminar (fifth semester of Ph.D. program)
MEPH	5821	Ethics for Scientists and Engineers (Required of all μ EP students)
MEPH	5832	Proposal Writing and Management (Required of all μ EP students)

OTHER ELECTIVE COURSES (WITH COMMITTEE APPROVAL)

BENG	5103	Advanced Instrumentation in Biological Engineering
BENG	5703	Design and Analysis of Exp for Eng Research
CHEM	4213	Instrumental Analysis
CHEM	5223	Chemical Instrumentation
ELEG	587(3)	Engineering Technical Writing
CVEG	563(3)	Design of Experiment (Special Problem)
INEG	5333	Design of Industrial Experiments
MEPH	587V	Special Topic – Regular Classroom Schedule
MEPH	588V	Special Problem – Self Study on Narrow Topic
MEEG	4703	Mathematical Methods in Engineering
PHYS	5073	Mathematical Methods for Electromagnetics
PHYS	5313	Advanced Electromagnetic Theory I
PHYS	5323	Advanced Electromagnetic Theory II
PHYS	5363	Scientific Computation and Numerical Methods
PHYS	5263L	Experiment and Data Analysis
PHYS	5423	Quantum Mechanics II
PHYS	5613	Intro to Biophysics
STAT	4373	Experimental Design
OTHER	xxxx	Any other grad course appropriate to research or career preparation
INEG	5683	Nonlinear Programming

RESEARCH/INTERNSHIP COURSES

DEPT	600V	Master Thesis in Department of Major Professor
DEPT	700V	Ph. D. Dissertation in Department of Major Professor
MEPH	555V	Professional Masters – Internship
MEPH	5513	Professional Masters – External Research
MEPH	5523	Professional Masters – On-Campus Research

UNDERGRADUATE DEFICIENCIES

The μ EP graduate program is a professional development style graduate program. As such, it welcomes students into the program from any rigorous science or engineering B.S. or M.S. degree program.

Undergraduate course deficiencies in traditional graduate programs are designed to assure the public that a student achieving an advanced degree in that department has the equivalent of the core undergraduate courses needed to achieve the underlying BS degree in that department. A student entering traditional science or engineering graduate programs is therefore required to take approximately 30 hours of undergraduate deficiency courses before officially beginning their M.S./Ph.D. degree path.

The μ EP graduate course has no B.S. degree to protect, therefore allowing the undergraduate deficiencies to be defined only using the criteria “what is needed to assure a μ EP student’s success in the graduate courses for which they enroll?”

The first answer to that question is based on the broad background needed for many of the graduate courses taken by μ EP students. Every student is required to take three semesters of calculus based physics (through an introduction to quantum mechanics), mathematics through differential equations, and a course introducing electronic theory or practice.

The second answer to that question is based on what specific knowledge is needed by a student to be successful in a graduate course of interest. μ EP students work directly with the faculty member teaching the graduate course to understand the critical knowledge in the listed undergraduate pre-requisite courses needed to be successful in the graduate course. If the critical pre-requisite knowledge is narrow in scope, then that knowledge might be gained through self-study with tutorials from μ EP colleagues from that academic tradition. If the critical pre-requisite knowledge is broad, then the student will be encouraged to take the undergraduate course as the most efficient method to ensure success in the graduate course.

The key element of this discussion is that students are key participants in understanding what is necessary to increase the probability of their success as they take the graduate course. Our goal is to ensure graduate success, not to increase the enrollment in our undergraduate classrooms.

DEGREE REQUIREMENTS – MASTER OF SCIENCE DEGREE

A student who completes the μ EP M.S. degree program is granted a Master of Science in Microelectronics-Photonics. The degree conferral follows the tradition of the Fulbright College of Arts and Sciences, the diploma displaying only “Master of Science” and the transcript displaying the “Master of Science, Microelectronics-Photonics”.

PREREQUISITES TO DEGREE PROGRAM

Applicants to the program must satisfy the requirements of the Graduate School as described in the Graduate School Catalog and have the approval of the GSCMEP.

Prerequisites to Degree Program: Applicants to the program must satisfy the requirements of the Graduate School as described in this catalog and have the approval of the Graduate Studies Committee of the Microelectronics-Photonics program (GSCMEP). Candidates typically have completed a Bachelor of Science degree in either engineering or science, and candidates’ academic backgrounds will be evaluated by the GSCMEP for suitability to the graduate program. To be admitted to graduate study in Microelectronics-Photonics (μ EP) without deficiency, candidates are required to have completed a math course sequence through differential equations, an introduction to quantum mechanics through courses such as PHYS 3603, PHYS 3614, or CHEM 3504, and a junior-level introduction to electricity and magnetism or electronic circuits. Other undergraduate deficiencies may be identified during the evaluation process, and degree completion will be contingent on successful completion of these identified deficiencies.

Prospective students from foreign countries in which English is not the native language must submit nationally recognized standardized testing results on written English proficiency for consideration to the Graduate School during the admission process. Students may be given conditional admittance pending demonstration of English language skills in appropriate courses at the University of Arkansas. Students wishing to apply for graduate assistantships that require direct contact with students in a teaching or tutorial role in a department must meet that department’s English Language proficiency test requirements and the requirements of the Graduate School for such GA positions.

REQUIREMENTS FOR THE DEGREE

Requirements for the Master of Science Degree: Students choosing this degree program will be assigned an initial adviser upon acceptance to the program. This adviser will be their Cohort Manager during that academic year. Students will work with the Director of the μ EP program to define their M.S. path to best support their career goals after graduation, with three curriculum paths available to μ EP students.

- Non-Thesis path: Students who are funded by personal resources, education grants, or by graduate assistantships not associated with research may complete a M.S. degree with additional coursework in place of independent research. While there may be specific narrow career options where this is an appropriate path, the μ EP program strongly recommends the Professional or Academic paths as providing a much better overall career preparation for working in a technical position. Students completing this path cannot be accepted for the Ph.D. μ EP program. Non-thesis students are required to pass MEPH 5393 Product Development Process as their comprehensive examination. The μ EP PhD candidacy exam is used for MEPH 5393 and it is administered concurrently with the candidacy exam.
- Professional path: Students who plan to enter the technical marketplace after M.S. completion will find this path most beneficial, as it requires independent graduate level research in collaboration with an external technical organization. The research may be in the form of a traditional M.S. six-hour research topic and thesis, or may instead be in the form of two three-hour independent research efforts resulting in written reports with the clarity, style, analysis, and conclusions expected of a journal paper submission. Both the thesis and the written reports will be orally defended before the appropriate student committee. Students in this path will also be required to complete at least one internship with at least six weeks duration to experience a non-academic technical environment. Students completing this path may be considered by the

DEGREE REQUIREMENTS – MASTER OF SCIENCE DEGREE (CONTINUED)

GSCMEP for admission to the Ph.D. μ EP program based on the strength of their academic course grades, their independent research depth, and quality of the written research document.

- Academic path: Students who plan to complete an academic campus-based research thesis will take this path, although the research topic may include funding and collaboration with outside technical organizations. Students who complete all requirements for M.S. graduation, including an independent research project and thesis acceptable to their thesis committee, will be eligible without GSCMEP review for admission to the Ph.D. μ EP program.

Each student will form either a thesis committee or an advisory committee after they have chosen their M.S. path, defined any independent research areas, and been accepted into a research group if appropriate. A thesis committee will be made up of at least three faculty members, with at least one faculty member each from the Fulbright College of Arts and Sciences and the College of Engineering (the student's research professor will chair the thesis committee). The advisory committee will include at least one GSCMEP member, the supervising faculty member for a research experience, and the μ EP program director. If the student is Professional path then either committee must also include at least one technical professional from the partner external organization as either an adjunct or an Ex Officio faculty member.

COURSE HOUR REQUIREMENTS

Each student is required to enroll in a least one hour of course work each fall and spring semester until the M.S. degree is issued. If all required course work has been completed, the student may enroll in one hour of master's thesis, or in one hour of a special problems course for credit only.

Students in this degree program can choose an Academic path, a Professional path, or a Non-thesis path. The course hours to meet the minimum hours for each path are as follows:

Subject Area	Academic Path/Hours	Professional Path/Hours	Non-Thesis Path/Hours
Science	6	6	6
Engineering	9	9	9
MEPH 5383 Research Commercialization	3	3	3
MEPH 5393 Product Development Process	Not Available	Not Available	3
Design of Experiments (such as BENG 5703)	Elective	Elective	Elective
2 nd course in management of technology	Not available	Not Available	3
MEPH 5811 /5911/6811/6911 Open Seminar	≥ 3	≥ 3	≥ 3
MEPH 5821 Ethics	In Ph.D. Curriculum	1	Recommended
MEPH 5832 Proposal Writing & Management	In Ph.D. Curriculum	Recommended	2
Technical Elective	6	6	6
DEPT 600V Research Thesis	6	(Option) 6	0
MEPH 5513 Applied External Research	Not Available	(Or Option) 3 + 3	Not Available
MEPH 5523 Applied Internal Research	Not Available	(Or Option) 3 + 3	Not Available
MEPH 588V Independent Project	Elective	Elective	(≤ 3 as technical elective)
MEPH 555V External Technical Internship	Recommended in Ph.D. studies	1 \leq V \leq 3	Not Available
Total hours	33	35-38	36

DEGREE REQUIREMENTS – MASTER OF SCIENCE DEGREE (CONTINUED)

If a University of Arkansas undergraduate student is pursuing a Bachelor of Science degree in a department that has implemented an accelerated B.S./M.S. program (typically allowing six hours of graduate-level course work to be shared between the two degrees), the student may implement the same acceleration to a B.S. departmental degree/M.S. μ EP degree set. Both the undergraduate department and the μ EP Program Director must approve the shared courses prior to enrollment.

Additional core courses to develop operations management skills also have been defined for μ EP students. During year one of their graduate studies at the University of Arkansas, students are required to take MEPH 5811 Infrastructure Management and MEPH 5911 Personnel Management in the fall and spring semesters, and MEPH 5821 Ethics for Scientists and Engineers in their first summer. During year two, students are required to take MEPH 6811 Management and Leadership and MEPH 6911 Advanced Management and Leadership in the fall and spring semesters, and MEPH 5832 Proposal Writing and Management in their second summer. In addition, all cohort members participate in two days of industrial-style inventiveness and team training during the week directly preceding the start of fall classes. Three to five of these seven credit hours may be used in M.S. curricula as shown in the table, and the remaining credit hours may be applied as Ph.D.-level technical electives.

Students are required to attend monthly μ EP Research Communication Seminars during the first four semesters of their M.S. degree program, and will enroll in MEPH 5611 Research Communication Seminar of MS Students in their third semester.

Research thesis hours will be chosen from the department of the student's research adviser (PHYS 600V, ELEG 600V, etc.) and will require a written thesis successfully defended in a comprehensive oral exam given by the thesis committee. A research thesis is required for Academic path students, and is optional for Professional path students. Professional path thesis research must include direct collaboration with an external technical organization.

A student on the Professional path may substitute two Applied Research efforts for a thesis under MEPH 5513 (External location) or MEPH 5523 (Internal on-campus location), provided each semester's research is of graduate quality level and is reported at the end of the semester through a written paper and in an oral presentation to the advisory committee (note that the written paper must match the clarity, style, analysis, and conclusions expected of a journal paper submission). Regardless of where the research is performed, it must include direct collaboration with an external technical organization.

Independent project hours in support of the Non-thesis path may be either MEPH 588V Special Problems in Microelectronics-Photonics or a departmental Special Problems course number, and will require a written project report modeled after a professional journal submission that is then defended in a comprehensive oral exam given by the advisory committee.

COURSE SELECTION (27/36)

Courses may be chosen by the student to meet the criteria described in the prior curriculum section. It should be noted that the degree plan created by the student must meet the conditions on (1) areas of emphasis and (2) mix of engineering, science, elective courses.

RESEARCH THESIS (6/0)

Research thesis hours are chosen from the department of the student's research advisor (PHYS 600V, ELEG 600V, etc.) and require a written thesis successfully defended in a comprehensive oral exam given by the advisory committee.

DEGREE REQUIREMENTS - MASTER OF SCIENCE DEGREE (CONTINUED)

INDEPENDENT PROJECT (0/3)

Independent project hours are taken under MEPH 588V Special Problems in Microelectronics-Photonics and require a written project report successfully defended in a comprehensive oral exam given by the advisory committee.

Independent projects to satisfy requirements for the non-thesis-based M.S. μ EP degree program must be approved in advance by the Chair of the student's Advisory Committee (see Note 1). In consideration of the goals of the non-thesis-based degree program, wide latitude will generally be given on project selection. Particular examples of projects that are designed to benefit both the student and the mentor are:

- Independent data analysis for a professor or industry partner with conclusions drawn and a discussion of supportive literature.
- A comprehensive report on current state-of-the-art, application needs and compelling research directions in support of a professor considering a new research direction.
- Completion, data analysis, and discussion of the results of a small well-defined experiment using proven experimental analysis to investigate additional facets of a prior research project
- Other projects as proposed by the student with their project mentor.

The culmination of the Independent Project will be a PowerPoint presentation to the Advisory Committee, with a written report summarizing their work (typical reports have been at least 15 pages in length with Times New Roman, 12 point, single space, and one inch margins) delivered to the Advisory Committee members at least one week prior to the presentation. This Advisory Committee must include at least the sponsoring faculty member, the μ EP Director, and one other member of the μ EP Graduate Studies Committee.

NOTE 1: SPECIAL CONDITIONS FOR NON-THESIS OPTION

The μ EP faculty feels that the best preparation for a career in this field is through a research-based degree, with a written thesis and defense. All traditional M.S. μ EP students are initially enrolled as a research thesis or professional path student, but it is recognized that at times a non-thesis option may better support a student's career plans. Before a student will be considered for admission to the non-thesis M.S. μ EP degree program, the following steps and conditions must be met:

- The student must submit a document to the μ EP Director explaining in detail why the non-thesis option is better preparation for his/her career than a research based degree.
- The student must meet with the μ EP Director to discuss the cost/benefit balance of both M.S. options.
- If the student has received any Research Assistant funding, that professor must send the μ EP Director written notice that (a) the student has been released from any thesis obligation under that funding and that (b) the student is approved to convert to a non-thesis option.

An independent project course is equivalent to a three hour graduate course, which has 45 contact hours and an assumption of at least 90 hours of out of class preparation. The project's acceptable level of effort should be judged by this 135 hour baseline time commitment.

MASTER'S CALENDAR

ADVISORY COMMITTEE

The Graduate Advisory Committee consists of at least the μ EP Director and the faculty member under whom the student is working on a trial basis in a research group. The faculty member will be identified by the μ EP Director as Chair of the Committee through email communication to the Graduate School.

THESIS COMMITTEE

The thesis committee consists of the thesis advisor (as chair) and at least two other members of the faculty. The committee must contain at least one faculty member each from the College of Engineering and the Fulbright College of Arts and Sciences. The director of μ EP will also be on all committees as Ex Officio. The thesis committee assumes co-responsibility with the student's Cohort Manager for student guidance and graduation compliance. The proposed thesis committee form must be submitted to the Graduate School before registering for the semester following the student's acceptance into a research group. The form can be found in the forms section of this handbook or at <https://graduate-and-international.uark.edu/graduate/current-students/forms.php>.

THESIS AND PRESENTATIONS

Only a full and complete copy of the thesis may be submitted to the Committee Chair for final draft approval. This approved draft will then be submitted to the μ EP Director for review, and will be released by the Director upon verification that all required elements of the thesis exist. Upon release authorization, this final draft of the thesis will be submitted to the thesis committee for approval. The committee must receive the thesis no later than the date of the public presentation of the student's work. The thesis defense cannot be scheduled earlier than one week after the public presentation, and the defense must be scheduled at least five business days before the deadline for submission of the final thesis to the graduate school (typically one week prior to Dead Day) to allow time for any corrections or additions identified during the defense. The student must provide hardcopies of the PowerPoint presentation slides to the μ EP Director at the public presentation and to the Director and all committee members at the thesis defense.

ANNOUNCEMENT OF THE MASTER DEFENSE

Announcement of the master candidate's defense and a copy of the abstract must be submitted by email to the μ EP office at least one week prior to the date of the public presentation. This email must also contain the scheduled time and place of both the public presentation and the thesis defense. Only the student and committee members may attend the defense, unless the student specifically invites other visitors to the defense by email notification to the μ EP Director.

FINAL THESIS COPIES

All completed forms and documentation must be submitted per current Graduate School requirements after the thesis defense and final approval by the thesis committee and director. Submission must occur to the Graduate School by their specified deadline (typically one week prior to dead day). An unbound signed hard copy on 20lb cotton paper must be delivered to the μ EP program office, along with copies of all Graduate School forms, electronic copies (.pdf, .ppt and .doc(x)) of the thesis document, the public PowerPoint presentation, and the thesis defense PowerPoint presentation, in order to meet the μ EP Graduate Program requirements for graduation. Other unbound copies can be delivered for binding to the μ EP office for committee chair, committee members, parents, personal copy, etc. The μ EP program will pay for the binding of the program copy, the committee chair copy, and one personal copy for the student.

MASTER'S EXAMINATION

The final master's comprehensive oral examination will be conducted as part of the thesis defense meeting.

MASTER'S CALENDAR (CONTINUED)

APPLICATION FOR THE DEGREE

A student cannot be cleared for graduation until all Graduate School and University of Arkansas documentation requirements have been met. Please refer to the Graduate School web site for current requirements for graduation.

DEGREE REQUIREMENTS – DOCTOR OF PHILOSOPHY DEGREE

PREREQUISITES TO DEGREE PROGRAM

Applicants to the Ph.D. program are expected to have a Master of Science degree in either engineering or science, and each candidate's academic background is evaluated by the GSCMEP. Doctoral candidates in Microelectronics-Photonics are expected to achieve proficiency in the requirements for the Master of Science in Microelectronics-Photonics degree at the University of Arkansas before their Ph.D. degree completion.

Students who have graduated with a M.S. in Microelectronics-Photonics from the University of Arkansas are expected to take the Microelectronics-Photonics candidacy exam in the spring semester after M.S. graduation. Students requesting admittance to the Ph.D. program with an M.S. degree in another discipline must take the Microelectronics-Photonics Ph.D. candidacy exam within four semesters after enrollment.

Students who fail to pass the written candidacy exam may re-take the exam one time on its next available date. Any student who fails the written candidacy exam a second time will not be allowed to continue in this graduate program.

COURSE HOUR REQUIREMENTS

The Ph.D. curriculum must meet the following boundary conditions:

1. The total M.S./Ph.D. curriculum will contain at least 27 hours of coursework at the 5xxx level or above.
2. The total M.S./Ph.D. curriculum will contain no more than nine hours of special topics coursework.
3. The total M.S./Ph.D. curriculum will contain no more than six hours of independent study coursework.
4. The Ph.D. curriculum will contain at least 27 hours of coursework beyond the M.S. degree curriculum. This coursework may contain up to four hours of the organizational management seminars (MEPH 5811/5821/5832/5911/6811/6911) not used as part of any prior degree's curriculum.

Students are required to attend monthly μ EP Research Communication Seminars during the first five semesters of their Ph.D. degree program, and will enroll in MEPH 6611 Research Communication Seminar of PhD Students in their fifth semester.

In addition to these conditions, at least twenty-one hours of research dissertation will be taken under departmental course numbers such as PHYS 700V, CHEG 700V, ELEG 700V, etc., as appropriate, to match to the department and section of each student's major research professor.

Ph.D. students must complete at least one three-hour course in Design of Experiments as part of their graduate curriculum. If a DOE course has not been completed as part of the M.S. curriculum, it is highly recommended that this course be taken the first semester of the Ph.D. program.

DOCTORAL CALENDAR

DECLARATION OF INTENT

Prospective doctoral candidates must enroll in the Ph.D. μ EP graduate program after completion of an appropriate M.S. degree. This will establish residency as a prospective doctoral candidate.

ADVISORY COMMITTEE

The Graduate Advisory Committee consists of at least the μ EP Director and the faculty member under whom the student is working on a trial basis in a research group. The faculty member will be identified by the μ EP Director as Chair of the Committee through email communication to the Graduate School.

DISSERTATION COMMITTEE

The dissertation committee consists of the dissertation major professor (as chair) and at least three other members of the faculty. The committee must contain at least one faculty member each from the College of Engineering and the Fulbright College of Arts and Sciences. The director of μ EP will be on all committees as Ex Officio. The dissertation committee assumes co-responsibility with the student's Cohort Manager for student guidance and graduation compliance. The proposed dissertation committee form must be submitted to the Graduate School before registering for the semester following the student's acceptance into a research group. The form can be found in the forms section of this handbook or at <https://graduate-and-international.uark.edu/graduate/current-students/forms.php>.

CANDIDACY EXAMINATION

The full details of the candidacy process are included elsewhere in this handbook. It is expected that the two-part candidacy examination be completed at least one year before completing all other requirements for the degree. The Graduate School Dean will be notified by the μ EP Director when the student has passed both portions of the exam.

DISSERTATION TITLE

The title of the dissertation must be submitted to the Graduate School before the research proposal portion of the candidacy process is completed.

DISSERTATION FORMAT

The μ EP program considers a dissertation to be both a teaching and archival document that demonstrates to the reader the candidate's ability to clearly describe the Ph.D. level work in his or her own words. If a student wishes to include his or her prior publications in the dissertation, either through partial reuse of text or by compiling prior publications verbatim, permission must be obtained from the Graduate Studies Committee of the μ EP Graduate Program before writing of the dissertation begins, and at least six months before the planned graduation date.

DISSERTATION AND PRESENTATIONS

Only a full and complete copy of the dissertation may be submitted to the Committee Chair for final draft approval. This approved draft will then be submitted to the μ EP Director for review, and will be released by the Director upon verification that all required elements of the dissertation exist. Upon release authorization, this final draft of the dissertation will be submitted to the dissertation committee for approval. The committee must receive the dissertation no later than the date of the public presentation of the student's work. The dissertation defense can be scheduled no earlier than one week after the public presentation, and the defense must be scheduled at least five business days before the deadline for submission of the dissertation to the graduate school (typically one week prior to Dead Day) to allow time for any corrections or additions identified during the defense. The student must provide hardcopies of the PowerPoint presentation slides to the μ EP Director at the public presentation and to the Director and all committee members at the dissertation defense.

DOCTORAL CALENDAR (CONTINUED)

ANNOUNCEMENT OF THE DISSERTATION DEFENSE

Announcement of the doctoral candidate's defense and a copy of the abstract must be submitted by email to the μ EP office at least one week prior to the date of the public presentation. This email must also contain the scheduled time and place of both the public presentation and the dissertation defense.

FINAL DISSERTATION COPIES

All completed forms and documentation must be submitted per current Graduate School requirements after the dissertation defense and final approval by the dissertation committee and μ EP director. Submission must occur to the Graduate School by their specified deadline (typically one week prior to dead day). An unbound signed hard copy on 20lb cotton paper must be delivered to the μ EP program office, along with copies of all Graduate School forms, electronic copies (.pdf, .ppt and .doc(x)) of the dissertation document, the public PowerPoint presentation, and the dissertation defense PowerPoint presentation, in order to meet the μ EP Graduate Program requirements for graduation. Other unbound copies can be delivered for binding to the μ EP office for committee chair, committee members, parents, personal copy, etc. The μ EP program will pay for the binding of the program copy, the committee chair copy and one personal copy for the student.

APPLICATION FOR THE DEGREE

A student cannot be cleared for graduation until all Graduate School and University of Arkansas documentation requirements have been met. Please refer to the Graduate School web site for current requirements and deadlines for graduation.

PH.D. CANDIDACY EXAM

INTRODUCTION

The GSCMEP has defined the candidacy process for students seeking a Ph.D. μ EP degree.

The candidacy process was approved by the GSCMEP for submission in draft form to the full μ EP faculty on November 28, 2000. It was approved with minor modifications by the μ EP faculty on December 5, 2000. The first usage of this exam process was in March 2001.

NATURE OF THE CANDIDACY EXAM

The GSCMEP began the μ EP Ph.D. candidacy definition process by recognizing four guiding principles:

1. The μ EP Ph.D. program is defined as an experimental program for national dissemination (via the NSF IGERT competition). As such, the μ EP Ph.D. program has an explicit charter to examine a wide range of options that still meet the broad guidelines as established by the Graduate School of the University of Arkansas.
2. The historical methods used by the underlying traditional departments at the University of Arkansas for Ph.D. candidacy/qualifier testing have produced skilled Ph.D. graduates for many years, and should be closely examined to utilize recognized strengths.
3. The resulting μ EP Ph.D. candidacy process does result in an accurate assessment of a μ EP Ph.D. candidate's likelihood of successful completion of the Ph.D. degree program as early as possible after completing the M.S. degree and entering the Ph.D. program.
4. The implementation of the μ EP candidacy process has been closely examined after each year's process completion and change made as needed.

PH.D. CANDIDACY EXAM OVERVIEW

A student must be in good academic standing with the Graduate School of the University of Arkansas before beginning the μ EP Ph.D. candidacy process.

The Ph.D. candidacy exam consists of two components. The first component is a written exam to meet the requirements of the Graduate School, while the second component is a written research proposal with oral defense describing the student's research thrust. Either component may be taken at any time without regard to the status of the second component. A student must pass both components in order to be admitted as a μ EP Ph.D. candidate.

A student with an M.S. μ EP degree is expected to complete the both components in the spring and summer semesters following his/her completion of graduation requirements for the M.S. μ EP degree. A student entering μ EP with a M.S. degree from another degree field is expected to complete both components in the spring and summer semesters of his/her second calendar year of the program. A student should have completed MEPH 5383 and MEPH 5832 prior to taking the written exam.

Any student who does not pass the written examination may take the exam a second time, but it may not be taken a third time without full approval of the GSCMEP and then the μ EP faculty (a third exam opportunity would be an extremely unusual event). Failure to pass this candidacy component will result in the student leaving the μ EP Ph.D. program.

A student that does not have a completely defined research proposal will be told the proposal's deficiencies. The student will then be given an opportunity to resubmit an amended proposal. This candidacy component is designed to assure that the research project is fully optimized early in the research project. Even so, a student that refuses to create a timely and complete research proposal or one who is not making satisfactory progress toward the work described may be removed from the program on that basis.

PH.D. CANDIDACY EXAM (CONTINUED)

CANDIDACY WRITTEN EXAM

The written exam is a scenario-based evaluation administered to the student at least 10 days before the start of spring classes and the solution document must be delivered by a pre-assigned time on the first day of the spring semester classes. The evaluation is an open book process (including trade publications, internet, textbooks, reference books, etc), but no help may be requested from any person while creating the solution document. No help may be requested from any person during the evaluation period.

Students will be given a choice of typically three scenarios from which to choose. Each is a mixture of a NSF-style solicitation with a request for quotation for technology development. The student creates a solution document acting as the chief technology officer of a hypothetical technology-based company.

The student must write a complete approach to solving the problem contained in the scenario. The approach should include (but not be limited to) a description of the science behind the technical solution to the problem, resources required to solve the problem, expected commercial and societal impact of the problem and/or the solution, etc.

The answer is limited to a 15-page single spaced (maximum length) detailed problem solution (including diagrams and illustrations). The font is 12 point Times New Roman, with one inch margins on the page top, bottom, and sides. The pages are numbered at the bottom using the form "Page n of N pages". Each page includes the student code number self-assigned by student.

Note: The amount of information that should be included is extensive and will be difficult to compress into a 15 page document. Solutions that are shorter than 15 pages are probably lacking critical information.

References and an appendix containing a detailed listing of intellectual property documents examined are not included in the 15 page limit. Detailed instructions will be included with the scenario description, and past scenario descriptions may be viewed on the μ EP web site under Current Students > PhD Candidacy Exams.

Each solution will be assessed by a panel of at least three μ EP faculty with no knowledge of each solution's author. If the assessments from the original panel members show significant divergence, additional professors may be requested to read and assess the solution before the panel reaches a final decision.

After the panel reports the results of the written solution evaluation to the μ EP program, the panel is notified of the student names. The committee will schedule a one hour oral Question & Answer session to clarify any portion of the written document in which they are interested.

The panel will then issue a final recommendation for pass/fail with comments to the μ EP program, which will be reviewed and voted on by the full μ EP faculty for approval.

It has already been noted that while the maximum page limit cannot be exceeded, it would be unusual if the solution required fewer than the maximum number of allowed pages to meet the details expected in the document. Even so, the exam graders will deduct points from the exam score if superfluous material is detected in the exam solution, i.e., material designed only to make the exam reach the allowed page limit.

PH.D. CANDIDACY EXAM (CONTINUED)

The student will be given a compilation of comments from the assessment committee after the candidacy exam process is completed. This assessment will be reviewed with the student and his/her major professor by the μ EP director. No formal process is defined to contest the committee's decision beyond the standard process of appeal to the GSCMEP for any issue dealing with the μ EP governance.

CANDIDACY RESEARCH PROPOSAL - WRITTEN AND ORAL PRESENTATION

The second component is composed of a written research proposal submitted by the candidate to the μ EP graduate program for review, followed by an oral presentation of the proposal by the candidate (with a minimum of one week between submission of written proposal and oral). The timing of this Research Proposal is independent of the student's status with respect to the Candidacy Written Examination.

The student's PhD Dissertation Committee must accept the proposal by no later than 24 months after entry into the PhD program or the student will be removed from the PhD program.

The purpose of this component is for the Ph.D. candidate to describe the proposed research, including the background and outline of investigation, to his or her committee. The student has the responsibility to create the document, but is expected to do so in strong consultation with his or her Major Professor.

The proposal can be no more than 15 pages including diagrams and illustrations. The font is 12 point Times New Roman, single spaced, with one inch margins on the page top, bottom, and sides. The pages are numbered at the bottom using the form "Page n of N pages".

The proposal format is flexible and may be organized in a way that will best support its content migrating to the Ph.D. dissertation. It is suggested that the following information be addressed and included in the document when appropriate.

1. Executive Summary (1 page maximum, included in 15 page limit)
2. Project description
 - a. Introduction of proposed investigation
 - b. Current state of the art in proposed research area
 - c. Research objectives (With illustrative examples of preliminary/exploratory work if appropriate)
 - d. Feasibility of research, including high risk elements (with backup plan)
 - e. Experimental/investigative method to be used (see Appendix b. notes below)
 - f. Equipment list needed for research
3. References (not included in 15 page limit)
4. Required appendix (not included in 15 page limit)
 - a. Microsoft Project printout with major research and administrative events to graduation.
5. Appendices if needed (not included in 15 page limit)
 - a. Additional local research group activities in research area
 - b. Theoretical calculations as needed
 - c. Detailed experimental/simulation matrix
 - d. Other (with Permission)

PH.D. CANDIDACY EXAM (CONTINUED)

The proposal will be delivered to the μ EP office via one hardcopy document signed on all pages by the student. The document will be submitted electronically as one Microsoft Word document and to all committee members and the μ EP office one week prior to the committee presentation.

The oral defense of the research proposal is attended by all committee members and open to the public for observation and discussion unless otherwise requested by the major professor three weeks in advance (closed sessions are allowed only if needed to protect intellectual property under development). Questions to the student will be strongly based on items in the written proposal, but are not limited to the contents of the proposal. The student is responsible for scheduling the exam and should reserve the appointment (committee member calendar and conference room calendar) for 1.5-2 hours.

It is strongly recommended that the student review the proposal with the μ EP Director prior to distribution to the committee. A practice presentation is also encouraged.

The oral presentation should include a slide listing the key research goals/tasks categorized as follows:

Minimal:

- These are the minimum research goals which should be met for the committee to accept for approval of the Ph.D. degree in the event something catastrophic occurred which terminated the research.

Expected:

- These are the expected research goals (beyond those listed in minimal) which should be met for the committee to accept for approval of the Ph.D. degree.

Stretch:

- These are research goals which the student will strive to achieve beyond those expected to be met for the committee to accept for approval for the Ph.D. degree.

The student should be in agreement with their major professor(s) on these research goals and their categorization (minimal, expected, stretch) before the proposal defense.

Within three days of the oral defense, the student will be notified if his/her research proposal is acceptable to the μ EP program. The student will be given a summary of faculty comments and suggestions concerning their proposal.

Notes on Detailed experimental/simulation matrix appendix:

When considering the overall research approach to a Ph.D. early in the process, it is obvious that the final experimental details cannot be predicted. At the same time, if only a qualitative description of the experimental space is included without a first pass understanding of the types of experiments that will be run with the levels of variation – then the scope of work may be entirely too large for a single Ph.D. project. Microsoft Project is useful when creating a first pass detailed conceptual experimental plan, as it allows adjusts downstream dates automatically to early task timing changes.

One approach to creating this conceptual detailed experimental plan is:

- Take it one step at a time. Every time the step you are working on spawns the need for a screening experiment, stop and fully describe the screening experiment.

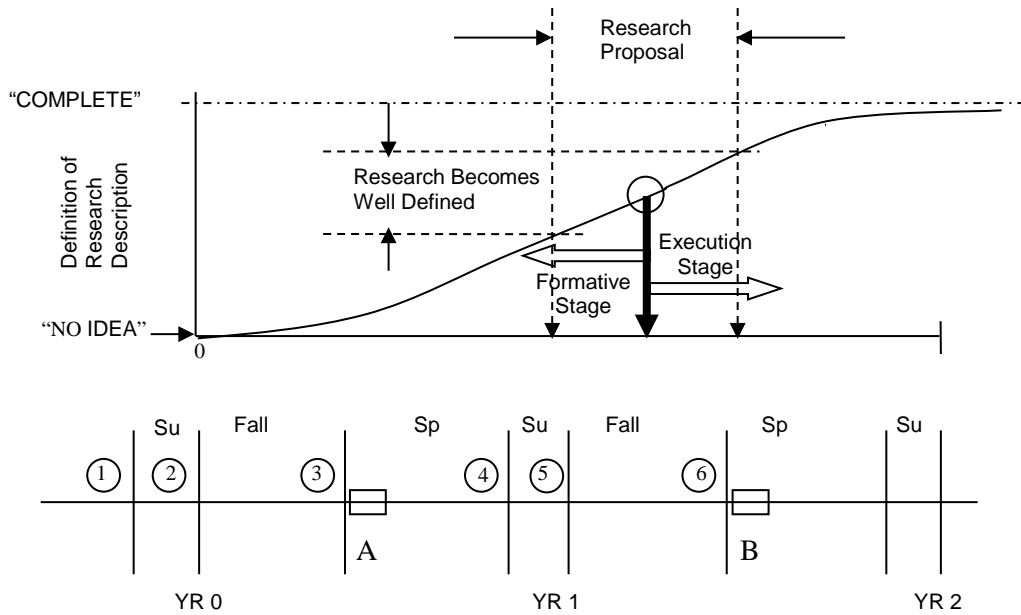
PH.D. CANDIDACY EXAM (CONTINUED)

- Some experiments will have multiple sub-steps for each data point (for example: create sample, map film thickness and composition across substrate, prepare device masks, process substrate to create devices, characterize all devices with substrate location included, analyze data, etc). In this case, create a detailed description of experiment (a) in Microsoft Project, and then just have a single task of appropriate length for experiments (b) through (n).
- As you define each experiment, sketch out the graphs, charts, and figures that you expect to have to generate to fully investigate your premise and defend your conclusions. Think about causes of variation that might require extra metrology steps, and don't forget to think of variability of your independent variables as well as your dependent variables. Think about if a single device will do, or will you have to have multiple devices/data for each particular data point on your graph. Make sure you put on the graphs what you think will be the minimum and maximum values you will be measuring, and what amount of accuracy may be required for each measurement - which will lead you to consider if you have an appropriate metrology tool for your experiment.
- After you have all your relationships defined that you wish to investigate, consider if you are doing a screening experiment with low resolution to confirm an earlier reported result - or if you need a higher resolution experiment to determine the true value of a local maxima or minima. Which brings to mind, if you are depending on a prior reported result for your starting point, have you considered if you trust that they have found the optimum operating point - or just possibly a local minimum/maximum.
- You will find your number of experiments growing at a near exponential rate at some time in this process - which is very discouraging. Ignore the feeling and continue defining your experimental sequence. Remember that it is much easier to go back and change a full factorial experimental set to a DOE (thereby reducing the number of needed experiments to get a complete picture of your experimental space, but at the cost of less resolution in your mapping of the space) than it is to go back and desperately try to fill in a critical hole in your experimental work the week before your defense.
- Going back to the first point. Put all this into Microsoft Project as linked tasks and let it keep up with the projected time to completion for you. This is why we have asked you to learn the software, and this is where it will do you a lot of good in deciding if your scope of project is too large for a single Ph.D. project.

EXAM TIMELINE

The figure below illustrates the timing of both components of the candidacy exam in terms of both the calendar time since entry, and in terms of number of semesters.

Ph.D. Candidacy Exam Timing



microEP M.S. = Exam 1ST Spring Semester after Degree

Degree Issued at (1), (2) OR (3) \implies Written Candidacy Exam Spring Semester A

OTHER M.S. = Exam 1ST OR 2ND Spring Semester after Degree

Degree Issued at (1), (2) OR (3) \implies Written Candidacy Exam Spring Semester A or B

M.S. THESIS AND PH.D. DISSERTATION COMPONENTS

The length of the M.S. μ EP thesis and Ph.D. μ EP dissertation is not defined by the program due to the large variation in research topics investigated by each student. However, as a minimum, each thesis or dissertation must contain the following sections:

- 1) All components as defined in the graduate school thesis and dissertation preparation guide (including fonts, margins, table of contents, etc.). Current guidelines are found at <https://graduate-and-international.uark.edu/resources/forms/thesis-dissertation-guide.pdf>.
- 2) An acknowledgements page, which will include at least recognition of the agencies providing financial sponsorship to the student.
- 3) An abstract of your work is now required for all theses and dissertations.
- 4) There are now two signature pages. See the μ EP template, which is an approved variation of the Graduate School Thesis and Dissertation guides. The Director of the μ EP Graduate Program is an ex-officio member of all committees and should be included on the signature page.
- 5) An organization structure must be defined to include a list of figures and tables and:
 - a) Prior state of the art in the research area
 - b) Overview of completed investigation
 - c) Experimental/investigative method used
 - d) Research outcomes (data and analytical methods)
 - e) Discussion of research outcomes (what it all means)
 - f) Future work suggested by current research conclusions
- 6) Appendices must be included that contain:
 - a) Description of research for popular publication (five page maximum length, single spaced, written in a similar fashion to a "Science News" article)
 - b) Executive summary of newly created intellectual property. This a numbered concise listing of the major new IP that you created during your research.
 - c) Potential patent and commercialization aspects of each numbered item in appendix B.
 - i) Patent prospects IP (*can* each be patented)
 - ii) Commercialization possibilities of IP (*should* each be patented)
 - iii) Possible prior disclosure of IP (list of possible prior patents or scientific publications that address each IP item)
 - d) Broader impact
 - i) Applicability of research methods to other problems
 - ii) Impact of research results on US and global society
 - iii) Impact of research results on the environment
 - e) Microsoft Project printout of research project plan
 - f) Identification of all software used in research and thesis/dissertation for each computer used (laboratory, home, laptop, etc)

Computer #1:		
Model Number and Serial Number:		
Location:		
Owner:		
Software #1:	Software #2:	Et cetera
Name:	Name:	
Purchased by:	Purchased by:	
License #:		

Computer #2: Continue until all computers and software are listed.
 - g) All publications published, submitted and planned
- 7) Appendices may be included that contain:
 - a) Equipment used in research (list of type, manufacturer, model number)
 - b) Detailed analytical techniques
 - c) Et cetera

M.S. THESIS AND PH.D. DISSERTATION COMPONENTS (CONTINUED)

You are required to submit your thesis or dissertation to the plagiarism check web site designated by the μ EP Graduate Program (www.turnitin.com for the 2017-18 academic year). You are encouraged to submit your working document to the draft assignments throughout your writing process, but you are required to submit the final copy you are about to submit to the Graduate School to the Final Submission assignment in the web site. Appropriate logon information to www.turnitin.com will be supplied by the μ EP program.

DO'S AND DON'TS OF M.S. THESIS AND PH.D. DISSERTATION WRITING

- 1) Read the entire Thesis/Dissertation Writing Guide on the Graduate School website <https://graduate-and-international.uark.edu/resources/forms/thesis-dissertation-guide.pdf>. Check every item against your template before you start adding significant content, including the template you can download from the μ EP web site (there may be a recent change from the Graduate School that has not yet migrated to the μ EP template). Do **NOT** use old μ EP thesis/dissertations as a model.
- 2) Read the prior page in this handbook again. No thesis or dissertation will be approved without all required appendices done with the same professionalism as the rest of the document.
- 3) Electronic Files
 - a) Keep your work in a single electronic file from the start - it will save you heartache at the end.
 - b) Always start an editing session by doing a "Save as" command as a new revision number.
 - c) Always end an editing session by saving your new revision ***in at least three different physical locations.***
- 4) Plagiarism check
 - a) Always write from a blank page. You cannot cut, paste, and alter any text block enough to make it different from the original author's work. Read, learn, and then teach the information to your reader in your own words.
 - b) Do routine plagiarism checks of your work in progress (maybe after each chapter is substantially completed). If you have any questions about whether or not something is really plagiarism, immediately discuss it with the Program Director.
 - c) A final plagiarism check is required of your completed document before submission to the Graduate School.
 - d) Do not use any directly copied text from your own prior publications without prior approval from the μ EP Program Director (the thesis/dissertation requires a much different writing style, and it is impossible to separate who wrote what part of a publication if it has multiple authors).
 - e) Any plagiarism found in the final submission ***will result in dismissal from the program.***
- 5) Naming Convention – Use the correct word for your document
 - a) M.S. work is contained in a "Thesis"
 - b) Ph.D. work is contained in a "Dissertation"
- 6) Acknowledgements of funding and support
 - a) If your work has been funded by the NSF, use the following language at the end of your acknowledgements "This program is financially supported by the National Science Foundation under Grant No. xxx-nnnnnnn. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation."
 - b) If your work included work done in HiDEC, use the following language "Research possible through the use of the High Density Electronics Center at the University of Arkansas, Fayetteville campus". Use similar language if you did a major element of your work in a lab other than that of your major professor.
 - c) Consider whether you should specifically recognize a staff person who has given you significant help in executing some design or fabrication element of your work.

DO'S AND DON'TS OF M.S. THESIS AND PH.D. DISSERTATION WRITING (CONTINUED)

- 7) References
 - a) Must be in one combined list at the end of the document rather than at the end of each chapter.
 - b) Must appear in numerical order as they appear from front to back of your thesis or dissertation.
 - c) References used in an appendix can be listed at the end of that appendix, but may be included in the full list if it is located at the end of the complete document.
 - d) If you use a web URL as a reference (not a recommended practice) then the hyperlink must be removed and the date you accessed the information must be included.
 - e) Do NOT use any Wikipedia reference.
- 8) Graphs (note that all comments in Section 13 – Figures may also apply to graphs)
 - a) Use clear backgrounds, not the default white in Microsoft Excel.
 - b) Use both lines and symbol styles, not just color changes, to display different data sets.
 - c) Use the same format on titles, figure captions, graph axis, etc. throughout paper.
 - d) Expand axis of dependent variable by using portrait layout instead of the default landscape format in Word (increase physical size of Y axis to increase ability to separate data points).
 - e) Most experimental data should use XY scatter style graphs, not the default Excel style with data displayed in even increments along the X axis.
 - f) When creating a graph in Excel, always create the graph on a separate page (the last option step in the graph wizard). Make the graph look good on that page, then copy it to the clipboard. Use the Paste Special option to put it into your document as a picture. Format the picture under advanced layout to force text lines to be only above and below it, which will then allow you to size the graph as needed and the text will scale with the graph.
 - g) Don't wrap text around a figure. This works well in some journal formats, but in a thesis or dissertation it makes the figure difficult to see and often results in text that is difficult to read.
 - h) Grow all graphs proportionally to full page width unless it reduces clarity of your graph.
- 9) Formatting Issues
 - a) Chemistry style dissertations of combined published articles can only be allowed if your major professor first formally applies for approval to the Graduate Studies Committee of μ EP six months prior to your defense date. The GSCMEP will discuss the pros and cons of this approach with the professor and student, and only if approved will the dissertation be allowed. Any dissertation that is submitted in this format without six month prior approval **will be rejected** and will be required to be re-written in standard format. The voice must not change throughout the document. (ex: I completed the experiment VS the experiment was completed)
 - b) Use of first person structure is discouraged but not forbidden. The voice must not change throughout the document.
 - c) Experiments were in the past – **always** use past tense verbs when describing your work.
 - d) No footnotes are allowed.
 - e) All page numbers must be right aligned in the table of contents, list of figures, list of tables, etc.
 - f) Page numbers preferred at bottom, not top right. The page number must touch a line drawn 0.75 inches from the bottom of the page to be acceptably placed.
 - g) No italics, bold, or whatever can be used in the body text to make a point. Use of these techniques may be good in a proposal, but are bad in a thesis or dissertation.
 - h) Buy your good 20lb, 100% cotton paper early in the semester, as they do run out sometimes at the end.
 - i) Print the watermark upright & readable from the front of your printed page.
 - j) Use no qualitative terms, only quantitative comparisons.
 - i) Correct: Within 10%, 10 times greater, less than 10 years, both were square but of different color, etc
 - ii) Wrong: Words such as almost, significantly, close, similar, etc

DO'S AND DON'TS OF M.S. THESIS AND PH.D. DISSERTATION WRITING (CONTINUED)

- k) Titles of your thesis/dissertation must be in “Title Case”.
 - l) When referring to figures, chapters, tables, sections, etc. in the text body, the item is considered a proper noun that should be capitalized and spelled in full (Figures x.x, Equation x.x, Chapter Two, etc.)
 - m) Titles of chapters, sections, etc. may be no more than one point larger than the body text.
 - n) Font style must remain the same for ALL elements of your thesis/dissertation.
- 10) Equations
- a) Should be outside the text body on a separate line.
 - b) Should be labeled with (Equation X) right justified against right margin on the same line.
 - c) Variables in the equation must have the exact font style and size when used in the body text as was shown in the numbered equation. This includes such things as italics.
- 11) Numbers
- a) Only display the correct number of significant digits.
- 12) Statistics and variation
- a) Always indicate variation in data by error bars on and data point graphed that contains consolidated data.
 - b) Consider if all data should be included on graph if each data point would only consolidate a few number of points – making the concept of average and standard deviation meaningless.
- 13) Figures
- a) Must be directly after mention in text (within a couple of lines) if at all possible – **without generating white space.**
 - b) Figures must be mentioned in text.
 - c) Figures placed in landscape mode always have their tops to the left (toward the binding).
 - d) Captions should be single spaced in a text box that is grouped with the image will not cause a problem when the figure is shifted. Use of the “insert caption” option is preferred to support automatic generation of Lists of Figures.
 - i) Correct: captions need to be grouped with the picture
 - ii) Wrong: text going to the next page
 - e) If you have scanned a figure from a reference to include in your document, the scan quality must be high enough resolution to match your document. Use the “Paste Special” to paste it as different kinds of objects/pictures to see which looks best.
 - f) A figure must be fully contained on one page.
 - g) Captions should only label the figure. Descriptive text must be in the body text.
 - h) Your figure should reduce the amount of text needed. Do not describe in detail what the figure looks like – describe what knowledge it demonstrates.
- 14) Tables
- a) Must be directly after mention in text (within a couple of lines) if at all possible – **without generating white space.**
 - b) Tables must be mentioned in text.
 - c) Tables may be rotated 90 degrees if needed, but top of table is to the left (toward the binding).
 - d) Text in cells is usually left justified unless it is text labeling a column of numbers. Then the numbers and the label should be right justified. If the numbers contain a decimal point, always use the same number of decimal points on each number and be sure you properly represent the proper accuracy and repeatability of your measurements).

DO'S AND DON'TS OF M.S. THESIS AND PH.D. DISSERTATION WRITING (CONTINUED)

15) Presentations

- a) Must be reviewed and approved by your major professor before making your public presentation a week before your thesis or dissertation defense.
- b) There should be a footer on each page outside of your content area that contains "Name, Date, and Slide n/Total Number".
- c) Always test your color scheme using a projector for readability from the back of the room. For instance, red letters on dark blue background look OK on the computer screen but cannot be read when projected on a screen during your defense.
- d) Label all figures used in your presentation with the figure number used in the thesis or dissertation.
- e) Presentations for thesis / dissertation public presentations and for candidacy exams cannot be electronically recorded unless using μ EP recording equipment with pre-approval of the μ EP Director.

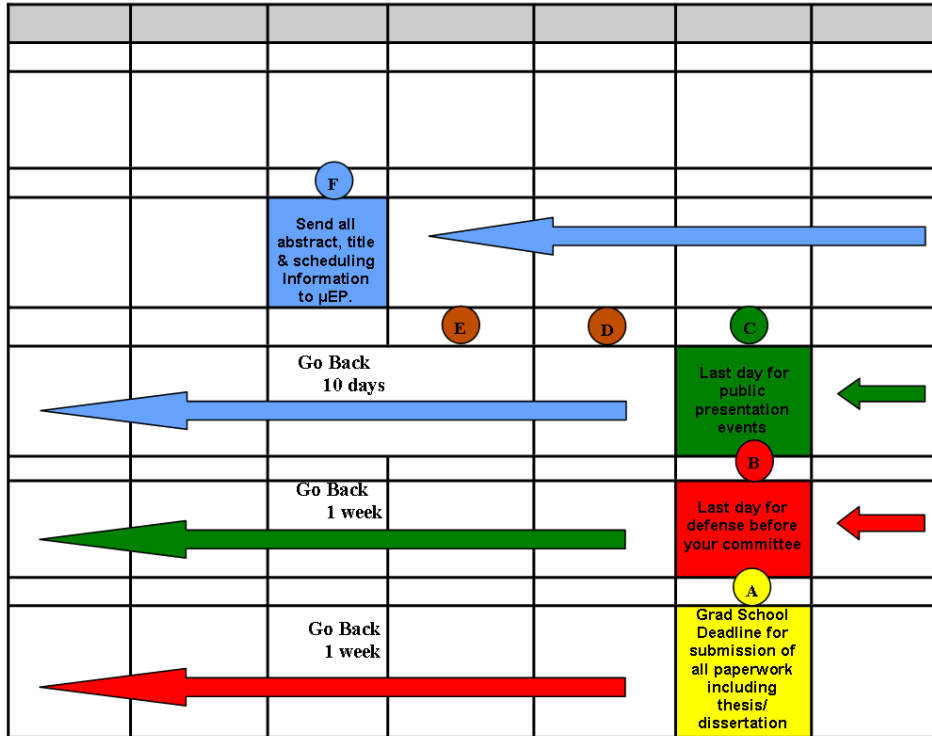
16) Signature Page

- a) The one exception to following the Graduate School guide is in the signature page. The μ EP program has an approved exception to the standard page to include signoff of plagiarism check and software usage. Please see the μ EP web site for the proper format of your signature page.
- b) The Director of the μ EP Graduate Program is an ex-officio member of the thesis and/or dissertation committee of each μ EP student. His or her name should be included on the signature page as a committee member.
- c) Bring all needed copies of the signoff page, plus extra cotton and paper pages, to your defense.

SEQUENCING AND TIMING OF FINAL DEFENSE COMPONENTS

Please enter your dates and remember if any event is missed then you will not graduate that semester.

Calendar



- A** Deadline for completion and submission of all graduation paperwork, including delivery of final thesis/dissertation printouts to the Graduate School.
- B** Latest date for Defense before your committee.
- C** Latest date for Public Presentation.
- C** The final draft of your thesis/dissertation must be delivered to all your committee members prior to your Public Presentation. (Requires signed approval page by major professor and μEP director before distribution to committee members)
- D** Last date for Director of μEP Graduate Program to authorize final draft for delivery to committee.
- E** Last date for Major Professor to approve the final draft for submission to μEP . This must be a complete document, exactly as specified in the Graduate School preparation guide and containing ALL μEP specific appendices.
- F** Student sends via email the reserved time and location of both the Public Presentation and the Defense to μEP office. The email also contains the Title and the Abstract. Public Presentations should have a three hour reservation, MS Thesis defenses a two hour reservation, and PhD defenses a two and a half hour reservation.

CLASSIFICATIONS OF ADMISSION TO GRADUATE STANDING

Full Graduate Standing, Regular Admission: Graduate School.

Before admission to the μ EP program, applicants must obtain full graduate standing, regular status, in the Graduate School. To be considered for full graduate standing, regular status, applicants must have a baccalaureate or a master's degree from the University of Arkansas, Fayetteville, or from a regionally-accredited institution in the United States with requirements for the degrees substantially equivalent to those of this University, or from a foreign institution with similar requirements for the degrees.

Admission to graduate standing does not automatically constitute acceptance to the μ EP Graduate Program leading to a M.S. or Ph.D. μ EP degree. To pursue these degrees, a person must also be accepted by the μ EP Graduate Program after gaining regular admission to graduate standing. International applicants cannot be admitted to graduate standing unless they are accepted into the μ EP Graduate Program at the same time.

Requirements for regular admission to graduate standing and acceptance in a program of study leading to a graduate degree can be found on-line at the web site <http://grad.uark.edu/>. A detailed guideline to the application is also found on the μ EP web site <http://microelectronics-photonics.uark.edu/student-future/application-process.php>

FORMS

Degree Plan

Funding Contract

Annual Review

Quadslide

Master's Committee

Master's Thesis Title

Declaration of Intent

Doctoral Dissertation Committee

Doctoral Dissertation Title

The Intellectual Property Disclosure Form

Electronic versions of these forms are available under the "Documents" link at <http://microep.uark.edu> or from the Graduate School website at <http://grad.uark.edu/>.