

microEP Graduate Program 2019 PhD Candidacy Exam Guidelines

January 3-14, 2019

Introduction

This exam is unlike any that you have ever taken before because it evaluates professional behaviors that may not have been formally assessed previously. Throughout your undergrad years, you were given information and, very shortly after that, were asked to give it back on a test or homework or a project. In the microEP Candidacy Exam, we are evaluating your accumulated skills in understanding a problem, putting it into the context of available technology, and using your own knowledge base to synthesize a novel solution that moves the boundaries of knowledge outward. Furthermore, it is particularly important for you to be able to make your concepts understandable to someone who is not intimately familiar with either the problem or your way of solving it.

This is the nineteenth time we have used this type of exam, and it will be a work in progress for as long as we follow this concept. In that regard, it is also a test for us in evaluating your skill sets. You are going to find this to be a lot of work and perhaps a bit more stressful than your customary assignments. But we think that this approach is more representative of the type of intellectual task you will be doing for the rest of your life either in industry or academia. We hope that when you have successfully passed this exam, you will give us feedback on the process so we can continue to improve our methods.

Logistics

You will meet on Thursday, January 3rd, 8:00 AM in NANO 105. You will receive a copy of each written candidacy exam problem statement. Each exam focuses on the development of an advanced application in a given field or area:

- SPAC: New materials, processes, devices or systems to support mission operations for robotic deep-space exploration
- AGRI: New materials, processes, devices or systems to support high-precision decisions to select resilient cultivars or to manage cropping systems

Weather contingency: in the event weather delays this meeting, you will be notified by email of a subsequent time to meet to pick up the exam.

You will have up to 20 minutes to select one exam. Before you leave the room, you will indicate on a sign-up sheet which of the TBD exams you intend to take. However, you will be allowed to take all TBD exams with you and you will be given until 12:00 noon on Friday, January 4th, to change your selection to another exam. You must send an e-mail to Drs. Rick Wise, Keith Roper, Panneer Selvam, and Renee Hearon if you wish to change to another exam. The e-mail must explicitly state your intention to change:

I, (your name), have decided to change to (exam name) as my Microelectronics-Photonics written candidacy exam.

If there is any ambiguity in your statement to change exams or if you do not notify by the required time (12 noon, Fri, January 4th), you will be responsible for continuing with the exam you selected on Thursday – NO EXCEPTIONS. You will receive an e-mail confirmation of your decision to change exams. If you do not receive this e-mail confirmation, contact Dr. Roper or Dr. Selvam by phone (before 12:00 noon, Fri, January 4th).

Following this initial session, you can request exam clarifications from the microEP exam administrator, Professor Keith Roper, until noon on Friday the 4th. You can ask any question you want, and Prof. Roper will provide a response. From past experience, the answer to most questions will be, “Read the following section of the exam or guidelines...” All questions and answers will be sent to all students affected by the information (everyone, in most cases).

Contact information for Dr. Keith Roper is:

cell phone: (801) 891-8921
email: dkroper@uark.edu

Contact information for Dr. Selvam (if you cannot reach Dr. Roper) is:

cell phone: (479) 236-2387
home phone: (479) 521-1023
work phone: (479) 575-5356
email: rps@uark.edu

Before you leave the room on Jan 3rd, you will receive a scheduled time on Tuesday Jan. 8, 2019 for Dr. Roper to call you to hear what is your status and respond to questions you may have (from past experience, the answer to most questions will be, “read the following section of the exam or guidelines...”). All questions and answers will be sent to all students affected by the information (everyone, in most cases).

Before you leave the room on Jan 3rd, you will receive a scheduled time to turn in your exam on Monday, January 14th, 2019. The completed examination must be returned to Renee Hearon in the microEP office by the start of your scheduled time. Please follow the process below for your submission.

1. Generate a PDF version of your final document.¹
2. Submit that PDF to the plagiarism web site.
3. Print the PDF onto paper, date and sign each page, and bring that hardcopy to the microEP office by the scheduled time.
4. Bring an electronic copy of your final document in PDF Format *on a new, clean flash drive* and the printed, signed and dated copy to the microEP office by the scheduled time.
5. Name the file ‘nnnnn.pdf’ where ‘nnnnn’ is the self-selected 5-digit code in your footer.
6. From the computer in Renee’s office, email the PDF document to Renee, and receive a confirming email from Renee that the document was received.

NO EXAMS WILL BE ACCEPTED AFTER YOUR SCHEDULED TIME

¹ “LaTEX software can create formatting issues when converted to Word or .pdf; take this into consideration when planning your timeline.” University of Arkansas Thesis and Dissertation Guide

Your exam will be reviewed and assessed by engineers and scientists with expertise in micro- to nano-scale materials, processes, devices and systems. Your exam will only be identified by your 5-digit code so that your identity will remain anonymous to the reviewers (until you appear in person for the oral examination). The reviewers will evaluate your exam, and provide written feedback, based on the following criteria:

- A. **Originality** -- creativity of proposed ideas, implementation methods, and solution;
- B. **Technical Understanding** – of scientific principles and concepts underlying the work;
- C. **Engineering** – Viability of proposed approach and methods; implementability of proposed solution considering economic, intellectual property, and other practical issues.

You will receive written feedback from the assessment panel *approximately* 7 to 10 days *before* your oral examination is scheduled. Multiple factors affect this time, so it is possible that it may vary within or outside this target.

All students will be scheduled to discuss their work with their exam’s assessment panel members. Each candidate will have *approximately* the same amount of time between receiving their written feedback and their oral presentation. This oral presentation will be about one hour and will be scheduled during Wednesday February 6th to Tuesday February 12th. Each student will be expected to bring to the oral exam a PowerPoint file with slides summarizing critical aspects of their solutions responding to written feedback received, including slides with all figures from their written report. A projector and computer will be supplied, although students may bring their own computers if they wish. The reviewers will be asked to evaluate your oral presentation on the three above criteria, but there is no restriction or limit on content area during the Q&A period or subsequent discussions. The schedule for oral exams is:

15 minutes	student arrives and prepares their materials <i>before</i> scheduled start time
5 minutes	evaluators and students introduce themselves
15 minutes	student oral presentation: refined solution addressing written feedback
25 minutes	Q&A (student leaves after Q&A)
15-30 minutes	panel deliberation, feedback, and scoring

The evaluation will be finalized by the assessment panels. The microEP administrators will assemble the assessment and all information relevant to the exam and prepare it for consideration by microEP faculty. The final assessment result will be approved by the microEP faculty within about one week after all panel discussions are complete. This may, however, take longer depending on several factors. You will receive notification of the outcome of your exam *approximately* 7 to 10 business days after panel discussions are complete.

Sources for information authorized during examination

You may use any written source of information in formulating your answer. This does include on-line searches and internet materials. If you are using textbooks that are in any of the university libraries, please do not check them out. Your microEP colleagues taking this exam may also need to use them in the course of formulating their own answers.

Library Hours can be found at: <http://libinfo.uark.edu/hours/default.asp?date=1/1/2017>

Access to most of the electronic databases, journals and books are available only from on campus and can be accessed through this link <http://www.informaworld.com>. Paper books or journals will not be available when Mullins Libraries are closed.

You may ***NOT*** discuss this exam in any fashion (oral, written, sign language, smoke signal, etc.) with any person except the microEP exam administrators. It is emphasized that your major advisor should specifically not be approached in casual conversation on your approach or progress to date. It is expected that you will have casual contact with faculty, microEP students, and other candidates during your exam week. General conversations with your colleagues are not restricted during this week, but it is your responsibility to immediately disengage from any conversation that might be construed to pertain to the examination process.

Areas of Emphasis

Each exam will allow an emphasis in either material/processes or device/systems. Your emphasis may be from 20 to 80% materials/processes; the difference will be in device/systems (100% total). You may choose to pursue an electronic, photonic, or combination approach to your solution.

The examiners will assess your understanding of both the science and engineering aspects of your selected problem. Your solution will concentrate on the use of advanced materials, processing, and devices at the micro and nanoscale. We anticipate that your response will give appropriate treatment to all of these areas.

While specific instructions will be given in each examination document, in general your solution will be expected to address:

- Current state-of-the-art – what you know of the field
- Your Proposed Solution - describe your solution to the problem, including both the scientific/engineering basis and the methods of applying this to a workable solution. Be sure to include the significance and novelty of your solution
- Testing and Qualification – how will you prove that the device works and is reliable
- Cost considerations – as contributing to your decision on a solution

The review panels will be strongly interested in your synthesis of knowledge gained from multiple sources into new approaches and ideas. While a solution may be found by piecing together component ideas that are appropriately cited, a solution that depends heavily from plugging prior work together in a new fashion will rarely be a better solution than one based on synthesized new approaches.

Examination format

This document (the Candidacy Exam Guide 2019) provides a template for you to use. In general:

1. It is critically important to fully reference any materials directly copied from another source. Material that meets the criteria for use of quotations (but are not in quotes) will be considered as plagiarized – ***even if you have your document's text marked with a reference that takes you to the exact paragraph in the original document.*** Plagiarism will be grounds for failure without grading of content. You are required to submit your final document to a website for plagiarism evaluation, and are encouraged to submit early revisions to the site to assure you

have no inadvertent plagiarized material in your document (see page 5 for more details on this program and its use).

2. Proper citations of paraphrased single source information must be rigorous.
3. Use 12 point, Times New Roman font. Smaller font may be used in diagrams or figures, provided it is readable to the review panel members when printed on normal office printers.
4. Use one inch margins on sides, top, and bottom.
5. Lines must be single spaced.
6. Modify the footer information contained in this document to replace “nnnnn” with a random five-digit number of your choice and use this as the footer of your document. Choose a number sequence that will not be associated with you by any member of the assessment panel.
7. The first page should include the title, and an Executive Summary that (i) introduces the science basis for your solution; (ii) describes the engineering approach; and (iii) summarizes the novel elements of your proposed solution.
8. The second page should be the Risk Assessment Roadmap (defined at the end of this document)
9. You are limited to a maximum of 15 pages beyond these two pages for your proposal (including diagrams and illustrations). A proposal less than 15 full pages is unlikely to be comprehensive. You may find important information must be left out in order to compress the response to 15 pages. Be sure to leave yourself time to edit the responses to meet the limit.
10. *Two required appendices are not counted toward the fifteen page limit. The list of references cited in the proposal [Appendix 1] and a ranked list of publications examined as part of the intellectual property question [Appendix 2]. No other appendices are allowed.*
11. Do not (i) use a cover page or (ii) restate the problem. Use your pages wisely to bring new information to the assessment panel members.

Final Note to Candidates

This is a PhD capability assessment process and should be approached with a great deal of seriousness. It is anticipated that fully answering the questions in the exam should require the full time allotted for the examination process (reflection, solution, documentation, reflection, and final documentation). Answers are expected to contain the level of detail necessary to fully evaluate your PhD level approach and understanding of a complex problem in the microelectronics-photonics field.

CAUTIONS:

- 1) Save often. Computers can crash. Save your written work often and in several locations (hard drive; email yourself; thumb drive).
- 2) For an unexpected emergency, contact Dr. Roper or Dr. Selvam as soon as you can.
- 3) Do not share your document with anyone until after the full process is complete.

Plagiarism Check Website Details:

You will have access to a plagiarism site for document evaluation. You may submit three drafts and 1 final document to the site. Multiple versions of each draft may be submitted. Your percentage score should be as low as reasonable possible. Following are typical levels of text identified as plagiarized, and the corresponding response you are expected to take:

- Expected (can be ignored): Required labeling on your document’s title pages, titles of papers in references, etc.

- Trivial (can probably be ignored, but think about it carefully): Lists of factual elements, common short phrases, etc.
- Marginal (requires some thought, but should probably be changed): Phrases from equipment descriptions, language used in your own prior published papers, etc.
- Terrible (probably needs to be changed or document will be rejected): Series of phrases that track similar phrases in another document.
- Catastrophic (must be changed or document will be rejected): Exact duplicate content in normal body of your document.

Do not wait until just before submitting your exam to check plagiarism. The plagiarism check may take many minutes. You will not be allowed to turn in your document late because of time required for the plagiarism check. The exam administrators will check the plagiarism report ONLY of your final submission (this must be the same document that you submit to the microEP office for panel evaluation), so be sure that you are satisfied with your final exam copy. The exam panel will use the originality report in their evaluation, and any plagiarism will be grounds for failure.

Please note that our experience is that you cannot cut and paste a body of text into your document and change it enough through editing to make it your own words. Instead, consider reading several bodies of work on a subject, put those papers away, and then write from a clear screen in your own words what you wish the reader to understand from those works.

Risk Assessment Roadmap

You are one of the lead technologists in your company and have been given the task described in the exam. This task spans materials science, process development, device design, and system definition. On the table below, you will put an ‘X’ in the appropriate box to identify, first, what is the aspect that your proposal focuses on at each of two levels:

- a. base materials and/or processes *and*
- b. devices and/or systems.

and second, what is the content level of intellectual property that your proposal represents at each aspect:

1. requiring pure research;
2. modifying known science and/or technology;
3. using known science and/or technology; or
4. not applicable.

You *must* identify content level 1, 2, or 3 for *at least one* of the aspects listed on both line a. *and* line b.

Your company thinks that a higher level of new intellectual property (pure research) embedded in your solution has higher profit potential. At the same time, pure research incurs higher risk, requires more time, and consumes more resources. These factors impact the probability of your proposal’s success. Thus, proposing pure research in *all four aspects* of a proposal would tend to increase the resources required, heighten uncertainty of progress, and minimize probability of a successful targeted outcome.

You will identify the ‘area of emphasis’ for your proposal by entering a value between 20% and 80% on the line representing

- i. Materials/Processes; and
- ii. Devices/Systems

You *must* identify *at least* 20% but not more than 80% on each line. The total of the two values must sum to 100%. The matrix shown below will be the second page of your proposal, and will be the road map by which your proposal will be evaluated.

	Not Applicable	Using Known Science/Tech	Modifying Known Science/Tech	Requiring Pure Research
Base Materials				
Processes				
Devices				
Systems				

Area of Emphasis: **Materials/Processes** _____ **Devices/Systems** _____