

University of Arkansas Materials Science & Engineering Interdisciplinary Graduate Program
MSEN Candidacy Exam Standard Operating Procedures (SOP) and Guidelines
(December 31, 2020 – January 11, 2021)

1 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 MSEN 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 21st 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.

2 Objectives

The objective of the Candidacy Exam (CE) is to test the student's intellectual maturity and fundamental knowledge in materials science and engineering (MSEN). This is achieved by requiring Ph.D. students to prepare a sound proposal that requests reasonable funding to conduct R&D on a unique, interdisciplinary topic. Students are also required to demonstrate their ability to effectively communicate their proposal in an entrepreneurial start-up context via a written proposal and oral presentation.

The CE and resulting evaluation will serve as an indicator of the candidate's ability to succeed in their doctoral careers, whether that be in academia or industry. An important component of the examination is evaluating the capability for critical and creative thinking, the ability to summarize and critically assess a large body of literature, and the ability to propose cutting-edge research to fill gaps in knowledge related to the selected topic.

As currently drafted, this CE process and requirements will be in addition to the existing PhD research proposal and presentation that the students are required to complete as a portion of their overall PhD candidacy preparation.

3 Requirements

All MSEN students pursuing the Ph.D. degree are required to pass the CE to be eligible to continue and complete their Ph.D. work. Students should take the CE for the first time before the second Spring Semester into their Ph.D. curriculum (or before first spring semester if they received their MS in UA MSEN program) via the CE Request/Readiness Procedure (Section 6). And per that procedure, if the student's advisor feels that the student is not ready, a 1-year extension may be requested. Currently, the Candidacy Exam is only offered during the Winter break between the Fall and Spring semesters. MSEN 5383 (Research Commercialization and Product Development – taken first Spring Semester) and MSEN 6323 (Materials Engineering Design and Proposal Writing – taken first Summer Semester) must be completed before taking the exam.

4 Components

The MSEN Candidacy Exam consists of:

(1) Ph.D. Candidacy Exam Proposal - a written, focused proposal based on NSF PAPPG/SBIR/STTR (https://www.nsf.gov/pubs/policydocs/pappg19_1/index.jsp; <https://seedfund.nsf.gov/>) requirements that

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is prepared in response to a specific topic, not directly connected to the candidate's Ph.D. thesis topic; and the

(2) Oral Ph.D. Candidacy Exam - a presentation and defense of the written Candidacy Exam Proposal. Students must demonstrate deeper knowledge of fundamental materials science and engineering concepts related to the written report guided by questions and feedback from the review committee.

These unique topic-based exam components are in addition to the student's Ph.D. Research Project Proposal and Presentation that is organized and overseen by their Dissertation Committee.

5 Timeline

Summary of the important dates for the Ph.D. CE is provided in Table 1 below:

Table 1: Important dates

Key Dates	Winter Break
MSEN Director to notify major professor of the students that must take the exam	~September 1
Submit request for CE Readiness or Extension to Dissertation Committee and MSEN Director for approval	~September 15
CE Orientation for Students	~October 15 and/or December 1
Schedule/confirm faculty review participants	~December 15
CE Coordinator prepares at least three CE topics for MSEN review/approval	~December 1
Candidates meet w/ CE Coordinator and select topic (Exam begins)	~December 31
Written portion due	~January 11
Written feedback to candidate from committee	~January 27
Oral portion due	~Feb. 3 – Feb. 9
Deadline for completing the re-writing, additional material and/or coursework to fulfill conditional pass requirements	If re-write, etc.: within 2-4 weeks of committee decision If coursework: by the end of the Spring Semester the following year

6 Exam Readiness Application and Extension Application Procedures

By September 1, the MSEN Graduate Program Director notifies the candidates (and their advisors) who must take the exam the following Spring Semester, i.e. PhD students who will be starting their 2nd spring semester in the program or 1st Spring Semester if they received their MS in the UARK MSEN program.

If the student's advisor feels that the student is not ready for the exam, a 1-year extension may be requested. This will be available to the student/advisor only once – either before the 1st exam attempt OR before the 2nd exam attempt, but not both.

Further, on the *MSEN CExam Extension Application Form*, the student's advisor must indicate why the student is not ready and what will be done over the course of the 1-year extension to help the student prepare for the next CExam cycle. This extension request must be approved by the student's dissertation committee and the MSEN director

Once the student is approved to proceed with the MSEN Ph.D. Candidacy Exam by their advisor, students will provide the MSEN Graduate Program Director with an electronic version with the following contents:

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the name of the candidate, the name of the candidate's advisor(s), degrees received, current dissertation topic, a 300-500 word abstract of current dissertation research. Candidates must also provide a 300-500 word abstract of their MS thesis.

This information, once the student is approved to proceed, is used by the MSEN CE Coordinator to suggest and assign the topic for the written portion of the CE.

Students who need special accommodation should provide recordation letter from the Disability services with their CE application. The Graduate Program Advisor and the Chair of the MSEN Ph.D. Examination Committee will then work together to meet special accommodation requirements.

7 Exam Committee Formation Procedure

The examination committee will consist of the MSEN CE Coordinator, the MSEN Program Director and four MSEN faculty members that are not part of the students' dissertation committee. All MSEN faculty are required to sign-up for at least one (1) candidacy exam review panel per year. Faculty with a student taking the candidacy exam are required to sign-up for at least two (2) candidacy exam panels. The written proposal review will occur from ~January 13 – January 20 and the oral examination will occur at some point between ~February 3 to ~February 9.

Allowable exceptions to faculty sign-up include: maternity leave taken during the exam review timeframe, conference travel/attendance that occurs during the exam review timeframe, sabbatical taken during the exam review timeframe, illness and/or other hospitalization that requires leave during the exam review timeframe. If any of the allowable exceptions are expected to occur and/or arise unexpectedly, please convey absence to the MSEN/MEPH Graduate Program Director. Any other special conditions that may apply should also be communicated to the MSEN/MEPH Graduate Program Director.

8 Exam Orientation

All Candidacy Exam students are required to attend the orientation session provided by the MSEN Program Director and/or the MSEN CE Coordinator. This session will explain the procedures for the MSEN Ph.D. Candidacy Exam and answer questions. Further, MSEN 6383 provides in-class training to assist MSEN students in preparing for the MSEN Ph.D. Candidacy Exam, and also leverages the NSF PAPPG/SBIR/STTR proposal requirements.

9 Exam Topics and Selection Process

The MSEN Ph.D. CE Coordinator will review the approved students MS thesis and/or Ph.D. dissertation topic summaries and prepare several unique topic descriptions for the MSEN Graduate Program Director and MSEN Associate Directors to review and approve. This will be completed per the schedule provided in Table 1. The topic description is prepared such that it lies outside of the candidates' dissertation topics but complements their doctoral coursework and general areas of research. The final topics chosen by MSEN Directors are presented to the students to select per the schedule provided in Table 1.

10 Logistics

You will meet on **Thursday, December 31, 9:00 AM via MS Teams** (meeting will be held online this year). 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 prepared by the Candidacy Exam Coordinator.

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. (not applicable this year)

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You will have up to 20 minutes to select one exam (for this year, you will notify the MSEN CE coordinator and MSEN program director by 10:30 am via e-mail which exam you intend to take). Before you leave the room, you will indicate on a sign-up sheet which of the TBD exams you intend to take (not applicable this year). However, you will be allowed to take all TBD exams with you and you will be given until 12:00 noon on **Friday, January 1**, to change your selection to another exam. You must send an e-mail to Drs. Rick Wise, Matt Leftwich, 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 Materials Science & Engineering 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, **Friday, January 1**), 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. Leftwich or Dr. Selvam by phone (before 12:00 noon, **Friday, January 1**).

Following this initial session, you can request exam clarifications from the MSEN Exam Coordinator, Professor Matt Leftwich, until noon on **Friday, January 1**. You can ask any question you want, and Prof. Leftwich 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. Matt Leftwich is:

cell phone: (479) 215-9438

email: mleftwi@uark.edu

Contact information for Dr. Selvam (if you cannot reach Dr. Leftwich) 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 (meeting) on **Thurs., Dec. 31**, you will receive a scheduled time on **Monday, Jan. 4, 2021** for Dr. Leftwich to call you to discuss 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).

Also before you leave the room (meeting) on **Thurs., Dec. 31**, you will receive a scheduled time to turn in your exam on **Monday, January 11th**, 2021. The completed examination must be returned to Dr. Leftwich and Renee Hearon in the MSEN 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. (*“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*)
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 MSEN office by the scheduled time.

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4. Bring an electronic copy of your final document in Word (or LaTeX) and PDF Format on a new, clean flash drive and the printed, signed and dated copy to the MSEN 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.
7. **NO EXAMS WILL BE ACCEPTED AFTER YOUR SCHEDULED TIME**

11 Exam Format

11.1 Written Exam (refer to Candidacy Exam Template)

The written proposal is composed of a rigorous literature review of the selected topic with the emphasis on critical analysis and identification of key outstanding issues and/or research opportunities with commercialization potential. The candidate is expected to propose ideas on how to address these issues, exploit the commercial opportunity and/or suggest and discuss possible future research directions towards eventual product or service development for a commercial application.

The proposal must be prepared and written by the candidate independently and individually. All Ph.D. Candidacy Exam Proposals will be submitted to the MSEN CE Coordinator for immediate Administrative Review by your submission time on the due date (see Table 1).

If the candidate passes the Administrative Review, the exams will be forwarded to MSEN Program Specialist for preparation and distribution to the CE Review committee per the typical "blind" review requirements.

Candidacy Exam Proposals submitted after the deadline will not be evaluated by the CE Committee. Candidacy Exam Proposals that do not satisfy the Administrative Review requirements will not be evaluated by CE Committee. In both cases, the student will fail the CE.

Each member of the student's CE Review Panel will provide written feedback per the review criteria revealed in the CE Written and Oral Review Worksheet. The MSEN CE Coordinator will collect the written reviews and distribute to the CE students (per Table 1) to aid in preparing their oral presentations.

All Ph.D. Candidacy Exam Papers will be checked for plagiarism before being evaluated by the Examination Committee. A plagiarized Ph.D. Candidacy Exam solution and will be reported per UA policy.

Students will have access to a plagiarism site for document evaluation. They may submit three drafts and one final document to the site. Multiple versions of each draft may be submitted. Your percentage score should be as low as reasonably 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.

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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 MSEN 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.

Refer to the accompanying *MSEN Candidacy Exam Template* for detailed formatting instructions.

11.2 Oral Exam

The CE proposal will be presented and defended by the candidate to the Examination Committee. The presentation should consist of no more than 20 power point slides. During or after the presentation, the Examination Committee will ask questions not only regarding the paper and presentation but also exploring the candidate's fundamental materials science and engineering knowledge needed for in-depth understanding of scientific issues, concepts and theories related to the selected topic. This oral defense component is expected to be 45-60 minutes. (Times noted are at the discretion of the committee)

The reviewers will be asked to evaluate your oral presentation on the criteria described in more detail in the *Oral Exam Review and Final Grade Form*, 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 before 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 designated chair of the Examination Committee is responsible for ensuring the integrity of the exam is maintained and all components of the exam are completed. AND, they are responsible for ensuring that the line of questioning from the panel members does not go beyond the scope of their specific curricular knowledge and limited research experience.

11.3 Sources of Information Authorized During the 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 MSEN 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.

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Students may **NOT** discuss this exam in any fashion (oral, written, sign language, smoke signal, etc.) with any person except the MSEN 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, MSEN 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.

12 Exam Evaluation

Student's exams will be reviewed and assessed by engineers and scientists with expertise in broad aspects of Materials Science and related device and system-level applications of nanoscale, microscale and bulk materials. 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 accompanying CE Evaluation and Review Sheet.

An Administrative assessment will occur immediately upon written exam submittal. Refer to the *Administrative Candidacy Exam Review Form* and the *MSEN Candidacy Exam Template* for explanation of required components and evaluation criteria. If the written exam is not fully compliant with the requirements indicated on that form, it will be rejected without further review. The candidate will have to wait until the next Candidacy Exam cycle for their second, and final attempt.

Students 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. Refer to the *Written Candidacy Exam Review and Feedback Form* for detailed explanation of the written evaluation criteria.

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 **~February 3rd to ~February 9th**. 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 evaluation will be finalized by the assessment panels. The MSEN administrators will assemble the assessment and all information relevant to the exam and prepare it for consideration by MSEN faculty. The final assessment result will be approved by the MSEN faculty within about one week after all panel discussions are complete. This may, however, take longer depending on several factors. Students will receive notification of the outcome of your exam approximately 7 to 10 business days after panel discussions are complete. Refer to the *Oral Exam Review and Final Grade Form* for detailed explanation of the oral exam review criteria.

Four members of the Candidacy Examination Committee will decide whether the candidate has passed or failed CE by a vote. The voting takes place immediately following the oral presentation and in the absence of the candidate. When appropriate, the committee may vote for a conditional pass. Scoring and voting are guided by the accompanying MSEN CE Review Sheet.

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All members of the Examination Committee indicate their vote (F, P, or CP), sign an evaluation form (CE report) and the Chair Examination Committee returns the completed form to the MSEN Program office immediately after the defense. A letter (or email) of the CE Results will be sent to the candidate and their advisor by MSEN Program Director after the recommendations have been approved by the MSEN faculty. CE Results Reports can have the following outcomes:

Pass CE – suggestions and recommendations for further improvements, if any.

Conditional pass of CE – justification for conditional pass and clear description of required improvements for passing CE.

Failed CE - justification for failing CE and recommendations for the further improvements.

In the case of conditional pass the Examination Committee can request following:

- Revision of the Ph.D. Candidacy Exam Paper – to be submitted to the Examination Committee within 2-4 weeks. The committee will review revised version of the paper and decide again whether the candidate has passed or failed CE by voting.
- The committee may require the candidate to answer questions to be submitted in the written form within 2-4 weeks. The committee will then review the candidate's answers and vote on pass or fail.
- Another oral exam may be required and will be held within 2 – 4 weeks. The committee will vote for pass or fail after the second oral examination.
- Coursework may be required to aid in addressing a deficiency and must be completed by the end of the Spring Semester of the following year.

In the event that the candidate fails the first attempt, a retake must be completed during the next CE cycle the following year. If the candidate does not pass on the second try, further doctoral work in MSEN is ended. In such a case, it may be allowable to continue to study for an M.S. degree in MSEN if one has not been conferred by the University of Arkansas.