PH.D QUALIFYING EXAMINATION
PROCEDURE

October 2014

SCHOOL OF NUCLEAR ENGINEERING
This document outlines the recommended process for and the content of the Ph.D. Qualifying Examination for the School of Nuclear Engineering at Purdue University. Organization of the recommendation is straightforward. First, the philosophy underlying the exam is stated. The second section outlines the format and content of the exam and has two subsections – one for the written examination and one for the combined research assessment paper and oral examination. The third section describes how the students’ grades will be determined on each portion of the exam and communicated to the students. The fourth section outlines how students who did not pass all parts of the Qualifying Examination in Spring 2015 will complete the qualifying process. Section five specifies how the papers from the Qualifying Examination will be filed. Finally, a list of attachments to this document is provided.

Philosophy

- An overarching goal of the School is for each student admitted to the NE Ph.D. program to work closely with an advisor and advisory committee, getting support as necessary from the entire NE faculty, to complete a Ph.D. and launch a successful career.

- The purpose of the qualifying examination is to determine whether the student has the knowledge, skills, and ability to conduct independent scholarly research

- The qualifying examination process must be equitable and transparent to all students and faculty

- Preparing for the qualifying exam should be viewed as an educational process that also helps to maintain high standards of the School.

- All faculty members are committed to ensuring confidentiality of the exam.

- Because the School of Nuclear Engineering is growing and changing – adding new faculty with new areas of specialization, attracting increasingly stronger students, receiving funding from new sources, preparing students for different careers – the qualifying examination process and content should be reviewed periodically.

Format and Content of the Exam

- The exam will consist of (1) a written portion testing the student’s general knowledge of fundamental nuclear engineering concepts and (2) a research assessment paper and oral examination covering the student’s selected specialization area.
• A description of the examination process and the general content of the exam are included in the Nuclear Engineering Graduate Program Manual.

• A comprehensive list of the concepts with which a student should be familiar for each portion of the written exam and each specialization area will be prepared by the faculty committee responsible for each examination and will be posted on the School’s website before the students sign up to take the exam.

• All concepts covered on the qualifying exam must be taught in the core courses required of incoming graduate students and may be complemented with additional preparatory coursework as deemed appropriate by the candidate’s advisory committee to ensure adequate preparation for the qualifying exam. Many of our new graduate students come from other universities, and several have undergraduate degrees in fields other than nuclear engineering. We cannot presume they have learned the concepts elsewhere.

• The questions on the written examination will be at the depth the material is covered in the Nuclear Engineering graduate core courses and the upper division Purdue undergraduate Nuclear Engineering courses. The questions on the written exams will also test the students’ comprehensive and integrated knowledge.

• The timeline for administering the qualifying exam will be as follows (The exact QE schedule will be posted on NE web site.):
  
  o Students will receive a journal paper they are to read for the research assessment paper around the middle of December.
  o Students will take the written examinations around the first week of February.
  o Students will turn in the research assessment paper around one week before the written examination.
  o Oral examinations will begin approximately around the third week of February.
  o Faculty will meet to discuss grades and make a recommendation to the Head about the line between pass and fail for each written exam approximately one week after the end of the oral examinations.
  o Students will be notified of their final grades on the exam approximately around the second week of March.

• Students planning to take the examination in the Spring Semester should sign up four weeks before the end of the previous Fall Semester and indicate, in writing with official registration form.

• The current areas of specialization are: fusion, materials, thermal-hydraulics and safety, reactor physics, and nuclear structures and radiation interactions. In future years, the list of areas of specialization may change. Two criteria for preparing the list are (1) each faculty member should be confident that each of his or her students can be accommodated in one of the areas and (2) the areas should be broad enough that the
Head can assemble for each area a committee of at least 3 faculty members who are reasonably well versed in the area.

- The Graduate Chair will hold an information session for all students planning to take the Qualifying Examination in Spring. The briefing will be held at least 2 weeks before students must declare that they are taking the exam. Power Point slides used in that briefing will be sent to all faculty members prior to the briefing.

- Time line for preparing and announcing the Qualifying Examination. The exact QE schedule will be posted on the NE website.
  
  - Announce schedule for Spring 2015 Qualifying Exam to students – Fall 2014, week 1
  - Head appoints at least 2 faculty members to prepare each written general exam – Fall 2014, week 2
  - Head appoints 3 or 4 faculty members to each Area Committee. Each Area Committee will be responsible for the research assessment paper and oral exam in one specialty area – Fall 2014, week 2
  - Faculty members responsible for each written exam prepare a list of concepts that could be covered by that exam and submit to the Graduate Chair – Fall 2014, week 6
  - Each Area Committee prepares a list of concepts that could be covered in the research assessment paper and oral exam in its area and submit to the Graduate Chair – Fall 2014, week 6
  - Graduate Chair sends faculty members copies of draft slides for presentation to potential QE participants – Fall 2014, week 7
  - Graduate Chair has concepts posted on the website and holds briefing for students planning to take the QE in Spring 2015 – Fall 2014, week 8
  - Students planning to take the QE in Spring 2015 must notify Graduate Chair of that intention via e-mail by 5:00 p.m. and include their area of specialization – Fall 2014, Friday of week 12.
  - If the thesis advisor of any student who is planning to do the research assessment paper and oral examination in a specialty area is not on the Area Committee that will administer the student’s exam, the Head will appoint the advisor to that Area Committee as a full member – Fall 2014, week 13.
  - Two faculty members writing each general exam submit exam, solutions, and grading rubric to Graduate Chair – Fall 2014, Friday of week 14.
  - Each Area Committee selects the journal paper students in that specialization area will read for the research assessment paper – Fall 2014, Friday of week 14.
  - Graduate Chair and faculty writing each general exam discuss any questions the Graduate Chair may have about the exam – Fall 2014, week 15.
  - The two faculty members writing each general exam submit final exam, solutions, and grading rubric to the Graduate Chair – Fall 2014, Friday, week 16.
Written examination

- Each student will be required to take four 90-minute written general examinations. The four areas are listed below along with the courses in which topics in these areas are currently taught.

1. Nuclear Engineering Fundamentals and Reactor Physics (NUCL 300, 310, 510 (501))
2. Nuclear Materials (NUCL 320, 501, 420, 520)
4. Nuclear Radiation Detection and Protection (NUCL 200, 300 (205, 305, 504, 501))

- Faculty members with responsibility for preparing each general examination will be assigned by the Head of the School of Nuclear Engineering in consultation with the Graduate Chair. At least two faculty members will collaborate on each general exam.

- The faculty members’ assigned responsibility for a specific examination will develop or select questions for that exam and prepare solutions to all problems along with a grading rubric indicating how partial credit will be assigned.

- By Friday of Week 14 of the semester preceding the semester of the Qualifying Exam, the pair of faculty members preparing each written general exam will give the questions, solutions, and grading rubric to the Graduate Chair for review. The review will include ensuring that the questions relate directly to concepts listed for the exam and that the exam is of the specified length and level of difficulty.

- Any concerns about the questions, solutions, or grading rubric will be resolved by the faculty members preparing the exam and the Graduate Chair with the final resolution approved by the Head.

- The Graduate Chair will coordinate the examination.

- All faculty members with access to the examination and solutions will protect that material and convey no information about the exam to any student beyond that provided in the Graduate Chair’s briefing to the students.

- The written examination in each area will be 90-minute long. Students will be given one exam at the beginning of the exam, and all exams will be collected at the end of the exam. After a 15-minute break, the students will be given the second exam and will have 90 minutes to complete it.

- The students will take 2 general exams one day and the other 2 the next day.
• The examinations will be closed book.

• Each student will be assigned an ID number which will be used on the examination in lieu of the student’s name. Faculty members grading the exam will not know the students’ ID numbers. Only the Graduate Chair and the Head will have access to the names associated with the ID numbers.

• The name associated with each ID number will not be revealed until after the final decision on the minimum passing grade for each written exam is made.

• Each written exam answer will be graded by the two faculty members who wrote the question with the grading based on the solutions and rubrics provided to the Graduate Chair. The Graduate Chair may assign a third grader in case of a significant discrepancy between the two grades.

• Within one week following the exam, graded written examinations will be given to the Graduate Chair along with a summary of results showing the number of points earned by each student on each question.

Research Assessment Paper and Oral Examination

• Each student will declare a specialization, in writing, when registering to take the qualifying exam.

• The areas of specialization are fusion, materials, thermal-hydraulics and safety, nuclear structure and radiation interactions, and reactor physics. (Over time, the areas of specialization will change as the faculty, students, and external conditions change.)

• The student will be assigned one archival journal paper in the specialization area to read, summarize, critique, and extend. The summary of the paper will demonstrate the student’s understanding of the material. The critique will include both the student’s own evaluation of the work and a comparison with work of other researchers in the area. It will also include a discussion of the impact of the paper and place the paper in historical perspective. In the extension, the student will identify important questions raised by the paper, gaps in the research, or substantive weaknesses in the paper. He or she will then make a preliminary attempt to address the questions or gaps or otherwise strengthen the paper.

• Each Area Committee Chair will send a copy of the paper to the Graduate Chair by Friday of Week 14 of the Fall semester preceding the Qualifying Exam. In the event that the Area Committee cannot reach agreement on a paper to be assigned, the Graduate Chair and the Head will decide which paper to assign.
• All students in one specialization area will receive the same paper to assess. The requirement for independent work on the research assessment paper must be emphasized to the students.

• At the time that the student picks up the archival journal paper to be read, he or she will be asked to sign a form indicating that the student received the research assessment package (article to read, outline of paper the student is to write, and due date) and that the student will work independently. In addition the student will acknowledge receipt of a statement that if plagiarism is detected in the written assessment paper, the student will receive a failing grade for the research assessment paper and oral examination and may be subject to further penalties up to and including dismissal from the university.

• The journal article assigned for the research assessment paper cannot be written by any current Purdue NE faculty member, recent NE faculty member, current student, recent graduate, or anyone with a close enough association with one of the Area Committee members to cause a conflict of interest.

• The assigned paper should be of the quality that a faculty member would prepare.

• The assigned paper should not be on a topic on which one of the students is currently conducting research.

• The research assessment paper prepared by the student should be approximately 15-20 pages, double spaced, exclusive of title page, table of contents, abstract, nomenclature, figures, tables, and references. The student will receive a general outline of the assessment paper that is to be prepared.

• Students will have six weeks to prepare the research assessment paper. The paper will be due one week before the written examination.

• All members of the Area Committee will independently grade the written research assessment paper the student prepares based on a standard grading rubric that will be provided and using a standard grading sheet that will also be provided. On the grading sheet, the faculty member will indicate how well the student performed in each of several areas and whether the faculty member judges the paper to be passing or failing. Each Area Committee Chair will collect grading sheets done by each Area Committee members and will submit them to the Graduate Chair.

• The written document prepared by the student as part of the research assessment paper and oral examination may be checked by a plagiarism checking software. If the written assessment paper is found to contain plagiarized material, the student will not be allowed to take the oral exam and will receive a failing grade for the research assessment paper and oral examination. In addition, the student may be subject to further penalties up to and including dismissal from the university.
• Prior to the oral examination, each Area Committee member should prepare questions for the students in that specialization area related to the research assessment paper. All students taking the oral exam in a specialization area will be asked similar initial questions. However, follow-up questions may vary depending on the student’s answers.

• The oral portion of the research assessment paper and oral examination will be scheduled for 2 hours and will be held approximately one week after the written exam. The oral exam will be conducted by the Area Committee that assigned and reviewed the Research Assessment Paper. It will consist of a presentation by the student followed by questions from the Area Committee.

• The student will give a 30-minute presentation on his or her research assessment paper.

• Following the presentation, Area Committee members will ask questions related to the research assessment paper and in the specialization area (i.e. related to the concepts listed for the specialization area). The Area Committee Chair will be responsible for ensuring that (1) each Area Committee member has equal partnership in the examination process, (2) each Area Committee member has approximately the same amount of time to question the student, and (3) the questions and tone of examination are appropriate for the area of specialization.

• A grading form will be provided to each Area Committee member prior to the oral exam. Area Committee members may use that form to keep notes on the student’s performance. The form will also include a set of metrics used to evaluate the student’s performance and a place to indicate whether the student passed or failed the oral portion of the research assessment paper and oral examination. At the end of the oral examination, each Area Committee member will independently complete the grading form and submit it to the Area Committee Chair.

**Determining Each Student’s Grade and Following Up**

• Following completion of each portion of the qualifying exam, all exam materials and grades will be given to the Graduate Chair. The Graduate Chair will have the independently graded written general examinations from the two faculty members who prepared and graded each exam, the independently prepared grading sheet from each Area Committee member for each student’s written research assessment paper, and the independently prepared grading sheet from each Area Committee member for the oral portion of each student’s research assessment paper and oral examination.

• For each written general examination, the Graduate Chair will prepare a histogram showing the average score for each student taking that exam. (Average score being the average of the two scores reported by the two faculty members assigned to write and grade the general examination. If the two scores are widely separated and one score is likely to be in the passing range while the other is likely to be in the failing range, the
Graduate Chair will meet with the two faculty members to resolve the discrepancy. If the discrepancy cannot be resolved, a third person will be asked by the Head of the school to grade the exam using the solutions and rubric agreed to by the faculty members who wrote the exam.) The scores will be presented in descending order. Neither the ID numbers nor the students’ names will be shown on the graph.

- Within a week of completion of the last oral exam, the Graduate Chair will convene a meeting of the Nuclear Engineering faculty. The faculty will review the results of the written general examinations and recommend where the line should be drawn between passing and failing on each written general examination.

- At that meeting, if there is time, faculty members will also have an opportunity to discuss the examination process and make recommendations for improvements in future years.

- Within approximately two days of the faculty meeting, the Graduate Chair will prepare a recommendation to the Head with the following information:
  - For each written general examination, the histogram showing all grades on the exam and the minimum passing grade recommended by the faculty, along with the two grades that were averaged to determine each score
  - For each research assessment paper and oral examination, there will be a sheet showing all grades on the exam and pass or fail recommendation by the faculty.
  - Recommendations from the faculty on ways to improve the examination process.
  - A list showing the ID number of each student taking the qualifying examination.

- The Head, after reviewing the results of the exam, will make the final decision on whether each student has passed or failed each portion of the exam. The Head may consult with the Graduate Chair, the Area Committee or the student’s advisor before making a final decision.

- The Head will inform each student of the result of his or her examination in writing in a timely manner. The Head will also inform each advisor of his or her student’s performance on the Qualifying Examination upon request.

- If the Head’s decision to pass or fail a student differs from the faculty recommendation, the Head should discuss his or her reasons for that decision with the faculty in an effort to build a common understanding of the School’s standards.

- Any concerns about the exam’s content, its administration, or its grading will be submitted to the Head, in writing, for resolution. The Head will document his decision in writing and meet with the student(s) or faculty member(s) who raised the concern to discuss the decision if such a meeting is requested.
• Students who fail the Qualifying Examination will have an opportunity to receive comments and advice from the Graduate Chair to improve his/her preparedness for next Qualifying Examination by the end of March.

• A student must pass (1) all four written general examinations and (2) the research assessment paper and oral examination before being judged to have passed the Qualifying Examination. If a student fails any of the four written general examinations, he or she will need to retake those examinations the next time the Qualifying Examination is offered. If he or she fails the research assessment paper and oral examination, he or she must take that entire portion of the examination the next time the Qualifying Examination is offered.

• If a student passes all parts of the Qualifying Examination except one written general examination, he or she may petition the Graduate Committee and the Head to retake the one written general examination in Fall Semester. Permission to take the one written exam in the fall is likely to be granted only if the student can show that waiting until Spring Semester to take the exam will significantly hamper progress toward graduation.

• A student may take any part of the examination only twice. If a student has not passed the complete examination after two attempts, he or she will not be allowed to continue in the Ph.D. program.

Records Retention

• The Academic Program Administrator will keep an electronic copy of the Research Assessment Paper submitted by students each year. Also, that same office will keep copies of the attachments listed below.

Attachments

1. Outline of written research assessment paper
2. Form students sign to indicate they have received the research assessment paper package and the work they submit will be their own
3. Grading sheet for the written research assessment paper
4. Grading sheet for the oral portion of the research assessment paper and oral examination
5. Grading sheet for the overall oral examination

• The following materials will be kept in a locked file cabinet in the office of the Administrative Assistant to the Head:
  o Copy of all the written general examinations (questions only) given each year
  o Journal article assigned for the research assessment paper in each specialization area
  o Solutions used to grade the written examinations and grading rubrics
- Students’ original written general examinations
- Faculty members’ graded copies of the students’ written general examinations
- Faculty members’ grading sheets for the written research assessment papers
- Faculty members’ grading sheets for the oral examinations
- Copy of the Graduate Chair’s report on faculty recommendation to the Head
- Key showing each student’s assigned ID number for the examination
General Outline for Research Assessment Paper
SPRING 2015 – QE

1. Title page (including bibliographic information on the article read, student’s name and date)
2. Abstract
3. Table of contents
4. List of figures and tables
5. Nomenclature and abbreviations
6. Summary of article (~ 5 pages)
   Note: This section will demonstrate the student’s clear understanding of the material presented in the article. Simply copying equations or tables or quoting phrases from the article is not acceptable.
7. Critique of article (~ 8 pages)
   Note: This section should demonstrate knowledge of the relevant literature (written both before and after the article being reviewed). The article will be critiqued based on information found in the literature and the student’s careful reading of the article. This section will also include a discussion of the impact of the paper and place the paper in historical perspective.
8. Extension of article (~ 3 pages)
   Note: In the extension, the student will identify important questions raised by the paper, gaps in the research or substantive weakness in the paper. He or she will then make a preliminary attempt to address the questions or gaps or otherwise strengthen the paper.
9. Conclusions (~ 2 pages)
10. References (a minimum of 10 references must be provided)
Acknowledgement of Receipt of Research Assessment Article
SPRING 2015 QE

Please read and complete this form before taking the article you will be reading for your research assessment paper from the Student Services office (NE 127). It will be used to maintain a complete record of the Qualifying Exam.

I have received the article entitled:

Author(s)

______________________________

I understand that I am to prepare a research assessment paper, following the general outline provided with the article and that I am to work independently, neither seeking nor accepting help from others.

Name: ________________________________

Signature: ________________________________

Date: ______________

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Rubric for Grading Written Research Assessment Paper
Nuclear Engineering Qualifying Examination
Examinee Name: ________________________  Date: _____________________

(Note that this rubric should be shared with students at the time of the Graduate Chair’s briefing on the qualifying examination process.)

<table>
<thead>
<tr>
<th>Evaluation/Guidance</th>
<th>Does not meet Expectations</th>
<th>Meets Expectations</th>
<th>Exemplary Performance</th>
</tr>
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<tbody>
<tr>
<td>1. <strong>Summary:</strong> Major gaps in summary. Lack of understanding. <strong>OR</strong> Accurate, complete summary</td>
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<td>2. <strong>Critique:</strong> No personal observations. Limited knowledge of relevant literature. No mention of historical significance. <strong>OR</strong> Insightful observations. Appropriate comparison with literature. Discusses historical significance.</td>
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<tr>
<td>3. <strong>Extension:</strong> No, or trivial suggestions for improvement. <strong>OR</strong> Describes at least one way to extend or improve paper. <strong>OR</strong> Identifies multiple ways to extend paper. Conducts and reports work to extend paper.</td>
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<tr>
<td>4. <strong>Organization of paper:</strong> Few headings. Key sections hard to find. <strong>OR</strong> Paper well organized. Key sections easy to find.</td>
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<tr>
<td>5. <strong>Clarity:</strong> Sentences unclear. Paragraphs contain multiple, related ideas. Graphics not properly labeled or introduced. <strong>OR</strong> Sentences and paragraphs clearly written. Graphics properly incorporated.</td>
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<tr>
<td>6. <strong>Spelling/Grammar/Punctuation:</strong> Little evidence of proof reading <strong>OR</strong> Very few errors.</td>
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<tr>
<td>7. <strong>Format:</strong> Did not follow outline <strong>OR</strong> Followed outline. Included all sections</td>
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</tbody>
</table>

**Overall Assessment:** The assessment of the overall performance of the candidate based on the evidence provided in items 1 – 7 above.

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>PERFORMANCE RATINGS</th>
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<tbody>
<tr>
<td><strong>OVERALL RATING OF RESEARCH ASSESSMENT PAPER:</strong></td>
<td>DOES NOT PASS RESEARCH ASSESSMENT PAPER</td>
</tr>
<tr>
<td>Does not meet Expectations</td>
<td>Meets Expectations</td>
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</table>

Faculty Member’s Name: ________________________

Faculty Member’s Signature: ________________________
Rubric for Grading Oral Portion of Research Assessment Paper and Knowledge of Material Nuclear Engineering Qualifying Examination

<table>
<thead>
<tr>
<th>PRESENTATION SCORE</th>
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<table>
<thead>
<tr>
<th>KNOWLEDGE OF THE MATERIAL</th>
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<tbody>
<tr>
<td>Q1 /100</td>
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<tr>
<td>Q2 /100</td>
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<td>Q14 /100</td>
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<td>Q15 /100</td>
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<table>
<thead>
<tr>
<th>OVERALL SCORE</th>
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<tbody>
<tr>
<td>PASS</td>
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</table>
### Overall Results of Oral Exam

<table>
<thead>
<tr>
<th>Written Research Assessment Paper</th>
<th>Presentation</th>
<th>Knowledge of Material</th>
<th>Overall Results of Oral Exam</th>
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</thead>
<tbody>
<tr>
<td>Pass</td>
<td>Fail</td>
<td>Pass</td>
<td>Fail</td>
</tr>
<tr>
<td>Pass</td>
<td>Fail</td>
<td>Pass</td>
<td>Fail</td>
</tr>
</tbody>
</table>

Faculty Member’s Name: ________________________________

Faculty Member’s Signature: ________________________________