Department of Biomedical Engineering
UNIVERSITY OF COLORADO DENVER | ANSCHUTZ

Procedure Title: Department of Biomedical Engineering Comprehensive Examination
Effective Date: 8/20/2026

I. Purpose

The purpose of the comprehensive exam is to assess the student's conceptual understanding and preparation for advancement to candidacy. **After completing or registering for all program-required, non-dissertation coursework,** and concurrent with admission to candidacy, doctoral students must take a comprehensive examination. The department recommends this exam take place **before no more than 10 dissertation credits have been completed.** This examination will test a student's mastery of a broad field of knowledge, not merely the formal coursework that has been completed. Students may not participate in the comprehensive examination if on academic probation. Students and committee members should **schedule 3 hours** for the exam.

II. Committee

The Comprehensive Examination Committee must consist of **at least 4 faculty, at least half of whom must be core faculty of the Biomedical Engineering Department**. **The Comprehensive Exam Committee Chair must also be a Biomedical Engineering core faculty member (see the BME core faculty document on the BME academic website) and may not be the Dissertation Mentor.** All committee members must have a graduate faculty appointment, which is now automatic for all faculty at CU Denver | Anschutz. Committee members from industry or other campuses or schools must have a graduate faculty appointment approved prior to the exam.

III. Examination Procedure

The comprehensive exam consists of two components, a written document and public oral presentation. These sections are described in more detail below. Students are highly encouraged to discuss with their research mentor(s) and exam committee.

a. **Written Document:** Students should prepare a written proposal covering their research project and proposed thesis work. Preliminary data is helpful but not required. Students should work with their mentor to develop their aims, get feedback on the proposal and prepare for the oral exam. Mentors should not directly edit the written document but should provide general comments and feedback. The document should be based on appropriate predoctoral research proposals (F31 or similar). This document should generally contain five sections not to exceed the maximum page lengths below. The following sections are based on an NIH F31 pre-doctoral fellowship proposal but should other funding agencies/programs require different formats, these formats would be acceptable. The mentor may, at their discretion, provide the candidate with example documents conforming to this format. Ideally, this document will be submitted to the comprehensive committee as well as to extramural funding organizations (pre-doctoral awards). **The proposal must be submitted to the committee at least two weeks before the exam.**

    1. **Specific Aims (1 page):** a brief narrative that introduces the overall problem, lists the major goals (i.e. specific aims) of their proposed research, and provides the overall research hypothesis that drives these goals.

    2. **Significance (~1 page – Significance, Innovation, Preliminary Data, and Approach may not exceed 6 pages):** a summary of relevant background material, gathered primarily from peer-reviewed journal articles, which support the relevance of the research goals and hypothesis.

3. **Innovation / Preliminary Data (~2 pages):** description of existing work toward the research goals, with descriptions of the novelty of the work; this should include relevant figures, tables, and other quantitative details. Essentially, this section should demonstrate that the goals are achievable and that the candidate has already made significant progress.
4. **Approach (~3 pages):** a description of additional studies needed to attain the research goals, categorized by specific aim. This usually includes but is not limited to: methods of how the data will be measured and analyzed (statistical or otherwise); statements describing how the work will address the primary hypothesis; a statistical power analysis; review of anticipated problems and alternative approaches the candidate may consider during the course of research; and a timeline for completion of the research.
5. **Training Activities and Timelines (3 pages):** A statement of proposed training activities which may include, for example, coursework taken or currently enrolled in, workshops and/or scientific meetings, journal clubs, and meetings with mentors. The training plan should reflect the proposed research and include development of the necessary skills for further career advancement. Additionally, the plan should include a timeline.

b. **Public Presentation:** The candidate will give a **presentation of 45-minutes maximum** followed by up to 15 minutes for audience Q&A on their proposed thesis work. The committee may halt the presentation after 45 minutes. The format should roughly follow an introduction and background for a public audience, proposed specific aims, and current research progress and approach. In the public presentation, students should demonstrate deep scientific understanding of the field and formulate how their proposed research could address a significant scientific question or technical innovation in the biomedical engineering field.

c. **Oral Exam:** After the public presentation there is a **closed session with the Comprehensive Exam Committee.** Format of the oral exam is as follows:

1. The Exam Committee chair should outline the exam process and remind the committee of the different criteria on which the evaluation of the student will be based (see Evaluation Criteria below).
2. The student should be ready to present a summary of their training plan. The format could include a brief review of classes the candidate has completed (or is currently taking) to fulfill their training plan and any revisions to their prelim exam training plan. If the candidate has successfully obtained a pre-doctoral award, they should briefly review their progress during this period. This presentation should include ~ 4-5 slides.
3. For a period lasting 1-1.5 hours, faculty on the Exam Committee will ask the student questions about knowledge of the field, specific aims, the scientific plan, and the training plan.

d. **Evaluation:** Following the oral exam, the student will be asked to leave the room.

1. The research mentor will provide the Exam Committee with an assessment of the student's progress to date.
2. The Exam Committee Chair will summarize the student's academic progress to date (obtained from the student's unofficial transcript).
3. The committee will explicitly discuss of the student's performance in the following 4 areas: Knowledge and Scholarship, Scientific Reasoning and Experimental Design,

Written Communication, and Oral Communication (see attached rubric) and then debate and reach a majority agreement whether to give the student an overall score of **Pass, Pass with Conditions, or Fail**. Committee members should indicate their vote for that result on the exam report form.

IV. Communicating outcome:

a. The student will return to the exam room and be told the outcome of their exam.

b. All Committee members will Docusign the exam form sent by the Director of Student Services, indicating the result of the exam. If a pass with conditions is given, the conditions are entered in the Exam form along with the deadline for completion.

c. The Exam Committee Chair will document the evaluation of the student's performance on the attached form along with a summary of the discussion and constructive feedback in each of these areas and overall. The Exam Committee Chair is responsible for communicating this evaluation to the student by email.

d. If a student received a Pass-with-Conditions, the examining committee must clearly define the conditions and a timeline for completion of these conditions, not to exceed one (1) year, in a document amended to the exam report. The following is a non-exhaustive list of examples of conditions: rewriting portions of the written document, changes to the hypothesis or aims, training in a specific technique or area, taking a course in a technique or area, or presenting at a seminar or meeting. Once conditions are met, the committee chair will sign the form to approve. **Failure to satisfy the stated conditions within the time required will result in failure of the examination.**

e. A student who fails the comprehensive exam may retake the examination one additional time. **Students who fail the comprehensive exam twice will be subject to dismissal**.

Evaluation Criteria

The exam committee will evaluate the student on the following four criteria: Knowledge and Scholarship, Scientific Reasoning and Experimental Design, Written Communication, and Oral Communication. Evaluations for each category will be expressed as Outstanding, Pass, or Fail. Outstanding rankings would include all the listed qualities, and Pass rankings would include at more than half of those qualities. Note that passing the exam is judged holistically taking all evaluations into account. Passing requires a majority of the committee voting to pass.

1. KNOWLEDGE AND SCHOLARSHIP.

- Identifies background, existing information, and reasoning.
- Strong evidence of synthesis of concepts to support the thesis topic.
- Terms, concepts, principles and methods are correct and described in depth.
- Clearly identifies research problem in the field, based on prior knowledge.
- Critiques prior work on the problem.
- Demonstrates command of literature relevant to the thesis topic.
- Information presented is appropriately cited.
- Demonstrates independence in reasoning and understanding of the topic.

Ranking: Outstanding Satisfactory Unsatisfactory

Comments:

2. SCIENTIFIC REASONING AND EXPERIMENTAL DESIGN.

- Written or oral description of hypotheses and experiments designed to test it.
- Hypothesis is clearly stated, along with compelling rationale.
- Compelling rationale for experimental approach is provided.
- Experiments are clearly described, powered, and appropriate.
- Clearly describes controls and how they impact interpretation of the results.
- Alternative experimental approaches are clearly described.
- Clearly describes how experiments and results test the hypothesis.
- Identifies weaknesses in interpretation.
- Alternative results are described, and impact on the hypothesis is considered.
- Statistics, rigor, reproducibility and sex as a biological variable are considered and suitable to the thesis project.

Ranking: Outstanding Satisfactory Unsatisfactory

Comments:

3. WRITTEN COMMUNICATION.

- Communicates knowledge and reasoning through writing and graphics.
- Writing is clear and effective.
- Graphics are well-organized and effective.
- Terms, concepts, principles and methods are used correctly.
- Writing takes full advantage of the student's preliminary data, experience, and/or supporting literature.
- Citations are organized, appropriate, and of sufficient depth.

Ranking: Outstanding Satisfactory Unsatisfactory

Comments:

4. ORAL COMMUNICATION.

- Communicates scientific knowledge and reasoning through speech and visual displays.
- Oral communication is exceptionally clear and effective.
- Graphics are well-organized and effective.
- The public seminar is highly effective, engaging, and on-time.
- Response to questions (public and with the committee) consistently incorporates appropriate evidence and reasoning.
- Response to questions is reflective and shows independent thinking.

Ranking: Outstanding Satisfactory Unsatisfactory

Comments:

Overall Comments: