

## **PhD Examination Requirements for Chemical and Biological Engineering PhD Candidates**

The Montana State University requirements for completion of a PhD in Engineering are set by the College of Engineering. The requirements include:

- 1) A **qualifying exam** covering undergraduate discipline knowledge to be administered within two semesters of matriculation into the program, which can be either written or oral at the discretion of the department and,
- 2) A **comprehensive exam** within two years of qualifying exam with written and oral components administered by the PhD Committee including the external Graduate Studies representative.

For additional information on the College's Ph D requirements, follow this link:

[http://www.coe.montana.edu/coe/depts/PhD\\_in\\_Engineering.pdf](http://www.coe.montana.edu/coe/depts/PhD_in_Engineering.pdf)

The rules governing PhD Qualifying and Comprehensive Examinations for candidates in the Department of Chemical and Biological Engineering are listed below.

### **Qualifying Exam**

The qualifying exam will be a written examination on undergraduate Chemical Engineering topics including:

- mass and energy balances
- thermodynamics
- separations (mass transfer)
- heat (energy) transfer
- fluid mechanics
- transport phenomena
- chemical reaction engineering

#### ***Exam Topics***

The exam will be ~1 hour per topic area in an open book, open notes format. Students will solve problems in 4 of the 7 topic areas.

Each problem set will be graded by the faculty member that submitted the set.

#### ***Exam Scoring***

The results will be analyzed by a committee composed of all department faculty, and each candidate will receive a grade of Pass (P), Fail (F) or Remediate (R). Students will not be given the test back in order to protect the questions from dissemination. In cases where remediation in certain topic areas

is required, the Ph.D. advisor will develop a problem-solving-based plan with the PhD candidate to prepare for a retest on the identified topic areas. The retest must occur prior to the next fall semester and will be overseen by the PhD Advisor.

#### ***Timing of the Qualifying Exam***

The qualifying exam must be completed within two semesters of matriculation into the PhD program. Failure to take the exam in that time period may result in suspension of PhD candidate status, including stipend. The exam will be administered on the second Tuesday in February of the Spring semester to all students required to take the exam each year.

### **Comprehensive Exam**

The comprehensive exam is required of all PhD candidates, and must be completed within two years after taking the qualifying exam.

The PhD comprehensive examination in the Department of Chemical and Biological Engineering will include:

- A written NSF-style proposal associated with the research topic for the PhD.
- An oral presentation of the proposal and oral examination.
- A written exam on graduate level thermodynamics, transport phenomena, mathematical methods, and kinetics and reactor engineering will be required of graduate students who have a GPA in the CHBE graduate option required courses of less than 3.5.

#### ***Research Proposal***

The candidate will prepare a written NSF-style proposal associated with the research topic for the PhD. The proposal should include significant preliminary data on the research to date, and the research proposed to complete the PhD. The exam will be administered by the student's PhD Advisor and graduate committee. The proposal will be in the NSF format, in compliance with the current year's grant proposal guidelines (gpg) at [www.nsf.gov](http://www.nsf.gov).

#### ***Seminar and Oral Examination***

A public seminar will be given by the PhD candidate to present the proposal. The candidate will have 40 minutes for the presentation of the research to date and proposed research to complete the PhD, plus 10 minutes for questions from the audience. This will be followed by a closed-session oral examination of 45-90 minutes by the student's PhD committee on:

- the candidate's research
- the candidate's graduate level understanding of Chemical and Biological Engineering principles
- additional topics relevant to the research including fundamentals of other disciplines drawn on in the research

***Written Examination***

A written exam on graduate level thermodynamics, transport phenomena, mathematical methods, and kinetics and reactor engineering will be required of graduate students who have a GPA in graduate coursework of less than 3.5.