Graduate Student Handbook[†]

Department of Chemical, Biochemical and Environmental Engineering
University of Maryland Baltimore County
Baltimore, MD 21250

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[†]The most recent version of this document is available on-line at:
http://cbee.umbc.edu/academics/graduate-resources/

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1. Application for Admission to the Programs

The Program's admission requirements and procedures correspond to the requirements set forth by the UMBC Graduate School. Students who do not have an undergraduate degree in chemical or environmental engineering may apply for admission to the Program. However, upon admission, these students should consult with the Graduate Program Director (GPD) to determine whether additional courses, which are remedial in nature need to be taken in addition to the required courses listed below. The cost of taking remedial classes will be the responsibility of the student.

2. Master of Science Degree Requirements

2.1. General Policies

The Department of Chemical, Biochemical and Environmental Engineering (CBEE) offers Master of Science degrees in Chemical and Biochemical Engineering (CBE) and Environmental Engineering (EE). Other than the specific classes taken, the two degree programs have the same requirements, which are summarized below. It is the responsibility of the student to ensure that all Graduate School and CBEE Program requirements are met. Questions regarding the requirements may be directed to the GPD. If there is a conflict between the Graduate School and CBEE requirements, the Graduate School requirements and policies have precedence.

2.2. Course Requirements

A minimum of 30 credit hours in technical areas is required for the Master of Science degree. The candidate for the Master of Science (MS) degree has the choice of following a plan of study either with or without a thesis.

<u>MS in Chemical and Biochemical Engineering</u>

- Required courses: ENCH 610, 630, 640, and MATH 404 (applies to both thesis/non-thesis options)
- For students who do not have a BS degree in Chemical Engineering a maximum of 2 courses from the following list: ENCH 660, 662, 664, and 666 (applies to both thesis/non-thesis options). Students who have a BS degree in Chemical Engineering are allowed to take all 4 of these courses (ENCH 660, 662, 664, and 666) (applies to both thesis/non-thesis options).
- A maximum of 9 credit hours from 400 level courses may count towards the course requirements subject to <u>prior</u> approval from the GPD (applies to both thesis/non-thesis options)

- ENCH 648 Special Research Project: Maximum of 6 credit hours of ENCH 648 for non-thesis option; maximum of 3 credit hours for thesis option). Prior to the start of the project the student should meet with the instructor and develop a work plan (1-3 pages) which will be submitted to the GPD within 2 weeks of the start of the work. At the end of the project the student will submit to the GPD a 3-10 page report outlining the work that was completed.
- Remaining coursework will be at the 600 or higher level and must be approved by the GPD.
- Thesis option - ENCH 799 (6 hours required)

MS in Environmental Engineering

The core for a master's of environmental engineering requires the following classes: ENEN 610, 612, 614, 660. Students are highly encouraged to take ENEN 621 and ENEN 648 when they are offered. (applies to both thesis/non-thesis options)

- A maximum of 9 credit hours from 400 level courses may count towards the course requirements subject to prior approval from the GPD (applies to both thesis/non-thesis options)
- ENEN 648 Special Research Project: Maximum of 6 credit hours of ENEN 648 for non-thesis option; maximum of 3 credit hours for thesis option). Prior to the start of the project the student should meet with the instructor and develop a work plan (1-3 pages) which will be submitted to the GPD within 2 weeks of the start of the work. At the end of the project the student will submit to the GPD a 3-10 page report outlining the work that was completed.
- Remaining coursework will be at the 600 or higher level and must be approved by the GPD.
- Thesis option - ENEN 799 (6 hours required)

Lists of approved 400-level courses for both degree programs are available in Appendix A.

2.3. Minimum Course Grade Requirements

A grade point average of 3.0 in all courses must be maintained to remain in good standing with the Graduate School.

2.4. Transfer of Credit

A maximum of 6 semester hours of graduate coursework taken at other regionally accredited institutions may be applied toward the Master's degree. The GPD and the graduate school must agree that the specific courses are appropriate to, and acceptable in, the student's

program; the student is responsible for providing an official transcript of this work to the Graduate School, along with appropriate course descriptions and syllabi. No credit transfer will be allowed for courses which have been used in fulfillment of the requirements of other degrees. Due to academic and procedural differences between accredited U.S. and foreign institutions, credit from foreign universities is not normally acceptable for transfer. The grades of transfer work do not affect the grade point average from UMBC. Transfer work cannot be used to satisfy the requirements for upper level courses in a student's program. The request for transfer of credit should be submitted to the Graduate School for approval at the earliest possible time.

2.5. Master of Science Thesis Option

Under the Master of Science Thesis Option, students take 6 credits of research (ENCH 799 or ENEN 799) toward their degree. Candidates for the MS Thesis Option are required to pass an oral qualifying examination, whose format is outlined below and described in greater detail in Appendix B. Master's qualifier procedure:

Overview of Oral Qualifying Exam for Master of Science Thesis Option:

- The Oral Qualifier written report can be no more than 7 pages in length and the details and format are in Appendix B.
- The written report is due to the committee at least one week prior to the oral qualifier.
- The qualifier is scheduled by the faculty on the graduate committee following the guidelines in the graduate handbook.
- Students must prepare the written report and oral presentation independently and not engage faculty or postdocs in feedback
- Students may consult with other graduate students and practice their presentations with other graduate students
- The maximum time limit for the oral presentation is 20 minutes. Questions from the committee will follow the oral presentation.
- The committee will consist of three faculty one of whom is the student's advisor.
- The deadline is the beginning of the second semester in residence. For students who enter in August, the deadline is the end of the winter term. For students who enter in January, the deadline in August 1. If the student or faculty advisor has an issue with the timeline, the student can petition the Graduate Program Committee for an extension.

2.6. BS/MS Degree Program

Undergraduate students in the Department who have an overall cumulative grade point average of at least 3.0, and also a grade point average in the major of at least 3.0, may apply for

admission to the BS/MS degree program. Students should apply to the Program for pre-admission to the BS/MS program in the spring semester of their junior year by filling out and submitting a pre-admission application, which is available online. This application includes a current transcript and one letter of reference from a faculty member in the Department. A delay in the graduation date for the MS degree portion of the BS/MS program may result if the pre-admission application is not submitted at the proper time. Students are encouraged to discuss their plans related to the BS/MS degree with their undergraduate academic advisor before they apply to the program to make sure they are informed of all the necessary procedures related to the program. During the senior year, students in the BS/MS program must apply to the UMBC Graduate School for admission and, if they intend to pursue a thesis degree, they must obtain consent from a departmental faculty member to serve as their thesis advisor. Students applying to the BS/MS program are not required to take the GRE examination.

Both thesis and non-thesis options are available to students in the BS/MS program. Course requirements in the BS/MS program are the same as those listed above for the thesis and non-thesis options of the regular MS program. However, students in the BS/MS program are allowed to count 9 credits of elective courses taken to fulfill their BS degree requirements toward the course requirements for the MS degree, provided that these courses are dual level 400/600 level courses and taken at the 600-level. If a student is pursuing a BS/MS with a thesis option it is recommended that one these elective courses taken during the senior year should be ENCH 648/ENEN 648 (Special Problems). Students in the BS/MS program may also choose to take some of the required courses for their MS degree in their senior year. In all cases, the credits, but not the grades, are counted toward the MS degree for any courses taken during the undergraduate senior year that are to be applied toward the MS degree.

It is recommended that students pursuing the thesis option should select a research advisor during the junior year and begin their research no later than the summer between the junior and senior years. A delay in starting the thesis research project may result in a corresponding delay in finishing the MS portion of the BS/MS degree program.

2.7. Suggested Timeline for Completion of the Master of Science Degree

Full-time students in the BS/MS program who are pursuing the thesis option are expected to complete their MS degree after no more than 3 semesters in residence as a graduate student, while students in the regular MS degree program, who are pursuing the thesis option, are expected to complete their MS degrees after no more than 4 semesters in residence as a graduate student. For BS/MS students pursuing the thesis option, the oral qualifying examination should be taken within 12 months of completion of ENCH 446. For students in the regular MS degree

program pursuing the thesis option, the qualifying examination should be completed within four months after being assigned a thesis advisor. For all thesis MS degree students, the MS thesis should be defended within 12 months after passing the oral qualifying examination. Failure to meet these timelines may affect the funding status of a student. Requests for postponement of the MS thesis defense beyond the 12 month time limit must be made in a written petition to the Graduate Program Committee during the eleventh month following the passing of the oral qualifying examination.

Students in the BS/MS program pursuing the non-thesis option are expected to complete their MS degree after no more than two semesters, and students in the regular MS program who are pursuing the non-thesis option are expected to complete their MS degree after no more than 3 semesters. Students who do not meet these timelines should discuss their situation with the GPD to determine how to finish their course of study in a timely manner.

Part-time students are expected to make steady progress towards the completion of their degree and should meet annually with the GPD to assess progress. Steady progress will be defined before student begins the program by collaborative development of a coursework and/or research timeline. Part-time students are expected to complete at least 3 credits per semester. As per Graduate School requirements for MS degree must be completed within a 5 year period.

3. Doctor of Philosophy Requirements

3.1. General Policies

CBEE offers Doctor of Philosophy degrees in Chemical and Biochemical Engineering (CBE) and Environmental Engineering (EE). Other than the specific classes taken, the two degree programs have the same requirements, which are summarized below. Additional requirements are imposed by the UMBC Graduate School and are documented in its catalog. It is the responsibility of the student to ensure that all Graduate School and CBEE Program requirements are met. Questions regarding the requirements may be directed to the GPD.

The Doctor of Philosophy Degree is awarded only upon sufficient evidence of high attainment in scholarship and the ability to engage in independent research in the field of Chemical and Biochemical Engineering or Environmental Engineering. It is not awarded for the completion of course requirements.

3.2. Admission to the Program/Selection of Dissertation Advisor

Students are admitted to the program as either “direct admits” or “general admits”. Direct admit students have agreed to work in a particular faculty’s research lab upon their arrival at UMBC, and the faculty has agreed to serve as the student’s dissertation advisor and provide

funding. General admit students go through research rotations in their first year, which allows students to clarify any student-faculty interest developed through prior communication and develop optimal student-faculty matches.

Acceptance to the program will be based on the applicant's academic record, as well as the availability of funding in the research area. As part of the evaluation process, applicants to the CBEE graduate programs will be asked to fill out a form identifying 2-3 faculty members with research programs of interest. Final acceptance into the program will not occur until this form is received. The form is provided in Appendix C.

After an applicant is accepted to the program, but prior to arriving at UMBC, general admit students will be contacted by the two to three faculty identified above ("Rotational Faculty"). The Rotational Faculty will develop a list of courses to be taken in year 1 (see Section 3.3 for detailed information) and devise a rotation plan by August 15th. The latter would include partnering the student with existing lab members to perform research, allowing the student to participate in group meetings, providing the student articles to read that are discussed in research groups, etc.

In their first semester, students will sign up for three credits of either ENCH 898 or ENEN 898. The list of courses and finalized plan for the first rotation must be submitted to the GPD by the first day of classes. The finalized research rotational plan for the second rotation must be submitted to the GPD by the end of week eight of the first semester. Rotational plans will be developed with input from the Rotational Faculty.

One week after the end of each rotation, students will submit a 3-5 page summary to the rotation advisor and the GPD. The rotational plans and summaries will be used by the Rotation Faculty to assign a single Pass/Fail grade in ENEN 898/ENCH 898. The rotational plan and the evaluation rubric are listed in Appendix D. If a third rotation is required, it will occur in the first half of the student's second semester. The procedures outlined for the first two rotations will be followed.

Following satisfactory completion of rotations (*i.e.*, passing grades in ENEN 898/ENCH 898) and completed coursework, the student will submit a ranked list of up to three choices for their dissertation advisor to the GPD. The GPD and the listed faculty will meet and assign the student a dissertation advisor based on the student's ranked list, faculty needs, and the availability of external funding.

Direct admit students will also register for one credit of ENEN 898/ENCH 898 in the first semester and will be graded on performance in the research area by the faculty advisor. To maintain consistency for all students, direct admit students will be required to write a 3-5 page summary of their research experience at the end of year 1 which will be evaluated by faculty advisor using the rubric given in Appendix D leading to a grade in ENEN 898/ENCH 898. <u>For all students, a failing grade in ENCE 898/ENCH 898 will result in the student being terminated from the PhD program</u>.

3.3. Course Requirements

Classes that a student takes in their first year will be determined in consultation with the advisor if the student is directly admitted into a research lab or by the Rotation Faculty if the student is generally admitted. Rotation Faculty will meet prior to the start of the student's first semester and select four to five courses that would best serve the student in understanding their upcoming research topics. In addition to these courses, students will take discipline specific required course work. For the Chemical and Biochemical Engineering Program discipline specific required courses are ENCH 610, 630, 640, MATH 404. These four courses must be completed before a PhD student advances to candidacy. For the Environmental Engineering Program, discipline-specific required courses are four chosen from the following: ENEN 610, 612, 614, 621, 660, MEES 617 or GES 616, ENCH 630, ENME 645, and MATH 441. The four courses must be completed within three years of joining the program.

For both programs, a minimum of 21 credit hours of courses are necessary to graduate. Appropriate courses taken while earning the Master of Science degree may be used to fulfill this requirement. For all students, a maximum of 9 credits of 400-level courses taken from other disciplines may count towards the course requirements subject to prior approval by the student's advisor and the GPD.

Competency in the discipline will be measured through grades in courses. A minimum 3.0 GPA in all courses is required to be in good standing in the Doctor of Philosophy program. Students who earn a C+ or lower in a course will be placed on probation and required to retake the course. The student will be allowed one chance to retake a class and is responsible for the cost of the course credits and fees. Continuation of funding during this probationary period is not guaranteed. Students (i) having an overall GPA below 3.0 for more than one semester or (ii) receiving a D grade in a course can be cause for dismissal from the program. A decision regarding dismissal will be made by the graduate committee. If student wishes to remain in the program, he/she will be required to write a petition providing rationale for why they should remain in the program.

A minimum of 18 credit hours of Thesis Research (ENEN 899; ENCH 899) is required. ENCH/ENEN 899 must be taken, in accordance with graduate school policy for at least two consecutive semesters after achieving candidacy and before completing degree requirements. Please look at the requirements for completion of graduate requirements on the Graduate School webstie. Course credits obtained from Thesis Research do not count toward the required 21 credit hours of coursework. Only two courses taken from the series of courses ENCH 660, 662, 664, and 666, or from any of the Professional Masters Programs, may be used to satisfy the requirement for 21 credit hours of coursework. A list of approved 400 level courses can be found in Appendix A.

Students whose native language is not English are required to pass the TA spoken English examination administered by the UMBC Graduate School at the level of 3 or higher. Students who are not able to meet this standard are required to take an appropriate remedial English language speaking and listening comprehension course as recommended by the Graduate School.

3.4. Transfer of Credit

A maximum of 21 semester hours of graduate coursework taken at other accredited institutions may be applied to the PhD degree. The GPD must agree that the specific courses are appropriate to, and acceptable in, the student's program; the student is responsible for providing an official transcript of this work to the Graduate School along with appropriate course descriptions and syllabi. Due to academic and procedural differences between accredited U.S. and foreign institutions, credit from foreign universities will be considered on a case to case basis. The grades of transfer work do not affect the grade point average from UMBC. No credit transfer will be allowed for courses that have been used in fulfillment of the BS degree. The request for transfer of credit shall be submitted to the GPD for approval at the earliest possible time.

3.5. Requirements for Achieving Doctor of Philosophy Candidacy Status

3.5.1. Qualifying Examination

The qualifying exam should be taken at the end of the student's first academic year (before August 1st for Fall admission; January 1st for Spring admission). The goal of the qualifying exam is to determine if the student has the potential to conduct independent research. To this end, the qualifying examination is taken after a student has had a reasonable opportunity to initiate their research and complete the core courses. Briefly, the exam consists of submitting a written document one week before a 30 minute presentation on the student's research area followed by 45-60 minutes of questions. The written document and presentation must be a truly independent effort by the student, thus **input from faculty and post-doctoral fellows is strictly prohibited.** In the written document and presentation, the student should connect their research topic/results to their core courses, highlighting the main fundamental principles that apply to their research project. A detailed set of instructions is presented in Appendix B.

Students who do not pass the qualifying examination on their first attempt are permitted a second attempt. The timing of the second attempt will be defined by the Qualifying Exam Committee. Continuation of funding for a student who fails on their first attempt is not guaranteed and will be addressed on a case by case basis. Students will be given a written assessment of their performance. If the student fails the qualifying exam after exhausting all of their allowed chances, the student's status will be terminated or changed from Ph.D-seeking to

MS-degree seeking. There are no cases where a petition to reconsider change of status will be considered. Requests for postponing the oral qualifier must be made by written petition to the Graduate Program Committee at least one month prior to the scheduled qualifying exam date.

The qualifying exam committee will consist of at least five Faculty Members and include Rotation Faculty and those faculty who will test minimum competency in the core courses (*i.e*, CBEE faculty who taught the student in first year courses). At least three of the five members must be tenure-track or tenured faculty in the department with full-time appointments. This definition includes full-time faculty members in the department who have joint appointments, even if their tenure resides outside the department. When the student submits their exam document to the committee before the exam, they will also submit a copy of their UMBC transcript to the committee.

3.5.2. PhD Proposal Defense

The examining committee for the proposal defense consists of at least five persons. At least three of the five members must be tenure-track or tenured faculty in the department with full-time appointments. This definition includes full-time faculty members in the department who have joint appointments, even if their tenure resides outside the department.

As part of the proposal examination, students are required to submit a written document that describes the research project. The format for this document is the same as described in Appendix D for the written document associated with the qualifier examination, except that it may be up to 15 pages in length instead of 7 pages. Proposal should follow NSF guidelines for length and style. The document should contain enough introductory material to inform the proposal examination committee about the underlying background of the project. The document should also contain additional logically arranged sections, such as objectives, experimental and theoretical methods, results and discussion, conclusions, and plans for finishing the dissertation. The document should be submitted to the exam committee at least one week in advance of the proposal defense seminar.

The seminar should be 45 minutes in length and open to the public. The student is responsible for sending the announcement to the Department (Faculty and Students) at least two weeks before and a reminder email one week before. Following the seminar, the examining committee conducts an oral examination of the student on the area of the proposed research. Students should take this examination within one year of passing the qualifying examination. If a student does not pass the proposal examination on their first attempt, a second and final attempt

must occur within one additional semester. Continuation of funding for a student that fails their proposal defense is not guaranteed and will be decided on a case by case basis.

Students who pass the qualifying and research proposal examinations are considered to be PhD candidates. A student must be admitted to candidacy within three semesters after passing the qualifying examination. A student must be admitted to candidacy at least two full sequential semesters before the date on which the doctorate degree will be conferred.

3.6. Final Oral Defense of the Ph. D. Dissertation

The oral defense is conducted by a committee of at least five members recommended by the graduate faculty advisor and approved by the Vice President for Graduate Studies and Research. This committee should consist of the same examining committee of at least five persons that constituted the proposal examination with one person added. In the event that not all of the people who served on the proposal examination are available to serve on the dissertation defense committee, substitutions may be made. However, the final makeup of the dissertation defense committee must in all cases consist of the faculty advisor, at least three faculty members from the department (as defined in 3.5.2), and at least one person from outside the department. The candidate may only take the final oral defense twice, and students who are not able to pass the defense in two attempts are not allowed to obtain their degree. The time and location of the defense must be publicized two weeks ahead of time with a one week reminder, so that the defense can be attended by all interested parties. Students must complete all requirements of their program for the degree, including the dissertation and final oral examination, within four years after admission to candidacy.

3.7. Timeline for Completion of the Doctoral Degree

Students are expected to make steady and consistent progress toward their degree. It is acknowledged that regular meetings with the PhD committee will both guide the student and serve as motivation for steady progress. Thus, it is required that the student meets with the appropriate committees one time per year. For a five year PhD degree, an example meeting schedule for a student entering the graduate program with a BS degree would be as follows:

End of year 1: Qualifying Exam (five faculty members)
End of year 2: PhD Proposal Defense (PhD committee)
End of year 3: Committee update meeting (PhD committee)
End of year 4: Committee update meeting (PhD committee)
End of year 5: PhD Dissertation Defense (PhD committee)

It is expected that students will complete the doctoral degree within five years of admission if they enter the program with a BS degree and within 4 years if they enter the program with an MS degree. After a student has had six years of residency in the doctoral program, thesis advisors are no longer allowed to provide stipend or tuition support for students. However, if there are extenuating circumstances, a student may petition the Graduate Program Committee for an extension of this time limit.

4. Annual Review of Student Progress

By August 1 each year, all students in the PhD and MS thesis degree programs will fill out the Annual Graduate Student Evaluation self-assessment form (Appendix E) provided to them by the Department and will give these completed forms to their thesis advisor and the GPD. Coursework MS students will submit their forms to the GPD by May 30 of the same year. The thesis advisor and co-advisor (if applicable) or the GPD will complete an annual student progress evaluation form using the information in the self-assessment with other appropriate information. The completed annual student progress evaluation form will then be given to each student by the start of the Fall semester of that year. The thesis advisor, together with any co-advisors involved in the project, will then discuss the contents of the completed annual student progress evaluation and submit their evaluation forms to the GPD by September 1st. The overall objective of this process is to keep students on track for finishing their degree in a timely manner.

5. Good Standing Status

Students are considered to be in good standing with the UMBC Graduate School if they maintain a grade point average of 3.0. Students not in good standing with the Graduate School are considered to be on probation and must, in consultation with the GPD, agree to a timeframe and procedure to re-establish good standing status. Students must also make every effort to conform to the time limits for various activities described elsewhere in this handbook.

6. Special Problems Course (ENEN 648/ENCH 648)

Students in the Master of Science non-thesis program are permitted to count up to 6 credits of ENEN 648/ENCH 648 toward their degree. Students in the either the Master of Science thesis program or the PhD program are permitted to count up to 3 credits of ENEN 648/ENCH 648 toward their degree. For students in a thesis program, the research conducted for an ENEN 648/ENCH 648 course should not overlap significantly with their thesis project, and the results obtained for an ENEN 648/ENCH 648 course should not appear in the final thesis of a student. An exception to this rule occurs for students in the BS/MS program who are pursuing the thesis option. These students typically take 3 credits of ENEN 648/ENCH 648 in their senior

undergraduate year with the research topic for this course being directly related to their thesis project. Prior to the start of the project the student should meet with the instructor and develop a work plan (1-3 pages) which will be submitted to the GPD within 2 weeks of the start of the work. The number of credit hours taken should be indicated and the proposed work must be in proportion to the number of credits taken both in time and intellectual difficulty (*e.g.*, 3 hours of ENEN 648/ENCH 638 should be equivalent to a 3 credit hour graduate course). At the end of the project the student will submit to the GPD a 3-10 page report outlining the work that was completed.

7. Courses at the 400-Level Which Can Be Used to Satisfy Course Requirements

The majority of courses that are taught at the 400 level in the Departments of Chemistry, Biology, Mathematics, Physics, Mechanical Engineering, Computer Science, and related departments can be used as electives to satisfy the course requirements in the MS and PhD programs. Students must confirm with their advisor and the GPD that a particular course can be applied to their graduate program before they take that course for credit. Appendix A contains a list of courses that have previously been approved for use in satisfying elective requirements for graduate degrees.

8. Regulatory Engineering and Professional Masters Courses

For MS degree seeking students who do not have a BS degree in Chemical Engineering, a maximum of 2 courses from the following list: ENCH 660, 662, 664, and 666 (applies to both thesis/non-thesis options). Students who have a BS degree in Chemical Engineering are allowed to take all 4 of these courses (ENCH 660, 662, 664, and 666) (applies to both thesis/non-thesis options). For PhD students only two courses from the sequence ENCH 660-666 or from the Professional Master's Program can be counted toward the elective courses. Students must confirm with the GPD that a particular course from the Professional Master's Program can be applied to their graduate program before they take that course for credit.

9. Communication/Mentoring Requirement

As part of the 898/899 credits, the PhD student in conjunction with their primary advisor will devise a list of activities that enhance communication and mentoring skills. Example activities are as follows:

- Give an internal seminar on research area
- Attend workshop on teaching/communication
- Present at professional conference

- Present at Annual GSA Conference
- Participate in recruiting events
- Mentor undergraduate student or lower level graduate students in their laboratory
- Run laboratory classes
- Conduct discussion sessions
- Develop and present class lectures

The list of planned activities will be submitted to the GPD in the first week of the fall semester and activities conducted during the subsequent academic year will be documented on the Annual Graduate Student Evaluation that is submitted the following summer.

Appendix A: Example List of 400-Level Courses Approved as Electives for Graduate Degrees in Chemical and Biochemical Engineering and Environmental Engineering

The following courses have been approved for use in satisfying elective course requirements for graduate degrees in Chemical and Biochemical Engineering:

BIOL 414 (Eukaryotic Genetics and Molecular Biology)
BIOL 422L (Microscopy in the Biological Sciences)
BIOL 434 (Microbial Molecular Genetics)
BIOL 456 (Plant Molecular Biology)
CHEM 431 (Chemistry of Proteins)
CHEM 432 (Advanced Biochemistry)
CHEM 433 (Biochemistry of Nucleic Acids)
CHEM 435 (Biochemistry of Complex Carbohydrates)
CHEM 441 (Physical Chemistry of Macromolecules)
CHEM 442 (Physical Biochemistry)
CHEM 443 (Molecular Spectroscopy and Biomacromolecules)
CHEM 444 (Molecular Modeling)
MATH 441 (Numerical Modeling)
MATH 481 (Mathematical Modeling)

The following 400 level courses have been approved for use in satisfying elective course requirements for graduate degrees in Environmental Engineering:

CHEM 461 (Advanced Instrumental Methods of Analysis)
CHEM 470 (Toxicological Chemistry)
GES 411 (Fluvial Geomorphology)
MATH 404 (Introduction to Partial Differential Equations 1)

Appendix B: MS and PhD Degree Oral Qualifying Examination Guidelines

These guidelines have been adapted from the National Science Foundation proposal guide. You can find the original document at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg

1. Written Report Maximum Length and Pagination Instructions

The Oral Qualifier written report can be no more than 7 pages in length for the MS report and no more than 15 pages for the PhD report. Each page of the report must be paginated. Do not number the Title Page if included, and begin numbering your pages with 1. Appendices are not allowed.

2. Written Report Margin and Spacing Requirements

The written report must be clear, readily legible, and conform to the following requirements:

1. One of the following typefaces identified below must be used:
    - Arial, Courier New, or Palatino Linotype at a font size of 10 points or larger
    - Times New Roman at a font size of 11 points or larger
    - Computer Modern family of fonts at a font size of 11 points or larger

A font size of less than 10 points may be used for mathematical formulas or equations, Figure, Table or diagram captions and when using a symbol font to insert Greek letters or special characters. Students are cautioned, however, that the text must still be readable;

2. No more than 6 lines of text can be within a vertical space of 1 inch; and

3 . Margins, in all directions, must be at least one inch.

3. Page Formatting

Since ALL faculty members in the department will be reviewing the written report, students should only use a standard, single-column format for the text.
While line spacing (single-spaced, double-spaced, etc.) is at the discretion of the student, established page limits must be followed.

The guidelines specified above establish the minimum font size requirements; however, students are advised that readability is of paramount importance and should take proper care in selection of an appropriate font for use in the written report. Small font size makes it difficult for faculty members to read the written report; consequently, the use of a small font not in compliance with the above guidelines may result in a failing grade. Adherence to font size and line spacing requirements also is necessary to ensure that no student will have an unfair advantage by using a smaller font or line spacing to provide more text in the written report.

4. References Cited

Reference information is required. Each reference must include the names of all authors (in the same sequence in which they appear in the publication), the article and journal title, book title, volume number, page numbers, and year of publication. If the document is available electronically, the pubmed id

and website address should be identified. Students must be especially careful to follow accepted scholarly practices in providing citations for source materials relied upon when preparing any section of the proposal. While there is no established limitation for the number of references, the reference section must include bibliographic citations only and must not be used to provide parenthetical information outside of the 7 page limit.

5. 1 Students Will Work Independently on the Written Report

The Graduate Program Committee will provide three examples of previous oral qualifier written reports to every student taking the examination. Students should not ask for any other examples from older classmates, research group members or their advisor. Note that these provided documents may have been written before the guidelines described in this document were instituted so that they may not conform precisely to these guidelines.

Students will prepare the written report and oral presentation independently. Advisors/Mentors are available to discuss ideas and answer questions, but will not read or comment on the written report. Students are encouraged to use the writing center at UMBC. Senior graduate students will also be available for discussions or for sharing ideas but should not read or critique the written report of students being examined.

5.2 Oral Presentation

Students should work independently on the first draft of their oral presentation. Students should not request assistance from any Faculty member at UMBC while preparing their oral presentation. Students will not be evaluated or receive any kind of critique from Faculty members on their oral presentation before the exam takes place. Additionally, students presenting the exam cannot practice in a formal research group setting, *i.e.,* students should not present their oral qualifier at a group meeting. However, we encourage students to recruit senior students in the Department (same or different groups) to participate in a practice. The request to present in seminar is on a first-come-first serve basis. When students present their oral qualifier during ENCH 609 Faculty will not participate in writing feedback.

Oral presentations do not have a required format, and students may use any software of their choice to create the visual aides for their presentation. The maximum time limit for the oral presentation is 20 minutes. Questions from the Departmental Faculty will follow the oral presentation.

All students are required to sign a written pledge that they will follow the guidelines described above when preparing for the oral qualifying examination.

6. Delivery of Written Document

The written document is due to the Faculty members a week before the scheduled exam date i.e. if your exam is scheduled on Friday your paper is due on the previous Friday at noon.
Students should save their file as: LAST NAME_ FIRST NAME Oral Qualifier DATE.
Students should convert their file into a pdf document.

7. Content Ideas

To help you think about your document here are some ideas of the topics you should include. You do not need to follow the exact sequence of topics or include all of them.

I. Aim/Hypothesis/Objective of study: What are you going to do?
II. Background: What has already been done? Place your work/ideas in context of the field of study.
III. Materials & Methods: What did you? What are you planning to do?
IV. Experimental design and expected outcomes: Experiments/Modeling you planned but might not have done yet? What do you expect the results to look like (if they have not taken place)? What equations/measurements you propose to use?
V. Preliminary Work/Results to date: What data have you gathered, what equipment have you learned to use? What programs have you written?
VI. Discussion/Conclusions: What does it all mean? If you have results that are unexpected, can you explain them? Can you make any conclusions of the work you put together in context of the advancement of your field.
VII. Future Work: Ideas you want to pursue next?
VIII. References

Tip for document: Make sure each section of document has a title, include an index and title page (will not count as part of the seven pages). Tip for references: if you have not used a *reference* software we recommend you start as soon as possible. *EndNote Web* is a *reference* software available at no charge for current UMBC students, staff, and faculty. You can find instructions and access using the following link: http://aok.lib.umbc.edu/reference/Endnote/

8. Agreement by Students

The GPD will meet with all graduate students at the beginning of each academic year. The student is expected to read the Oral Qualifier Guidelines prior to the meeting. Student questions about the guidelines will be addressed at the GPD meeting. Students will be asked to sign an agreement that they have read, received a copy and agree to follow the Oral Qualifier Guidelines for the CBEE Department at UMBC.

9. Checklist:

A list has been provided that you should go through as a final check before submitting your qualifier.

1) Title page is included
2) Numbering of pages started at 1 on first text page
3) I have 7 pages with text, figures, tables and no appendices
4) I have reference page/s that are not part of the 7 pages
5) The font and spacing follow the rules
6) I have read all the instructions and if I had questions I asked a Faculty Member

Rubric for Qualifying Exam for MS Thesis and PhD students

The qualifier is described in detail in the graduate handbook. A week before the exam, students must turn in a document, written entirely independently without faculty or postdoctoral student help, in the form of an NSF proposal to address a research question. Graduate students are allowed to talk with other graduate students in the program about the proposals. The student at the exam provides a short (20 minute) overview of the project and responds to questions from the panel regarding the project. The rubric, below, is used to assess the performance on the written and oral presentation.

Students are expected to take the qualifier at the end of the first year, and the proposal may be drawn from their rotations or their first year research as direct admits.

Component	Does not meet expectations	Meets expectations	Exceeds expectations
Motivating the work	The reasons for the work are not covered or only minimally covered	Big picture presented. Reasons for research question laid out	Motivation is clear and documentation and/or data is used to show the importance and need for the work
Defining the specific research question	Not clear what problem is going to be addressed	Clear what problem is being addressed	Clear what specific problem is being addressed
Background	Limited background. No context. Limited or no signs of critical thinking regarding other work.	Relevant papers and work are cited and understood.	Relevant papers and work are cited, understood, and evaluated critically
Experimental design and analysis	Experiments and analysis are not clear Experiments are not tied to research question Alternatives are not presented	Clear experiments and analysis with specific anticipated results and alternatives tied to research question	Rigorous design of experiments and analysis that not only include alternatives but are designed so that a negative finding is still very informative
Integration with core material	Core material is not understood well or not connected to proposal	Core material is referenced and relevant parts are used to strengthen proposal	Core material is used to gain new and potentially important insights into field
Writing	Writing is unclear Organization is poor	Writing is clear Organization is logical	Writing is at the level of a fundable grant

Presentation	Slides hard to read Organization poor Speaker cannot be heard clearly	Slides are clear Presentation organized Speaker projects	Presentation equivalent to talk at national conferen es
Questions	Does not understand questions Is not able to answer questions	Understands questions Answers questions, potentially with some clarifications	Understands and responds to questions as well as gives context to larger issues around questions

Comments:

Pass or Fail:

Appendix C: Identification of Potential Faculty Advisors and Research Area for CBEE Graduate Applicants

Student Name: _____

PhD Degree Seeking: _____ Chemical and Biochemical Engineering
_____ Environmental Engineering

Research Areas of Interest (include up to three):

1._____

2._____

3._____

Faculty #1 Name:_____

Research Area:_____

Comments:

Faculty #2 Name:_____

Research Area:_____

Comments:

Faculty #3 Name:_____

Research Area:_____

Comments:

Appendix D: Rotational Research Plan and Student Summary

Rotational Research Plan

To be completed by week 1 of the student's first semester.

Student Name: _____

Rotational Faculty #1: _____

Rotational Faculty #2_____

Rotational Faculty #3: _____ (if needed)

Core Courses and semester taken (to be completed in first year)

_____ _____

_____ _____

_____ _____

For each rotation, the faculty will develop a research plan that describes the expectations that the student and rotational faculty will meet during the rotation. Example expectations include partnering the student with existing lab members to perform research (state experiments to be conducted, exposure to analytical methods, etc.), requiring student participation in group research meetings, and providing the student articles to read that are discussed in research groups, among others. The research plan should be developed such that the student can complete the rotation in a 6-7 week time frame. Example research plans are provided in the following pages. The rotational plans must be submitted to the GPD. Following each rotation the student should write a 3-5 page document that describes their work and how each expectation was met. The rotational faculty will use these documents to assign a grade for each rotation.

ENCH 898 – Rotation Plan for Student ZZZZ

Structure

The first rotation will take place from 9-7-2014 to 10-28-2014 in Dr. XXXX's laboratory. The second rotation will occur in Dr. YYYYY's laboratory from 10-29-2014 to 12-17-2014.

ROTATION 1 Dr. XXXX Lab

Title: Recovery of Phosphorus from Chicken Litter

Background: In the industrial way of poultry farming, large amounts of chicken litter are generated. Chemically, the chicken litter is rich in phosphorus. Disposing huge quantities of the litter into the soil can create soil with excess phosphorus and subsequently pollute water resources. Also, the fertilizer industry's need for inorganic phosphorus can be reduced if phosphorus from organic sources like chicken litter can be extracted and recovered. Hence, the research for the extraction of phosphorus from chicken litter gives us an opportunity to create a product of environmental value by reducing waste and creating economical value, *i.e.*, a high quality fertilizer.

Objectives

1. Use different acids to extract phosphorus from chicken litter in bench-scale batch reactors; determine the extraction efficiency and cost analysis for each acid.
2. Measure the settling time distribution for different chicken litters; and recovered phosphate salts.
3. Assist in setting up a continuous flow reactor system to extract phosphorus from chicken litter and recover the phosphorus in fertilizer form.

E**xpectations of Dr. XXX**

1. To comment on my timeline for the rotation to ensure that my goals are met.
2. To allow me to update the Dr. XXX research group at the Friday lab meetings.
3. To share and discuss interesting journal articles relating to the project.

Expectations of the student

1. To spend 20 hours per week in the lab.
2. To make at least two presentations in group meeting.
3. To make intellectual contributions to the project.

ROTATION 2 Dr. YYYY Lab

Title: Feasibility of a gas-phase ammonia measurement using an Ion Selective Electrode

Background: Ammonia is a pollutant which poses health risks. Exposure to even low levels can lead to irritation in the lungs and the eyes. It is produced in large amounts by the fertilizer and livestock industry. Ammonia can also form fine particulate matter when it combines with acidic species (for example, sulfuric and nitric acid) which can cause decreased visibility and adverse

health effects, as well. In this study we will assess the feasibility of measuring ammonia using a mist chamber coupled to an Ion Selective Electrode (ISE).. This method, if successful, would represent roughly an order of magnitude decrease in cost from existing ammonia monitors.

Objectives

1. Demonstrate and optimize Mist Chamber Sampling for ammonia.
2. Use Ion Chromatography for ammonia concentration comparisons with ISE.
3. Carry out a Feasibility study for ammonia measurement using Ion Selective Electrode method.

Expectations of Dr. YYYY

1. To comment on my timeline for the rotation to ensure that my goals are met.
2. To provide experimental guidance in weekly meetings.
3. To share and discuss journal articles relating to the project.

Expectations of the student

1. To spend 20 hours per week in the lab.
2. To make a report at the end of the lab rotation.
3. To make intellectual contributions to the project.

Rubric for Evaluating Student Research Rotation

CBEE at UMBC Laboratory Rotation Evaluation by Faculty Supervisor
Complete this form for each student performing a rotation in your laboratory and follow the CBEE Graduate Student Handbook for dates of submission. Please provide the student with a copy of this form.

Student's Name:
Faculty Member:
Rotation Start Date:
Rotation End Date: (rotations are expected to be 7-8 weeks)
Approximate Hours/Week spent in the Lab: (20 are expected)
Project Title:

The purpose of the evaluation is to provide an assessment and feedback regarding the student's aptitude and abilities doing research. The areas below are thought to be critical to develop the skills to be an independent researcher which is the goal of the PhD program. Acceptable would be the equivalent of a B. Passing. Outstanding would be an A.

The grading will be calibrated to the level of a chemical engineering undergraduate with a BS degree.

Please check the box that describes the performance in each other categories. Comments for each are also welcome to help students develop but not required unless a student is found to be performing at an unacceptable level for any of the categories. Then, feedback must be included below the table explaining what was unacceptable so the student has a chance to improve.

Area	Definition of acceptable: Meets standard	Unacceptable	Acceptable	Outstanding
Commitment (motivation, reliability, work ethic, conscientiousness)	Works on rotation project 20 hours a week. Communicates with PI and group. Documents work clearly.			
Abilities (independence, intellectual curiosity)	Can find and follow protocols. Can learn a method from others and do it independently by the 3rd try. Can read the literature and propose new			

	ideas and alternatives.			
Communication Skills (written and oral)	Can clearly summarize work done and outcomes in both written and verbal communication.			
Understanding of the research concepts (scientific comprehension, intellectual involvement)	Understands the scientific underpinnings to the research. Can explain why something is done and how it fits into the bigger picture of the research project.			
Conduct of research (lab skills, ability to organize scientific data, lab notebook keeping)	Keeps clean bench. Labels everything. Uses proper lab notebook procedures. Documents all data and makes it accessible to group			
Ability to work in a team	Collaborates. Shares data. Helps others.			

If the faculty has checked unacceptable in any category, they must explain what the student did not do so they can improve in the space below.

Would you accept this student in your lab, assuming no funding barriers? Yes No

Briefly explain:

Additional comments such as achievements and areas for improvement:

Grade Assigned __PASS/FAIL_____

Core courses successfully completed (PASSED). YES NO

Student Signature _____ Date_____

Faculty Supervisor Signature _____ Date _____

GPD Signature _____ Date _____

Appendix E: Annual Graduate Student Evaluation

Date:

Name: **Email**:

Program: **Level**: ☐ MS ☐ PhD

Project Title:

Status of Course Requirements:

Status of Laboratory Rotation:

Status of Qualifying Examination:

Status of PhD Proposal Defense:

Status of Thesis/Dissertation Defense:

Honors, Awards, Fellowships:

Publications:

Presentations:

Mentorship:

Conferences Attended:

Departmental/University Service:

Professional Service:

Workshops/Seminars Attended:

Projected Completion Date for Course Requirements:

PhD Candidacy Approval Date:

Projected Completion Date for Dissertation:

- ☐ The student has been dismissed because of academic performance.
- ☐ The student has been dismissed for failure to reach milestones (including Qualifying Examinations, Proposal Defense, and Thesis/Dissertation Defense).
- ☐ The student has left the program voluntarily.

Faculty Advisor's Signature: _____ **Date**:

Graduate Student's Signature: _____ **Date**: