THE OHIO STATE UNIVERSITY

College of Engineering

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Date: 9 November 2010

To: Randy Smith
Vice Provost, Office of Academic Affairs

From: Ed McCaul
Secretary, College of Engineering Committee on Academy Affairs (CCAA)

Subject: Semester Conversion Proposal for the BS/MS, MS, and PhD Degrees in Chemical Engineering

Attached is a letter from Stuart Cooper, Department Chair of Chemical and Biomolecular Engineering, as well as semester conversion proposals for their BS/MS, MS, and PhD Degree programs in Chemical Engineering.

These proposals were reviewed by a subcommittee of CCAA. After reviewing the proposals and having some changes made to them the subcommittee recommended to the full committee that they be approved. After a discussion, CCAA unanimously approved the proposals on the 8th of November 2010 and requested that I forward the proposals to you for consideration by CAA. If you have any questions concerning these proposals please let me know.

William G. Lowrie Department of Chemical and Biomolecular Engineering

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To: OSU Office of Academic Affairs

From: Stuart Cooper, University Scholar Professor and Department Chair

Date: June 22, 2010

Re: Semester program proposals for the William G. Lowrie Department of Chemical and Biomolecular Engineering

The proposed degree programs to be offered by the Department of Chemical and Biomolecular Engineering when the University converts to semesters in 2010 are enclosed. Preparation of these proposals was the responsibility of the Department's Curriculum and Graduate Studies Committees. Various constituencies were consulted during this process, including faculty, current students, and the Department's advisory board. Feedback from senior exit surveys and alumni surveys were also considered. The proposed BS program was benchmarked against chemical engineering programs at the University of Minnesota, Purdue, and Penn State.

The proposed programs were discussed regularly in faculty meetings over the past year. Several smaller groups, each headed by a member of the Curriculum Committee, worked on areas of the undergraduate core BS program. An ongoing Carmen sit open to all current undergraduate students was used to get feedback during the later stages of the process.

Results of the faculty vote on the proposed program were as follows (18 faculty were eligible to vote): 17 in favor of the BS program, and 17-0 in favor of the two graduate programs (MS, PhD). The Department's combined BS/MS plan does not impose additional requirements beyond those in the COE plan, so we are not submitting a separate proposal. I therefore recommend approval of the enclosed proposals for the following programs:

- BS in Chemical Engineering
- MS in Chemical Engineering
- PhD in Chemical Engineering

Sincerely,

Stuart L. Cooper

Stuart L. Cooper
Professor and Chair

MS in Chemical and Biomolecular Engineering (MS CBE) Program

Primary Contact: Kurt Koelling (koelling.1@osu.edu)

1. Name of Program

Chemical and Biomolecular Engineering

2. Name of Degree

Master's in Chemical Engineering (MS ChE)

3. Responsible Academic Unit

William G. Lowrie Department of Chemical and Biomolecular Engineering

4. Type of Program

d. Graduate degree program

5. Semester Conversion Designation

b. Converted with minimal changes to program goals and/or curricular requirements (e.g., name changes, changes in electives and/or prerequisites, minimal changes in overall structure of program, minimal or no changes in program goals or content)

6. Program Learning Goals

Not required at this time for graduate programs.

7. Proposed Program Requirements

See Attachment #1A: MS CBE Proposed Program Requirements.
See Attachment #1B: Non-thesis CBE Proposed Program Requirements

8. Current and Proposed Advising Sheets

See Attachment #2A for the current MS CBE program requirements. This document serves as the current MS CBE Advising Sheet. Attachment #1A, along with an updated version of the program requirements, and included as Attachment #3A, will serve as the proposed MS CBE Advising Sheet.

See Attachment #2B for the current Non-thesis CBE program requirements. This document serves as the current Non-thesis CBE Advising Sheet. Attachment #1B, along with an updated version of the program requirements, and included as Attachment #3B, will serve as the proposed Non-thesis MS CBE Advising Sheet.

9. Curriculum Map

Not required at this time for graduate programs.

10. Rationale for Program Changes and Description of Changes

Thesis MS Program

A significant portion of the MS program is research, leading to a thesis that a MS student conducts under the supervision of their advisor. This component of the MS program is not impacted by the change from quarters to semesters.

To prepare students for research, and to ensure that a MS graduate has sufficient background in the core Chemical Engineering areas, our current program includes core coursework, advanced coursework in Chemical Engineering and advanced coursework in other scientific, mathematics, or engineering disciplines are to be selected to fit the candidate's goals with the consent of the advisor. These requirements add to 32 qtr-cr-hrs. The proposed semester plan adds to 21. Currently, the advanced ChBE course requirement is 6 qtr-cr-hrs and other advanced coursework requirement is 6 qtr-cr-hrs. In the semester system, this requirement will be changed to 6 sem-cr-hrs of advanced coursework, to allow more flexibility for students. This coursework can be graduate level ChBE courses or other scientific, mathematics, or engineering disciplines, to fit the candidate's goals with the consent of the advisor.

The last substantial change in the MS program requirements was made in January 2007. At that time, the credits required for Advanced CBE courses and Other Advanced courses were reduced. The goal was to allow students to get more actively involved in research earlier in the program. The change was also based on a careful survey of peer programs, which led to the conclusion that our MS coursework requirements prior to 2007 were higher than almost all peer institutions.

Non-thesis MS

Our current program includes core Chemical Engineering coursework, advanced coursework in Chemical Engineering and advanced coursework in other scientific, mathematics, or engineering disciplines are to be selected to fit the candidate's goals with the consent of the advisor. These requirements add up to 39 qtr-cr-hrs. The proposed semester plan adds to 27.

11. Credit Hour Changes

Thesis MS

	Number of qtr-cr-hrs in current program	Calculated result for 2/3 of current qtr-cr-hrs	Number of sem-cr-hrs required for proposed program
Total cr-hrs required for completion of program	45	30	30
Prerequisite cr-hrs required for admission to program which are not counted	0	0	0
Required cr-hrs offered by the unit	37-43	24.7-28.7	23-29
Required cr-hrs offered outside the unit	2-8	1.3-5.3	1-7

Non-thesis MS

	Number of qtr-cr-hrs in current program	Calculated result for 2/3 of current qtr-cr-hrs	Number of sem-cr-hrs required for proposed program
Total cr-hrs required for completion of program	45	30.0	30

Prerequisite cr-hrs required for admission to program which are not counted	0	0	0
Required cr-hrs offered by the unit	33-45	22.0-30.0	24-30
Required cr-hrs offered outside the unit	0-12	0-8.0	0-6

12. Rationale for Significant Change in Credit Hours

Not applicable.

13. Transition Policy

No CBE graduate student who began the degree program under quarters will have progress toward graduation impeded by the transition to semesters. Graduation requirements beginning Summer 2012 will be those in force for CBE graduate students under semesters; but every quarter-credit-hour that would have counted toward a CBE graduate degree under the quarter-based program will count (as 2/3 of a semester-credit-hour) toward the requirements for graduation under the corresponding semester-based program. Additional advising support will be provided for CBE graduate students to assist in planning course schedules for the last year of quarters (2011-2012) and for the first year of semesters (2012-2013). If it is determined that the "normal" conditions covered by the CBE transition policy would result in a particular student facing an unavoidable delay in graduation compared to quarters to the change to semesters-rather than the student's failure to meet with an advisor to complete a proposed plan of study or to make satisfactory progress through the mutually agreed program plan – then a revision of specific requirements will be worked out for that student by their faculty advisor, with approval by the CBE Graduate Studies Committee.

- Stuart Cooper, CBE Department Chair

The MS degree conversion policy has been designed so that a student finishing a requirement in the quarter system will be deemed to have met the corresponding requirement in the semester system. Total cr-hrs taken under quarters will be converted according to the usual 2/3 sem-cr-hr per qtr-cr-hr completed, and any excess or deficit in sem-cr-hrs for the degree after fulfilling the requirements will be applied to the electives. A student in transition will be deemed to have enough sem-cr-hrs to graduate if his/her total sem-cr-hrs are less than 1 sem-cr-hr below the semester requirement for the MS program.

The current requirement for the Thesis MS core is 6 CBE classes and 1 Chemistry class, totaling 20 qtr-cr-hrs. Under semesters, as seen in Attachment #1, the new graduate core requirement will be 5 CBE classes and 1 Chemistry class totaling 15 sem-cr-hrs. The graduate core will be deemed to have been completed with the student has finished a graduate core class (in either the quarter or semester system) in analysis, thermodynamics, kinetics, transport (momentum transfer and/or mass transfer), research methods, and chemistry safety seminar.

The current core requirement for the Non-thesis MS core is 5 CBE classes, totaling 15 qtr-cr-hrs. Under semesters, as seen in Attachment #1, the new graduate core requirement will be 4 CBE classes totaling 12 sem-cr-hrs. The graduate core will be deemed to have been completed with

the student has finished a graduate core class (in either the quarter or semester system) in analysis, thermodynamics, kinetics and transport (momentum transfer and/or mass transfer).

Regarding Advanced CBE and Other Advanced Coursework, classes taken under quarters will be converted directly as 2/3 sem-cr-hr per qtr-cr-hr, and these will apply to the new sem-cr-hr requirements.

There are no graduate course sequences in which a student might be caught part-way during the switch to semesters, so there is no need for bridge courses in the CBE graduate programs.

14. Assessment Practices
Not required at this time for graduate programs.

15. Assessment Plan on File with OAA
Not required at this time for graduate programs.

Attachment #1A

CBE M.S.-Degree Proposed Program Requirements

Graduate Core*	Course Number	Cr-hrs
Chemical Engineering Analysis	8801	3
Advanced ChBE Thermodynamics I	8808	3
Advanced ChBE Kinetics I	8812	3
Advanced ChBE Transport	8815	3
Research Communications in ChBE	8781	2
Chemistry Safety Seminar		1
Total Graduate Core cr-hrs		15

Advanced Coursework **	Course Number	Cr-hrs
Total Adv cr-hrs (≥6)		

MS Research	Course Number	Cr-hrs
Total MS Research cr-hrs (≥9)		

Total Hours ≥ 30	

Notes:
*Waived Requirements must be accompanied by copy of approved petition
**Graduate level courses in ChBE or other scientific, mathematics, or engineering disciplines are to be selected to fit the candidate's goals with the consent of the advisor.

Attachment #1B

CBE Non-thesis M.S. Proposed Program Requirements

Graduate Core	Course Number	Cr-hrs
Chemical Engineering Analysis	8801	3
Advanced ChBE Thermodynamics I	8808	3
Advanced ChBE Kinetics I	8812	3
Advanced ChBE Transport	8815	3
Total Graduate Core cr-hrs		12

Advanced ChBE Coursework	Course Number	Cr-hrs
Total Adv ChBE cr-hrs (≥9)		

Other Advanced Coursework	Course Number	Cr-hrs
Total Other Adv cr-hrs (≥6)		

Independent Study	Course Number	Cr-hrs
Independent Study (≥3)		

Total Hours ≥ 30	

Attachment #2A:

CURRENT MASTERS OF SCIENCE DEGREE PROGRAM

Program of Study

Candidates for the Master's of Science (MS) Degree in Chemical and Biomolecular Engineering will develop, with the advice and approval of their advisor, a program of study which satisfies the student's goals, subject to the requirements of the Graduate Studies Committee and the Graduate School. The minimum requirement for the MS degree is 45 credit hours beyond the Bachelor's of Science (BS) degree. The total academic course requirement, not including research or special project problems, is 32 credit hours. A minimum of thirteen (13) credits of Research ChBE 999 are required.

Course Requirements

Three categories of course work are described below. A minimum of thirty-two (32) quarter-credit hours of course work is required for candidates with a Bachelor's degree in Chemical Engineering from an Accreditation Board for Engineering and Technology, Inc. (ABET) accredited school. Students from schools which have other academic accreditation must fulfill supplementary undergraduate curriculum course work requirements.

There is a six-year time limit for application of credit earned in course work or research toward fulfilling MS-degree requirements.

A maximum of nine (9) quarter-credit hours may be accepted for candidates transferring into the MS-degree program. Transferred courses must have the written approval of the student's advisor and the Department Graduate Studies Committee.

Core Courses

Successful completion of the following twenty (20)-credit hours of academic quarter courses are required for graduation:

ChBE 801	(3)	Chemical Engineering Analysis
ChBE 808	(3)	Advanced Chemical Engineering Thermodynamics
ChBE 812	(3)	Advanced Chemical Engineering Kinetics
ChBE 815.01	(3)	Advanced Mass Transfer – I
ChBE 815.08	(3)	Advanced Momentum Transfer – I
ChBE 881	(3)	Seminar in Chemical Engineering
Chem 685	(2)	Safety Seminar

Chemical and Biomolecular Engineering Electives

A minimum of six (6) additional quarter-credit hours of advanced chemical and biomolecular engineering courses is required. Only courses at the 600, 700, and 800 levels are acceptable. Courses at the 600 or 700 level that are part of the Ohio State undergraduate curriculum (except ChBE 626) cannot be used to meet this requirement.

Up to three (3) quarter-credits of ChBE 801 – Advanced Special Problems in Chemical Engineering may be applied to meeting this requirement. If a student wishes to enroll in ChBE 801 to fulfill part of this requirement, the Section of the Course must be approved by the Graduate Studies Committee before the quarter in which it is offered.

Other Elective Courses
Graduate-level courses in chemical and biomolecular engineering or other scientific, mathematics, or engineering disciplines are to be selected to fit the candidate's goals with the consent of the advisor. Six (6) quarter-credit hours are required.

ChBE 995: As part of the department's on-going effort to improve its visibility and reputation in the Chemical Engineering community, several distinguished guests are invited each year to present seminars on timely topics. This is an opportunity for the Department to present its best image to those people who help determine academic reputation and ranking. Furthermore, these seminars are an opportunity to learn about new and different areas of research outside of one's own research group. Under the course number ChBE 995, these seminars are offered during Autumn, Winter, and Spring quarters only. Each quarter, all graduate students should enroll in this 1-credit course. Based strictly on attendance at the weekly seminars, it will be graded S/U. More than one (1) unexcused absence in any quarter may result in an unsatisfactory grade. This course counts toward the research requirement for all graduate degrees.

Language Requirements
All students must be proficient in written and oral English. Non-native English speaking students must pass the equivalent of English 106, 107, 108 and English 104 and 105. Note that these requirements must be fulfilled, including passing the Test of Spoken English or SPEAK Test, prior to undertaking the Teaching Experience Requirement. For more information on this topic, please refer to The Ohio State University Office of International Affairs (OIA) website at: http://www.oia.ohio-state.edu/.

Instructional Associate (IA) Requirements
Philosophy and Benefits to Graduate Students
A core graduate program educational objective in the Department of Chemical and Biomolecular Engineering is intellectual leadership. Intellectual leadership involves more than the generation of knowledge through research, but also its transfer through effective communication. We expect our students to be able to teach what they have learned, and to be able to critically judge the technical communications and ideas of others.

In addition to making an invaluable contribution to the undergraduate teaching mission of the CBE program, graduate students will benefit from this policy in several ways:
Critically evaluating technical work prepared by someone else, explaining difficult concepts, and teaching fundamental ideas are essential skills for M.S. engineers. We believe these skills can be most effectively developed by "hands-on" practice: having graduate students work directly in the role of teachers with undergraduate students. Unlike many other departments at OSU, all courses in CBE are taught by faculty, and

so graduate students generally have few opportunities to teach except through their experience as instructional assistants.

Teaching experience of some sort is essential for a graduate student seeking academic positions after completion of the M.S. The teaching statement of new faculty candidates is an important component of their application.

Serving as instructional assistants also benefits our graduate students by providing them opportunities to practice and improve communication skills. Most students have limited prior experience in communicating the detailed, technical, and complicated ideas and concepts that lie at the heart of science and engineering.

Implementation in CBE
Second year graduate students will complete the UCAT TA Orientation in September. Topics covered will include: OSU policies and procedures, academic integrity, working with students with disabilities, FERPA, teaching methods, learning styles, grading, and assessment. Students will be IA-eligible upon completion of this orientation.

Graduate students in their second year or later will be assigned to serve as an IA in a specific course. During this quarter, IAs will enroll in 899, a 2-credit course. This course is graded S/U. No student will be asked to serve more than one time in any given academic year. Note that IAs are not appointed as Graduate Teaching Assistants (GTA) nor paid additional compensation.

Each MS student is required to serve as an IA twice times during their time in the graduate program; they will therefore earn a total of 4 credits for 899.

The maximum average workload must not exceed 9 hr/week.

Additional Requirements
In order to maximize each student's potential for graduate coursework success; he or she may be required to complete selected undergraduate coursework. A student who has not earned an ABET-accredited Bachelor's (BS) degree in Chemical Engineering should expect this requirement. Based on each applicant's credentials, the Graduate Studies Committee makes these assessments and establishes remedial course requirements.

Application to Graduate
Within two weeks prior to the end of the quarter when you want to apply to graduate, notify the Graduate Program Coordinator. For example, if you plan to graduate Spring quarter, the Graduate Program Coordinator should be notified before the end of Winter quarter. This will provide sufficient time for the Graduate Studies Committee to review your academic record, to formally ensure that you have met the department's graduation requirements. In addition, the Department requires that graduating students return all keys, that laboratory equipment and desks be left clean and in order.

An Application to Graduate form may be obtained on the Graduate School's web site. Note: the completed, signed form must be submitted to the Graduate School by the end of the second Friday of the quarter in which you apply to graduate.

Master's Degree EXAMINATION

A final, oral defense of the Master's Degree Thesis is required for all candidates. Each student's academic advisor selects one (other) faculty member to serve on the Examination Committee. Each Committee member shall be given a copy of the thesis no later than one week prior to the defense date. An oral Master's Examination is held after the submission and preliminary approval of the thesis. Upon completion of the oral defense portion of the examination, the Committee will determine whether or not the work is satisfactory. The student and his or her advisor are responsible for having all forms completed and signed by the GSC Chair by the deadline dates. Department policy permits other faculty and graduate students to attend the oral examination if the following provisions are met.

- At the time that the examination is scheduled, the Graduate Program Coordinator or designee notifies the faculty and graduate students of the examination. It is the student's responsibility to request this service.
- Those faculty and graduate students who wish to attend the oral examination shall notify the student's advisor at least 24 hours before the exam.
- The level of participation of non-committee members shall be strictly in keeping with Graduate School rules and within the discretion of the student's advisor.

Master's-Degree THESIS

The written content and format of the thesis shall conform to The OSU *Graduate School Handbook* (Section VI.4). First, the thesis must have the advisor's approval. The Examination Committee grants final thesis approval.

Soon after advisors' assignments, Master's-degree students should discuss research opportunities with the advisor and, shortly thereafter, prepare a written research proposal for the thesis. The purposes of early research topic definition are: (1) to provide focus to the student's program, (2) to allow the advisor and the Department Chair to plan and manage resources, and (3) to permit the student advisor time to acquire appropriate instrumentation. Classroom learning and research discover should proceed concurrently throughout the entire program.

Attachment #2B:

CURRENT NON-THESIS M.S. PROGRAM IN CHBE

Admission requirements

Admission requirements are the same as for the thesis-M.S. program: Students are required to have an undergraduate GPA of 3.0 or higher (4.0 scale). Although not required for domestic students applying for the M.S. program, applicants are encouraged to take the Graduate Record Exam (GRE) General Test prior to submitting their application. The GRE is required for international students and all students who apply to the Ph.D. program. There are no formal minimum scores requirements for the GRE. Average scores for recent applicants are verbal: 550/800, quantitative: 750/800, and, and analytical writing: 4.5/6.0.

International students for whom English is not their native language may be required to take an English proficiency exam, usually TOEFL.

Applications for graduate study are accepted throughout the year.

Course requirements

The total number of course credit hours is the same as for the thesis option; however, to increase flexibility there are fewer core courses and more elective hours.

1. ***Core courses (15 credit hours)***
    a. ChBE 801 – Chemical Engineering Analysis
    b. ChBE 808 – Advanced Thermodynamics
    c. ChBE 812 – Advanced Kinetics and Reactor Design
    d. ChBE 815.01 – Advanced Mass Transfer
    e. ChBE 815.08 – Advanced Momentum Transfer
2. ***Chemical engineering electives (12 credit hours):*** Four three-credit ChBE technical elective courses.
3. ***Additional electives (12 credit hours):*** Three technical elective courses. These may be ChBE courses or graduate-level courses in mathematics, statistics, chemistry, biology, physics, or other engineering disciplines.
4. ***Independent study project (6 credit hours):*** Short term (1-2 quarters) project conducted under supervision of a faculty advisor on a topic of interest to the student. Project may be conducted at the student's work location. Project may be an in-depth study and analysis of technical literature on the topic of interest, or an original project involving experimental, computational, and/or theoretical work. The project is graded pass/fail.

Master's examination

The Master's Examination is taken after submitting the Application to Graduate form and during the quarter in which the student plans to graduate. A student must be registered for at least three graduate credit hours during the quarter this examination is taken. The student must successfully complete two activities that comprise the Master's examination: 1) preparation of a written report summarizing their independent study

project; 2) oral presentation and defense of their project. The oral examination may also test the student's knowledge of engineering fundamentals. The exam committee is composed of at least two faculty members, including the project advisor.

Teaching experience requirement
There would not be an Instructional Associate (IA) requirement for non-thesis students.

Seminar
Non-thesis students would not be required to attend weekly Departmental seminars.

Time limitations
There is no time limit, although students are encouraged to complete the program within 5 years of admission.

Transfer credit
A maximum of nine quarter credit hours may be accepted for coursework taken at another institution. Transfer courses are evaluated on a case-by-case basis by the Department.

Policy for applicants with non-chemical engineering undergraduate degrees
Students entering the ChBE graduate program without a B.S. degree in chemical engineering must first successfully complete the following undergraduate courses or have equivalent coursework in these subject areas: ChBE 509 (Thermodynamics II), ChBE 520 (Momentum Transport), ChBE 522 (Mass Transport), ChBE 610 (Chemical Kinetics and Reactor Design), Math 255 or 415 (Differential Equations).

Attachment #3A:

PROPOSED MASTERS OF SCIENCE DEGREE PROGRAM

Program of Study

Candidates for the Master's of Science (MS) Degree in Chemical and Biomolecular Engineering will develop, with the advice and approval of their advisor, a program of study which satisfies the student's goals, subject to the requirements of the Graduate Studies Committee and the Graduate School. The minimum requirement for the MS degree is 30 credit hours beyond the Bachelor's of Science (BS) degree. The total academic course requirement, not including research or special project problems, is 21 credit hours. A minimum of nine (9) credits of ChBE 8999 Research are required.

Course Requirements

Three categories of course work are described below. A minimum of twenty-one (21) semester-credit hours of course work is required for candidates with a Bachelor's degree in Chemical Engineering from an Accreditation Board for Engineering and Technology, Inc. (ABET) accredited school. Students from schools which have other academic accreditation must fulfill supplementary undergraduate curriculum course work requirements.

There is a six-year time limit for application of credit earned in course work or research toward fulfilling MS-degree requirements.

A maximum of six (6) semester-credit hours may be accepted for candidates transferring into the MS-degree program. Transferred courses must have the written approval of the student's advisor and the Department Graduate Studies Committee.

Core Courses

Successful completion of the following fifteen (15)-credit hours of academic semester courses are required for graduation:

ChBE 8801	(3)	Chemical Engineering Analysis
ChBE 8808	(3)	Advanced ChBE Thermodynamics I
ChBE 8812	(3)	Advanced ChBE Kinetics I
ChBE 8815	(3)	Advanced ChBE Transport
ChBE 8781	(2)	Research Communications in ChBE
Chem	(1)	Chemistry Safety Seminar

Advanced Coursework

The minimum requirement is 6 credit hours. Graduate level courses in chemical and biomolecular engineering or other scientific, mathematics, or engineering disciplines are to be selected to fit the candidate's goals with the consent of the advisor.

ChBE 8885: As part of the department's on-going effort to improve its visibility and reputation in the Chemical Engineering community, several distinguished guests are invited each year to present seminars on timely topics. This is an opportunity for the Department to present its best image to those people who help determine academic reputation and ranking. Furthermore, these seminars are an opportunity to learn about new and different areas of research outside of one's own research group. Under the course number ChBE 8885, these seminars are offered during Autumn and Spring semesters only. Each semester, all graduate students should enroll in this 1-credit course. Based strictly on attendance at the weekly seminars, it will be graded S/U. More than one (1) unexcused absence in any semester may result in an unsatisfactory grade. This course counts toward the research requirement for all graduate degrees.

Language Requirements

All students must be proficient in written and oral English and be certified through the ESL Department. Note that these requirements must be fulfilled, including passing the Test of Spoken English or SPEAK Test, prior to undertaking the Teaching Experience Requirement. For more information on this topic, please refer to The Ohio State University Office of International Affairs (OIA) website at: http://www.oia.ohio-state.edu/.

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Critically evaluating technical work prepared by someone else, explaining difficult concepts, and teaching fundamental ideas are essential skills for M.S. engineers. We believe these skills can be most effectively developed by "hands-on" practice: having graduate students work directly in the role of teachers with undergraduate students. Unlike many other departments at OSU, all courses in CBE are taught by faculty, and so graduate students generally have few opportunities to teach except through their experience as instructional associates.

Teaching experience of some sort is essential for a graduate student seeking academic positions after completion of the M.S. The teaching statement of new faculty candidates is an important component of their application.

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Graduate students in their second year or later will be assigned to serve as an IA in a specific course. During this semester, IAs will enroll in 8799, a 1-credit course. This course is graded S/U. No student will be asked to serve more than one time in any given academic year. Note that IAs are not appointed as Graduate Teaching Associate (GTA) nor paid additional compensation.

Each MS student is required to serve as an IA two times during their time in the graduate program; they will therefore earn a total of 2 credits for 8799.

The maximum average workload must not exceed 6 hr/week.

Additional Requirements
In order to maximize each student's potential for graduate coursework success; he or she may be required to complete selected undergraduate coursework. A student who has not earned an ABET-accredited Bachelor's (BS) degree in Chemical Engineering should expect this requirement. Based on each applicant's credentials, the Graduate Studies Committee makes these assessments and establishes remedial course requirements.

Policy for applicants with non-chemical engineering undergraduate degrees
Students entering the ChBE graduate program without a B.S. degree in chemical engineering must first successfully complete the following undergraduate courses or have equivalent coursework in these subject areas: ChBE 3508 (Thermodynamics), ChBE 2420 (Transport Phenomena I), ChBE 3521 (Transport Phenomena II), ChBE 3610 (Kinetics and Reactor Design), Math (Differential Equations).

Application to Graduate
Please notify the Graduate Program Coordinator by the end of the semester before you plan on graduating. For example, if you plan to graduate Spring semester, the Graduate Program Coordinator should be notified before the end of Autumn semester. This will provide sufficient time for the Graduate Studies Committee to review your academic record, to formally ensure that you have met the department's graduation requirements. In addition, the Department requires that graduating students return all keys, that laboratory equipment and desks be left clean and in order.

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- The level of participation of non-committee members shall be strictly in keeping with Graduate School rules and within the discretion of the student's advisor.

Master's-Degree THESIS

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Attachment #3B:

PROPOSED NON-THESIS M.S. PROGRAM IN CHBE

Admission requirements
Admission requirements are the same as for the thesis-M.S. program: Students are required to have an undergraduate GPA of 3.0 or higher (4.0 scale). Although not required for domestic students applying for the M.S. program, applicants are encouraged to take the Graduate Record Exam (GRE) General Test prior to submitting their application. The GRE is required for international students and all students who apply to the Ph.D. program. There are no formal minimum scores requirements for the GRE. Average scores for recent applicants are verbal: 550/800, quantitative: 750/800, and, and analytical writing: 4.5/6.0.

International students for whom English is not their native language may be required to take an English proficiency exam, usually TOEFL.

Applications for graduate study are accepted throughout the year.

Course requirements
The total number of course credit hours is the same as for the thesis option; however, to increase flexibility there are fewer core courses and more elective hours.

5. ***Core courses (12 semester- credit hours)***

ChBE 8801	(3)	Chemical Engineering Analysis
ChBE 8801	(3)	Advanced ChBE Thermodynamics I
ChBE 8812	(3)	Advanced ChBE Kinetics I
ChBE 8815	(3)	Advanced ChBE Transport

6. ***Chemical engineering electives (9 semester- credit hours):*** Nine semester-credit hours of ChBE technical elective courses.

7. ***Additional electives (6 semester- credit hours):*** Six semester-credit hours of technical elective courses. These may be ChBE courses or graduate-level courses in mathematics, statistics, chemistry, biology, physics, or other engineering disciplines.

8. ***Independent study project (3 semester- credit hours):*** Short term (1 semester) project conducted under supervision of a faculty advisor on a topic of interest to the student. Project may be conducted at the student's work location. Project may be an in-depth study and analysis of technical literature on the topic of interest, or an original project involving experimental, computational, and/or theoretical work. The project is graded pass/fail.

Master's examination
The Master's Examination is taken after submitting the Application to Graduate form and during the semester in which the student plans to graduate. A student must be registered for at least 3? (waiting for rule from Graduate School) graduate credit hours during the quarter this examination is taken. The student must successfully complete two activities that comprise the Master's examination: 1) preparation of a written report summarizing their independent study project; 2) oral presentation and defense of their project. The oral examination may also test the student's knowledge of engineering fundamentals. The exam committee is composed of at least two faculty members, including the project advisor.

Teaching experience requirement
There would not be an Instructional Associate (IA) requirement for non-thesis students.

Seminar
Non-thesis students would not be required to attend weekly Departmental seminars.

Time limitations
There is no time limit, although students are encouraged to complete the program within 5 years of admission.

Transfer credit
A maximum of 6 semester-credit hours may be accepted for coursework taken at another institution. Transfer courses are evaluated on a case-by-case basis by the Department.

Policy for applicants with non-chemical engineering undergraduate degrees
Students entering the ChBE graduate program without a B.S. degree in chemical engineering must first successfully complete the following undergraduate courses or have equivalent coursework in these subject areas: ChBE 3508 (Thermodynamics), ChBE 2420 (Transport Phenomena I), ChBE 3521 (Transport Phenomena II), ChBE 3610 (Kinetics and Reactor Design), Math (Differential Equations).

PhD in Chemical and Biomolecular Engineering (PhD CBE) Program

Primary Contact: Kurt Koelling (koelling.1@osu.edu)

1. Name of Program

Chemical and Biomolecular Engineering

2. Name of Degree

Doctor of Philosophy in Chemical Engineering (PhD ChE)

3. Responsible Academic Unit

William G. Lowrie Department of Chemical and Biomolecular Engineering

4. Type of Program

d. Graduate degree program

5. Semester Conversion Designation

b. Converted with minimal changes to program goals and/or curricular requirements (e.g., name changes, changes in electives and/or prerequisites, minimal changes in overall structure of program, minimal or no changes in program goals or content)

6. Program Learning Goals

Not required at this time for graduate programs.

7. Proposed Program Requirements

See Attachment #1: PhD CBE Proposed Program Requirements.

8. Current and Proposed Advising Sheets

See Attachment #2 for the current PhD CBE program requirements. This document serves as the current PhD CBE Advising Sheet. Attachment #1, along with an updated version of the program requirements, and included as Attachment #3, will serve as the proposed PhD CBE Advising Sheet.

9. Curriculum Map

Not required at this time for graduate programs.

10. Rationale for Program Changes and Description of Changes

The most significant component of the Ph.D. program is research, leading to a dissertation that a Ph.D. student conducts under the supervision of their advisor. This component of the Ph.D. program is not impacted by the change from quarters to semesters.

To prepare students for research, and to ensure that a Ph.D. graduate has sufficient background in the core Chemical Engineering areas, our current program includes core coursework, advanced coursework in Chemical Engineering and advanced coursework in other scientific, mathematics, or engineering disciplines are to be selected to fit the candidate's goals with the consent of the advisor. These requirements add to 34 (if the student transfers a MS degree) – 43 qtr-cr-hrs. The proposed semester plan adds to 21 (if the student transfers a MS degree) – 27 sem-cr-hrs.

Currently, the advanced ChBE course requirement is 12 qtr-cr-hrs (6 credits if the student transfers a MS degree) and the other advanced course work requirement is 9 qtr-cr-hrs (6 credits if the student transfers a MS degree). In the semester system, this requirement will be changed to 12 sem-cr-hrs (6 if the student transfers a MS degree) of advanced coursework, to allow more flexibility for students. This coursework can be graduate level ChBE courses or other scientific, mathematics, or engineering disciplines, to fit the candidate's goals with the consent of the advisor.

The last substantial change in the Ph.D. program requirements was made in January 2007. At that time, the credits required for Other Advanced courses were reduced. The goal was to allow students to get more actively involved in research earlier in the program. The change was also based on a careful survey of peer programs, which led to the conclusion that our Ph.D. coursework requirements prior to 2007 were higher than almost all peer institutions.

11. Credit Hour Changes

	Number of qtr-cr-hrs in current program	Calculated result for 2/3 of current qtr-cr-hrs	Number of sem-cr-hrs required for proposed program
Total cr-hrs required for completion of program	120	80	80
Prerequisite cr-hrs required for admission to program which are not counted	0	0	0
Required cr-hrs offered by the unit	67-109	44.7-72.7	43-67
Required cr-hrs offered outside the unit	2-11	1.3-7.33	1-13

12. Rationale for Significant Change in Credit Hours

The rational for significant change (in the range of 2-5 credits) is to allow more flexibility in advanced coursework required. In the quarter-system, there is a specific requirement for a set number of coursework hours in graduate level ChBE courses. This is changed in the semester system. Advanced coursework can be graduate level ChBE courses or other scientific, mathematics, or engineering disciplines, to fit the candidate's goals.

13. Transition Policy

No CBE graduate student who began the degree program under quarters will have progress toward graduation impeded by the transition to semesters. Graduation requirements beginning Summer 2012 will be those in force for CBE graduate students under semesters; but every quarter-credit-hour that would have counted toward a CBE graduate degree under the quarter-based program will count (as 2/3 of a semester-credit-hour) toward the requirements for graduation under the corresponding semester-based program. Additional advising support will be provided for CBE graduate students to assist in planning course schedules for the last year of quarters (2011-2012) and for the first year of semesters (2012-2013). If it is determined that the

"normal" conditions covered by the CBE transition policy would result in a particular student facing an unavoidable delay in graduation compared to quarters to the change to semesters- rather than the student's failure to meet with an advisor to complete a proposed plan of study or to make satisfactory progress through the mutually agreed program plan – then a revision of specific requirements will be worked out for that student by their faculty advisor, with approval by the CBE Graduate Studies Committee.

- Stuart Cooper, CBE Department Chair

The PhD degree conversion policy has been designed so that a student finishing a requirement in the quarter system will be deemed to have met the corresponding requirement in the semester system. Total cr-hrs taken under quarters will be converted according to the usual 2/3 sem-cr-hr per qtr-cr-hr completed, and any excess or deficit in sem-cr-hrs for the degree after fulfilling the requirements will be applied to the electives. A student in transition will be deemed to have enough sem-cr-hrs to graduate if his/her total sem-cr-hrs are less than 1 sem-cr-hr below the semester requirement for the PhD program.

The current requirement for the PhD core is 7 CBE classes and 1 Chemistry class, totaling 22 qtr-cr-hrs. Under semesters, as seen in Attachment #1, the new graduate core requirement will be 5 CBE classes and 1 Chemistry class totaling 15 sem-cr-hrs. The graduate core will be deemed to have been completed when the student has finished a graduate core class (in either the quarter or semester system) in analysis, thermodynamics, kinetics, transport (momentum transfer and/or mass transfer), research methods, and chemistry safety seminar.

Regarding Advanced CBE and Other Advanced Coursework, classes taken under quarters will be converted directly as 2/3 sem-cr-hr per qtr-cr-hr, and these will apply to the new sem-cr-hr requirements.

There are no graduate course sequences in which a student might be caught part-way during the switch to semesters, so there is no need for bridge courses in the CBE graduate programs.

14. Assessment Practices

Not required at this time for graduate programs.

15. Assessment Plan on File with OAA

Not required at this time for graduate programs.

Attachment #1

CBE Ph.D.-Degree Proposed Program Requirements

Graduate Core*	Course Number	Cr-hrs
Chemical Engineering Analysis	8801	3
Advanced ChBE Thermodynamics I	8808	3
Advanced ChBE Kinetics I	8812	3
Advanced ChBE Transport	8815	3
Research Communications in ChBE	8781	2
Chemistry Safety Seminar		1
Total Graduate Core cr-hrs		15

Advanced Coursework **	Course Number	Cr-hrs
Total Adv cr-hrs (≥12)		

PhD Research	Course Number	Cr-hrs
Total PhD Research cr-hrs (≥53)		

Total Hours ≥ 80	

Notes:
*Waived Requirements must be accompanied by copy of approved petition
**Graduate level courses in ChBE or other scientific, mathematics, or engineering disciplines are to be selected to fit the candidate's goals with the consent of the advisor

CBE Ph.D.-Degree After M.S.-Degree Proposed Program Requirements

Graduate Core*	Course Number	Cr-hrs
Chemical Engineering Analysis	8801	3
Advanced ChBE Thermodynamics I	8808	3
Advanced ChBE Kinetics I	8812	3
Advanced ChBE Transport	8815	3
Research Communications in ChBE	8781	2
Chemistry Safety Seminar		1
Total Graduate Core cr-hrs		15

Advanced Coursework **	Course Number	Cr-hrs
Total Adv cr-hrs (≥6)		

PhD Research	Course Number	Cr-hrs
Total PhD Research cr-hrs (≥29)		

Total Hours (after MS Degree) ≥ 50	

Notes:
*Waived Requirements must be accompanied by copy of approved petition
**Graduate level courses in ChBE or other scientific, mathematics, or engineering disciplines are to be selected to fit the candidate's goals with the consent of the advisor

This is based on the assumption that students entering with a MS degree will be able to transfer their degree as 30 credit hours (based from the 45 credits they can now transfer, 2/3 of 45 = 30)

Attachment #2:

CURRENT DOCTOR OF PHILOSOPHY PROGRAM

Introduction

This guide contains policies, rules, procedures and general information that affect both graduate students and graduate faculty in the Department of Chemical and Biomolecular Engineering (CBE). The material presented here has been discussed, and approved by a vote of the graduate faculty in CBE. The primary document governing graduate programs at The Ohio State University (OSU) is the most recent edition of the *Graduate School Handbook* (GSH). This guide, prepared by the Graduate Studies Committee (GSC) and Graduate Program Coordinator, is intended to specify Departmental policies and facilities unique to the Department and not covered in the GSH. CBE students are advised to become thoroughly familiar with, and abide by, the appropriate sections of the GSH and this departmental guide. None of the regulations of the department's graduate program should contradict those of the Graduate School. Faculty and graduate students in the CBE Program are strongly encouraged to refer to updated versions of the departmental Graduate Guide and the *Graduate School Handbook* (GSH). For updated departmental policies and procedures, please refer to the departmental website (http://www.chbmeng.ohio-state.edu/). The Ohio State University Graduate School regulations are available on-line at (www.gradsch.ohio-state.edu).

There are many other instructive publications which contain information directly relevant to graduate education. For example, refer to the *Guidelines for Preparing and Submitting Theses, Dissertations and D.M.A. Documents* (issued by The Graduate School) for specific instructions to prepare for the Master's Degree thesis and the Ph.D-degree dissertation. These documents are required reading for every graduate student who intends to submit a thesis or dissertation to the Graduate School. If you are new to the university, please visit the website of The Office of Student Affairs (http://studentaffairs.osu.edu/) and also obtain a copy of the *Graduate Quality of University Experience* (GQUE) from the Graduate School. The CBE Department will make every effort necessary to provide both the physical resources and intellectual environment for successful completion of your graduate program. Graduate students are expected to exhibit motivation, integrity, and the professional ambition in order to fully utilize the resources available for this achievement. We hope that each student will experience professional growth and personal enjoyment during their graduate program at OSU.

Doctor of Philosophy Degree Program

Ph.D.-Degree Requirements

Procedures and requirements for the Ph.D.-degree are detailed in Section VII of the GSH. The Department requires a qualifying examination. No foreign language is required

A minimum of 120 graduate credit hours are required beyond the Bachelor's degree of which 43 hours are for courses, not including ChBE 999. Course credit hours should normally be divided among (1) Chemical Engineering, (2) basic sciences, and (3) area of specialization. Students shall develop their course of study in consultation with their respective advisors and the other members of each student's Graduate Advisory Committee. The course work shall provide a concentration in a specific area, yet allow reasonable breadth of subject matter, being designed to foster both productive scholarship and knowledge of chemical engineering in relation to allied fields

Course Requirements
The minimum course requirements beyond the Bachelor's degree are classified into three areas:

Core Courses
The total core course requirements are 22 credit hours. These courses and the material prerequisite to them must be mastered by all Ph.D.-degree students. A student may be excused from any of the following required courses if an equivalent course was taken for the MS-degree at another university. In order to be excused from one of the core courses, the student should submit a detailed description of the course, including the syllabus, details of where and when it was taken, and a copy of the transcript showing a grade for this course, to the Graduate Studies Committee. The Committee will review these materials and then decide whether or not to allow the student to substitute the transfer course in place of the related OSU course.

ChBE 801	(3)	Chemical Engineering Analysis
ChBE 808	(3)	Advanced Chemical Engineering Thermodynamics
ChBE 812	(3)	Advanced Chemical Engineering Kinetics
ChBE 815.01	(3)	Advanced Mass Transfer – I
ChBE 815.08	(3)	Advanced Momentum Transfer – I
ChBE 881	(3)	Research Methods in Chemical Engineering
ChBE 981	(2)	Research Proposal in Chemical & Biomolecular Engineering
Chem 685	(2)	Safety Seminar

Advanced Graduate Courses in Chemical Engineering
The minimum requirement is 12 credit hours. Courses in this area must be selected with the advisor's guidance and will be integrated into a program that is of greatest value to the student.

Other Elective Courses
Graduate level courses in chemical and biomolecular engineering (6xx or higher) or other scientific, mathematics, or engineering disciplines (5xx or higher) are to be selected to fit the candidate's goals with the consent of the advisor. Nine (9) quarter-credit hours are required.

Research Requirements
At least 77 credit hours of research (ChBE 999) are required. It is recommended that each student select a research topic by the end of the first quarter of work in the Ph.D. program. A satisfactory dissertation, as judged by the advisor and the Reading Committee under the Graduate School Rules, must be submitted as one of the requirements for the Ph.D. degree.

ChBE 995: As part of the department's on-going effort to improve its visibility and reputation in the Chemical Engineering community, several distinguished guests are invited each year to present seminars on timely topics. This is an opportunity for the Department to present its best image to those people who help determine academic reputation and ranking. Furthermore, these seminars are an opportunity to learn about new and different areas of research outside of one's own research group. Under the course number ChBE 995, these seminars are offered during Autumn, Winter, and Spring quarters only. Each quarter, all graduate students should enroll in this 1-credit course. Based strictly on attendance at the weekly seminars, it will be graded S/U. More than one (1) unexcused absence in any quarter may result in an unsatisfactory grade. This course counts toward the research requirement for all graduate degrees.

Transferring Masters Degree Credits
If a student has a Master's Degree in Chemical Engineering from another university, they may transfer it as 45 quarter hours of credit. This will change the requirements for the following: Advanced Graduate Courses in Chemical Engineering from 12 to 6 credits, Other Elective Courses from 9 credits to 6 credits, and Research Requirements from 77 credits to 41 credits. You should transfer your MS Degree during your first academic year.

Language Requirements
All students must be proficient in written and oral English. Non-native English speaking students must pass the equivalent of English 106, 107, 108 and English 104 and 105. Note that these requirements must be fulfilled, including passing the Test of Spoken English or SPEAK Test, prior to undertaking the Instructional Associate Requirement. For more information on this topic, please refer to The Ohio State University Office of International Affairs (OIA) website at: http://www.oia.ohio-state.edu/.

Instructional Associate (IA) Requirements
Philosophy and Benefits to Graduate Students
A core graduate program educational objective in the Department of Chemical and Biomolecular Engineering is intellectual leadership. Intellectual leadership involves more than the generation of knowledge through research, but also its transfer through effective communication. We expect our students to be able to teach what they have learned, and to be able to critically judge the technical communications and ideas of others.

In addition to making an invaluable contribution to the undergraduate teaching mission of the CBE program, graduate students will benefit from this policy in several ways:

Critically evaluating technical work prepared by someone else, explaining difficult concepts, and teaching fundamental ideas are essential skills for Ph.D. engineers. We believe these skills can be most effectively developed by "hands-on" practice: having graduate students work directly in the role of teachers with undergraduate students. Unlike many other departments at OSU, all courses in CBE are taught by faculty, and so graduate students generally have few opportunities to teach except through their experience as instructional assistants.

Teaching experience of some sort is essential for a graduate student seeking academic positions after completion of the Ph.D. The teaching statement of new faculty candidates is an important component of their application.

Serving as instructional assistants also benefits our graduate students by providing them opportunities to practice and improve communication skills. Most students have limited prior experience in communicating the detailed, technical, and complicated ideas and concepts that lie at the heart of science and engineering.

Implementation in CBE
Second year graduate students will complete the UCAT TA Orientation in September. Topics covered will include: OSU policies and procedures, academic integrity, working with students with disabilities, FERPA, teaching methods, learning styles, grading, and assessment. Students will be IA-eligible upon completion of this orientation.

Graduate students in their second year or later will be assigned to serve as an IA in a specific course. During this quarter, IAs will enroll in 899, a 2-credit course. This course is graded S/U. No student will be asked to serve more than one time in any given academic year. Note that IAs are not appointed as Graduate Teaching Assistants (GTA) nor paid additional compensation.

Each PhD student is required to serve as an IA three times during their time in the graduate program; they will therefore earn a total of 6 credits for 899.

The maximum average workload must not exceed 9 hr/week.

Academic Standards
The Department follows the academic standards of the Graduate School specified in the GSH (Section V). If, in the opinion of his/her advisor, a CBE graduate student is not making reasonable progress toward the degree, the GSC shall review (the student's) academic and research performance. If the GSC concurs, the Chair may then recommend to the Dean of the Graduate School that the student be denied further registration in CBE.

Course Credit, Marks, and Point-Hour Ratio
The Department follows the policies and criteria of course credit, marks, and point-hour ration defined in the GSH (Section IV).

Ph.D.-Degree QUALIFYING EXAMINATION

Purpose and Format

It is essential that Ph.D.-degree bound graduate students have a sound background in chemical engineering and the creativity and judgment necessary to conduct independent research. The purpose of the Qualifying Examination is to assess these qualities with an emphasis on evaluation of the student's potential to conduct original research. To serve this purpose, the Exam will have two parts that are administered sequentially after the students have completed six core courses (ChBE 801, ChBE 808, ChBE 812, ChBE 815.01, ChBE 815.08, and ChBE 881) with a minimum average GPA of 3.2 in these six core courses. If a student has a Core GPA between 3.0 and 3.19, the student must petition, with approval of their advisor, to be able to take the Qualifying Examination. If a student has a Core GPA below 3.0, they will not be allowed to proceed in the Ph.D. program.

The first part of the exam will test the student's ability to comprehend and critique modern chemical engineering research literature. This examination should be taken immediately after the student has completed the six core courses. Part I will usually be administered immediately after the final week of Spring quarter for students started in Autumn quarter. Part II of the exam will test the student's ability to initiate original research and formulate a plan to conduct the research. This examination should be taken within two quarters after the student has passed the first part of the exam or before the start of the second Winter quarter (or the sixth quarter after the student's Autumn quarter matriculation), or when the student's Advisor feels it is appropriate. Students with an average core course GPA of 3.45 or higher may be waived from the first part of the qualifying exam. The student's advisor must submit a letter requesting the waiver to the GSC, who will make the final decision. If this request is approved, these students may proceed directly to the second part of the exam. Since the core course GPA is calculated based only on grades received in OSU courses, students who wish to be considered for a waiver of the first part of the exam must take at least three of the six core courses at OSU. Transfer students who take fewer than three core courses at OSU will be required to take the first part of the exam. Details about each part of the examination are explained as follows:

Part I: Literature-Critiquing Exam

This exam will be based upon the student's ability to critically evaluate a recently published research article in chemical engineering journals. Specifically, the student will be asked to:

a) Identify the problems addressed in the paper
b) Formulate a critical appraisal of the author's contributions to the problems and the significance of the work
c) Critically evaluate the technical soundness of the approach used and results obtained in the work
d) Propose in concrete terms research work that might be done to extend and (if necessary) improve upon the study discussed in the article.

The student taking the exam will be given three research articles to consider. The student will have one week to choose one of those three articles to evaluate, and another week to submit a written report addressing the four points listed above. Within 6 working days after the submission of the report, the student will give an oral presentation to a three-member faculty panel. The oral presentation will be approximately 1 hour in length; the student will first give a 20-minute presentation, followed by a 40- minute question and answer session. The panel members for this examination will be selected by the Graduate Studies Committee. The student's advisor will not be a member of the panel. A majority vote from the faculty panel is required for the student to pass this exam. If the student fails the exam, he/she must take the exam again after one quarter before he/she can take the Research Proposition Exam.

Part II: Research Proposition Exam

This exam will test the student's ability to initiate original research and formulate a plan to conduct the research. Immediately after having been waived from or having passed Part I, the student should consult with his/her advisor on the research topic and prepare a proposal outlining a research plan that may be conducted as a part of his/her dissertation research. The proposal should be prepared following the format and guidelines provided by the student's advisor. Usually the proposal should contain statements about the research problems and approaches to be used, literature review, project goal and specific objectives, experimental methods, and expected results and significance of the work. It is highly advisable to follow the NSF proposal guidelines in preparing the proposal. The proposal should be submitted to a three-member committee with the student's advisor as the chair of the committee. The student should then orally defend the proposal within two weeks of proposal submission. The oral defense should include a 30-minute presentation followed with questions and answers, for a total of 1.5 hours. A majority vote from the committee is required for the student to pass this examination. If the student fails the exam the first time, he/she may take the exam again after one quarter. If he/she should fail the exam twice, he/she will not be allowed to continue in the Ph.D. program.

Additional Requirements

The advisor and Graduate Studies Committee may determine that additional requirements are appropriate for an individual student's academic program. The nature of such requirements may be to satisfy unusual deficiencies or to recommend special professional enrichment opportunities. Such requirements will have been established within six months after (the student) passed the Qualifying Exam.

Ph.D.-Degree CANDIDACY EXAMINATION

When a student has passed the Qualifying Examination and met all of the course requirements, he or she becomes eligible to take the Ph.D. Candidacy Examination in Chemical Engineering. The Graduate School Handbook (Section VII.4) outlines the requirements for the Candidacy Examination. Refer to the GSH for policies about the timing and purpose of the Candidacy Examination. It is a single examination consisting of two portions, written and oral, administered under the auspices of the Graduate

Studies Committee in conjunction with the student's Advisory Committee and the Graduate School. The Candidacy Examination is a test of the student's knowledge of chemical engineering and allied areas of study, of the capacity to undertake independent research, and of the ability to think and express the ideas clearly. It should be open-ended in nature.

The Advisory and Candidacy Examination Committee (GSH, Section VII.4) is chaired by the student's advisor and is responsible for administering the written and oral examinations and for evaluating the examination in accordance with the rules of the Graduate Studies Committee and the Graduate School. The advisory committee consists of four authorized Graduate Faculty members including the student's advisor. The Candidacy Examination will cover the broad aspects of the student's area of specialization, but should not be limited to the dissertation subject. If the student has demonstrated a weakness in a major area of his or her course work, then the appropriate faculty member(s) will serve on the Advisory Committee. Each member of the Advisory Committee will prepare one or more questions for the student, for the written examination, which he or she will grade. The Advisory Committee will determine the dates for the written portion of the Candidacy Examination; however, the time period in which the written portion is administered to the candidate will not exceed seven calendar days. Each student must be responsible to learn for the deadlines, options, forms (which are) required and take the full responsibility of executing them in a timely manner.

The oral portion of the Candidacy Examination is conducted according to the rules of the Graduate School. The oral portion should be scheduled within one month of the completion of the written portion. The research proposal prepared by the student for ChBE 981 should be distributed to those Advisory Committee members who have not seen it, not less than one week prior to the oral portion of the exam.

Format for the oral presentation (GSH, Section VII.6). The Policy and Standards Committee Research and Graduate Council interpret this rule to mean that the presentation should not be a formal presentation of a prepared talk. To satisfy the oral part of the examination, the candidate must demonstrate a broad knowledge of the field. The oral portion of the Candidacy Examination lasts approximately two hours. Oral presentation of any proposal or other prepared materials must be made prior to or after the oral examination. Questioning of the student should occupy the entire period of the examination.

At the conclusion of the oral portion, the committee determines pass or fail of the entire Candidacy Examination, based on both the written and oral performance. Attendance at the oral portion of the exam is limited to the student and the members of the Examination Committee. Successful completion of the Candidacy Examination requires *a unanimously affirmative decision* of the Committee. After satisfactory completion of the Candidacy Exam the student may be admitted to the candidacy for the doctoral degree which signifies that the student is judged to be properly prepared to undertake work on the dissertation.

Application to Graduate
Within two weeks prior to the end of the quarter when you want to apply to graduate, notify the Graduate Program Coordinator. For example, if you plan to graduate Spring quarter, the Graduate Program Coordinator should be notified before the end of Winter quarter. This will provide sufficient time for the Graduate Studies Committee to review your academic record, to formally ensure that you have met the department's graduation requirements. In addition, the Department requires that graduating students return all keys, that laboratory equipment and desks be left clean and in order.

An Application to Graduate form may be obtained on the Graduate School's web site. Note: the completed, signed form must be submitted to the Graduate School by the end of the second Friday of the quarter in which you apply to graduate.

Ph.D.-Degree FINAL ORAL EXAMINATION
The *Graduate School Handbook* (Section VII.10) outlines rules and policies related to the conduct of this examination, commonly called the "defense" of the dissertation by students and faculty. A Dissertation committee is formed to read and evaluate the dissertation (GSH, Section VII.9). This committee should be selected (and may convene briefly) within a few months of the beginning of the student's research. It will have at least three faculty members, normally selected from the Advisory Committee, including the student's advisor. When all members of the Dissertation Committee have signed the Draft Approval form, that group conducts the Final Oral Examination in accordance with the rules of the Graduate School; in addition, the Graduate School assigns a Graduate Faculty Representative (GSH, Section VII.10) to the Dissertation Committee. This examination tests originality, independence of thought, the ability to synthesize and interpret, and the quality of the research presented.

The exam usually consists of two parts and should last for 2 hours: 1) a 45-60 minute (no longer than 60 minutes) oral presentation by the student, followed by 2) a question-and-answer session, lasting at least 1 hour (per Graduate School rules). Departmental Policy permits University faculty and graduate students to attend the oral presentation part of the Ph.D.-degree Final Oral Examination. One week prior to the Final Oral Exam, the student must give the Graduate Program Coordinator their thesis abstract, date, time and location of their exam. At least one day prior to the examination, all attendees must notify the Chair of the Examination Committee of their intent to attend. The candidate shall be excused when Committee members discuss and vote on the approval decision. The student is considered to have completed the final oral examination successfully only when the decision of the final oral examination committee is unanimously affirmative.

Ph.D.-Degree DISSERTATION
Purpose. The dissertation is a scholarly contribution to knowledge in the student's area of specialization. By researching and writing a dissertation, the student is expected to demonstrate a high level of knowledge and the capability to function as an independent scholar. Refer to the GSH, Sections VII.9 and VII.12 for policies and procedures

regarding external members, timing, draft approval, and format review. Note that the Graduate School format requirements are described in the *Guidelines for Preparing Theses, Dissertations, and D.M.A. Documents*.

Attachment #3:

PROPOSED DOCTOR OF PHILOSOPHY PROGRAM

Introduction

This guide contains policies, rules, procedures and general information that affect both graduate students and graduate faculty in the Department of Chemical and Biomolecular Engineering (CBE). The material presented here has been discussed, and approved by a vote of the graduate faculty in CBE. The primary document governing graduate programs at The Ohio State University (OSU) is the most recent edition of the *Graduate School Handbook* (GSH). This guide, prepared by the Graduate Studies Committee (GSC) and Graduate Program Coordinator, is intended to specify Departmental policies and facilities unique to the Department and not covered in the GSH. CBE students are advised to become thoroughly familiar with, and abide by, the appropriate sections of the GSH and this departmental guide. None of the regulations of the department's graduate program should contradict those of the Graduate School. Faculty and graduate students in the CBE Program are strongly encouraged to refer to updated versions of the departmental Graduate Guide and the *Graduate School Handbook* (GSH). For updated departmental policies and procedures, please refer to the departmental website (http://www.chbmeng.ohio-state.edu/). The Ohio State University Graduate School regulations are available on-line at (www.gradsch.ohio-state.edu).

There are many other instructive publications which contain information directly relevant to graduate education. For example, refer to the *Guidelines for Preparing and Submitting Theses, Dissertations and D.M.A. Documents* (issued by The Graduate School) for specific instructions to prepare for the Master's Degree thesis and the Ph.D-degree dissertation. These documents are required reading for every graduate student who intends to submit a thesis or dissertation to the Graduate School. If you are new to the university, please visit the website of The Office of Student Affairs (http://studentaffairs.osu.edu/) and also obtain a copy of the *Graduate Quality of University Experience* (GQUE) from the Graduate School. The CBE Department will make every effort necessary to provide both the physical resources and intellectual environment for successful completion of your graduate program. Graduate students are expected to exhibit motivation, integrity, and the professional ambition in order to fully utilize the resources available for this achievement. We hope that each student will experience professional growth and personal enjoyment during their graduate program at OSU.

Doctor of Philosophy Degree Program

Ph.D.-Degree Requirements

Procedures and requirements for the Ph.D.-degree are detailed in the GSH. The Department requires a qualifying examination. No foreign language is required

A minimum of 80 graduate credit hours are required beyond the Bachelor's degree of which 27 hours are for courses, not including ChBE 8999 Research. Course credit hours should normally be divided among (1) Chemical and Biomolecular Engineering, (2) basic sciences, and (3) area of specialization. Students shall develop their course of study in consultation with their respective advisors and the other members of each student's Graduate Advisory Committee. The course work shall provide a concentration in a specific area, yet allow reasonable breadth of subject matter, being designed to foster both productive scholarship and knowledge of chemical engineering in relation to allied fields

Course Requirements
The minimum course requirements beyond the Bachelor's degree are classified into three areas:

Core Courses
The total core course requirements are 15 credit hours. These courses and the material prerequisite to them must be mastered by all Ph.D.-degree students. A student may be excused from any of the following required courses if an equivalent course was taken for the MS-degree at another university. In order to be excused from one of the core courses, the student should submit a detailed description of the course, including the syllabus, details of where and when it was taken, and a copy of the transcript showing a grade for this course, to the Graduate Studies Committee. The Committee will review these materials and then decide whether or not to allow the student to substitute the transfer course in place of the related OSU course.

ChBE 8801	(3)	Chemical Engineering Analysis
ChBE 8808	(3)	Advanced ChBE Thermodynamics I
ChBE 8812	(3)	Advanced ChBE Kinetics I
ChBE 8815	(3)	Advanced ChBE Transport
ChBE 8781	(2)	Research Communications in ChBE
Chem	(1)	Chemistry Safety Seminar

Advanced Coursework
The minimum requirement is 12 credit hours. Graduate level courses in chemical and biomolecular engineering or other scientific, mathematics, or engineering disciplines are to be selected to fit the candidate's goals with the consent of the advisor.

Research Requirements
At least 53 credit hours of research (ChBE 8999) are required. It is recommended that each student select a research topic by the end of the first quarter of work in the Ph.D. program. A satisfactory dissertation, as judged by the advisor and the Reading Committee under the Graduate School Rules, must be submitted as one of the requirements for the Ph.D. degree.

ChBE 8885: As part of the department's on-going effort to improve its visibility and reputation in the Chemical Engineering community, several distinguished guests are

invited each year to present seminars on timely topics. This is an opportunity for the Department to present its best image to those people who help determine academic reputation and ranking. Furthermore, these seminars are an opportunity to learn about new and different areas of research outside of one's own research group. Under the course number ChBE 8885, these seminars are offered during Autumn and Spring Semesters only. Each semester, all graduate students should enroll in this 1-credit course. Based strictly on attendance at the weekly seminars, it will be graded S/U. More than one (1) unexcused absence in any semester may result in an unsatisfactory grade. This course counts toward the research requirement for all graduate degrees.

Policy for applicants with non-chemical engineering undergraduate degrees
Students entering the ChBE graduate program without a B.S. degree in chemical engineering must first successfully complete the following undergraduate courses or have equivalent coursework in these subject areas: ChBE 3508 (Thermodynamics), ChBE 2420 (Transport Phenomena I), ChBE 3521 (Transport Phenomena II), ChBE 3610 (Kinetics and Reactor Design), Math (Differential Equations).

Transferring Masters Degree Credits
If a student has a Master's Degree in Chemical Engineering from another university, they may transfer it as 30 semester hours of credit. This will change the requirements for the following: Advanced coursework from 12 to 6 credits. You should transfer your MS Degree during your first academic year.

Language Requirements
All students must be proficient in written and oral English and be certified through the ESL Department. Note that these requirements must be fulfilled, including passing the Test of Spoken English or SPEAK Test, prior to undertaking the Teaching Experience Requirement. For more information on this topic, please refer to The Ohio State University Office of International Affairs (OIA) website at: http://www.oia.ohio-state.edu/.

Instructional Associate (IA) Requirements
Philosophy and Benefits to Graduate Students
A core graduate program educational objective in the Department of Chemical and Biomolecular Engineering is intellectual leadership. Intellectual leadership involves more than the generation of knowledge through research, but also its transfer through effective communication. We expect our students to be able to teach what they have learned, and to be able to critically judge the technical communications and ideas of others.

In addition to making an invaluable contribution to the undergraduate teaching mission of the CBE program, graduate students will benefit from this policy in several ways:
Critically evaluating technical work prepared by someone else, explaining difficult concepts, and teaching fundamental ideas are essential skills for Ph.D. engineers. We believe these skills can be most effectively developed by "hands-on" practice: having graduate students work directly in the role of teachers with undergraduate students. Unlike many other departments at OSU, all courses in CBE are taught by faculty, and

so graduate students generally have few opportunities to teach except through their experience as instructional associates.

Teaching experience of some sort is essential for a graduate student seeking academic positions after completion of the Ph.D. The teaching statement of new faculty candidates is an important component of their application.

Serving as instructional associates also benefits our graduate students by providing them opportunities to practice and improve communication skills. Most students have limited prior experience in communicating the detailed, technical, and complicated ideas and concepts that lie at the heart of science and engineering.

Implementation in CBE
Second year graduate students will complete the UCAT TA Orientation. Topics covered will include: OSU policies and procedures, academic integrity, working with students with disabilities, FERPA, teaching methods, learning styles, grading, and assessment. Students will be IA-eligible upon completion of this orientation.

Graduate students in their second year or later will be assigned to serve as an IA in a specific course. During this semester, IAs will enroll in 8799, a 1-credit course. This course is graded S/U. No student will be asked to serve more than one time in any given academic year. Note that IAs are not appointed as Graduate Teaching Associates (GTA) nor paid additional compensation.

Each PhD student is required to serve as an IA three times during their time in the graduate program; they will therefore earn a total of 3 credits for 8799.

The maximum average workload must not exceed 6 hr/week.

Academic Standards
The Department follows the academic standards of the Graduate School specified in the GSH. If, in the opinion of his/her advisor, a CBE graduate student is not making reasonable progress toward the degree, the GSC shall review (the student's) academic and research performance. If the GSC concurs, the Chair may then recommend to the Dean of the Graduate School that the student be denied further registration in CBE.

Course Credit, Marks, and Point-Hour Ratio
The Department follows the policies and criteria of course credit, marks, and point-hour ratio defined in the GSH.

Ph.D.-Degree QUALIFYING EXAMINATION

Purpose and Format
It is essential that Ph.D.-degree bound graduate students have a sound background in chemical engineering and the creativity and judgment necessary to conduct independent research. The purpose of the Qualifying Examination is to assess these

qualities with an emphasis on evaluation of the student's potential to conduct original research. To serve this purpose, the Exam will have two parts that are administered sequentially after the students have completed five core courses (ChBE 8801, ChBE 8808, ChBE 8812, ChBE 8815, and ChBE 8781) with a minimum average GPA of 3.2 in these five core courses. If a student has a Core GPA between 3.0 and 3.19, the student must petition, with approval of their advisor, to be able to take the Qualifying Examination. If a student has a Core GPA below 3.0, they will not be allowed to proceed in the Ph.D. program.

The first part of the exam will test the student's ability to comprehend and critique modern chemical engineering research literature. This examination should be taken immediately after the student has completed the five core courses. Part I will usually be administered immediately after the final week of Spring semester for students started in Autumn semester. Part II of the exam will test the student's ability to initiate original research and formulate a plan to conduct the research. This examination should be taken within one semester after the student has passed the first part of the exam or before the start of the second Spring semester, or when the student's Advisor feels it is appropriate. Students with an average core course GPA of 3.45 or higher may be waived from the first part of the qualifying exam. The student's advisor must submit a letter requesting the waiver to the GSC, who will make the final decision. If this request is approved, these students may proceed directly to the second part of the exam. Since the core course GPA is calculated based only on grades received in OSU courses, students who wish to be considered for a waiver of the first part of the exam must take at least 8 of the 14 semester hours of core ChBE courses at OSU. Transfer students who take fewer than 6 semester hours of core ChBE courses at OSU will be required to take the first part of the exam. Details about each part of the examination are explained as follows:

Part I: Literature-Critiquing Exam
This exam will be based upon the student's ability to critically evaluate a recently published research article in chemical engineering journals. Specifically, the student will be asked to:

e) Identify the problems addressed in the paper
f) Formulate a critical appraisal of the author's contributions to the problems and the significance of the work
g) Critically evaluate the technical soundness of the approach used and results obtained in the work
h) Propose in concrete terms research work that might be done to extend and (if necessary) improve upon the study discussed in the article.

The student taking the exam will be given three research articles to consider. The student will have one week to choose one of those three articles to evaluate, and another week to submit a written report addressing the four points listed above. Within 6 working days after the submission of the report, the student will give an oral presentation to a three-member faculty panel. The oral presentation will be

approximately 1 hour in length; the student will first give a 20-minute presentation, followed by a 40- minute question and answer session. The panel members for this examination will be selected by the Graduate Studies Committee. The student's advisor will not be a member of the panel. A majority vote from the faculty panel is required for the student to pass this exam. If the student fails the exam, he/she must take the exam again after one quarter before he/she can take the Research Proposition Exam.

Part II: Research Proposition Exam

This exam will test the student's ability to initiate original research and formulate a plan to conduct the research. Immediately after having been waived from or having passed Part I, the student should consult with his/her advisor on the research topic and prepare a proposal outlining a research plan that may be conducted as a part of his/her dissertation research. The proposal should be prepared following the format and guidelines provided by the student's advisor. Usually the proposal should contain statements about the research problems and approaches to be used, literature review, project goal and specific objectives, experimental methods, and expected results and significance of the work. It is highly advisable to follow the NSF proposal guidelines in preparing the proposal. The proposal should be submitted to a three-member committee with the student's advisor as the chair of the committee. The student should then orally defend the proposal within two weeks of proposal submission. The oral defense should include a 30-minute presentation followed with questions and answers, for a total of 1.5 hours. A majority vote from the committee is required for the student to pass this examination. If the student fails the exam the first time, he/she may take the exam again after one quarter. If he/she should fail the exam twice, he/she will not be allowed to continue in the Ph.D. program.

Additional Requirements

The advisor and Graduate Studies Committee may determine that additional requirements are appropriate for an individual student's academic program. The nature of such requirements may be to satisfy unusual deficiencies or to recommend special professional enrichment opportunities. Such requirements will have been established within six months after (the student) passed the Qualifying Exam.

Ph.D.-Degree CANDIDACY EXAMINATION

When a student has passed the Qualifying Examination and met all of the course requirements, he or she becomes eligible to take the Ph.D. Candidacy Examination in Chemical Engineering. The Graduate School Handbook outlines the requirements for the Candidacy Examination. Refer to the GSH for policies about the timing and purpose of the Candidacy Examination. It is a single examination consisting of two portions, written and oral, administered under the auspices of the Graduate Studies Committee in conjunction with the student's Advisory Committee and the Graduate School. The Candidacy Examination is a test of the student's knowledge of chemical engineering and allied areas of study, of the capacity to undertake independent research, and of the ability to think and express the ideas clearly. It should be open-ended in nature.

The Advisory and Candidacy Examination Committee is chaired by the student's advisor and is responsible for administering the written and oral examinations and for evaluating the examination in accordance with the rules of the Graduate Studies Committee and the Graduate School. The advisory committee consists of four authorized Graduate Faculty members including the student's advisor. The Candidacy Examination will cover the broad aspects of the student's area of specialization, but should not be limited to the dissertation subject. If the student has demonstrated a weakness in a major area of his or her course work, then the appropriate faculty member(s) will serve on the Advisory Committee. Each member of the Advisory Committee will prepare one or more questions for the student, for the written examination, which he or she will grade. The Advisory Committee will determine the dates for the written portion of the Candidacy Examination; however, the time period in which the written portion is administered to the candidate will not exceed seven calendar days. Each student must be responsible to learn for the deadlines, options, forms (which are) required and take the full responsibility of executing them in a timely manner.

The oral portion of the Candidacy Examination is conducted according to the rules of the Graduate School. The oral portion should be scheduled within one month of the completion of the written portion. The research proposal prepared by the student should be distributed to those Advisory Committee members who have not seen it, not less than one week prior to the oral portion of the exam.

Format for the oral presentation. The Policy and Standards Committee Research and Graduate Council interpret this rule to mean that the presentation should not be a formal presentation of a prepared talk. To satisfy the oral part of the examination, the candidate must demonstrate a broad knowledge of the field. The oral portion of the Candidacy Examination lasts approximately two hours. Oral presentation of any proposal or other prepared materials must be made prior to or after the oral examination. Questioning of the student should occupy the entire period of the examination.

At the conclusion of the oral portion, the committee determines pass or fail of the entire Candidacy Examination, based on both the written and oral performance. Attendance at the oral portion of the exam is limited to the student and the members of the Examination Committee. Successful completion of the Candidacy Examination requires *a unanimously affirmative decision* of the Committee. After satisfactory completion of the Candidacy Exam the student may be admitted to the candidacy for the doctoral degree which signifies that the student is judged to be properly prepared to undertake work on the dissertation.

Application to Graduate

Please notify the Graduate Program Coordinator by the end of the semester before you plan on graduating. For example, if you plan to graduate Spring semester, the Graduate Program Coordinator should be notified before the end of Autumn semester. This will provide sufficient time for the Graduate Studies Committee to review your

academic record, to formally ensure that you have met the department's graduation requirements. In addition, the Department requires that graduating students return all keys, that laboratory equipment and desks be left clean and in order.

An Application to Graduate form may be obtained on the Graduate School's web site. Note: the completed, signed form must be submitted to the Graduate School by the end of the second Friday of the semester in which you apply to graduate, depending on the Graduate School Rules.

Ph.D.-Degree FINAL ORAL EXAMINATION

The *Graduate School Handbook* outlines rules and policies related to the conduct of this examination, commonly called the "defense" of the dissertation by students and faculty. A Dissertation committee is formed to read and evaluate the dissertation. This committee should be selected (and may convene briefly) within a few months of the beginning of the student's research. It will have at least three faculty members, normally selected from the Advisory Committee, including the student's advisor. When all members of the Dissertation Committee have signed the Draft Approval form, that group conducts the Final Oral Examination in accordance with the rules of the Graduate School; in addition, the Graduate School assigns a Graduate Faculty Representative to the Dissertation Committee. This examination tests originality, independence of thought, the ability to synthesize and interpret, and the quality of the research presented.

The exam usually consists of two parts and should last for 2 hours: 1) a 45-60 minute (no longer than 60 minute) oral presentation by the student, followed by 2) a question-and-answer session, lasting at least 1 hour (per Graduate School rules). Departmental Policy permits University faculty and graduate students to attend the oral presentation part of the Ph.D.-degree Final Oral Examination. One week prior to the Final Oral Exam, the student must give the Graduate Program Coordinator their thesis abstract, date, time and location of their exam. At least one day prior to the examination, all attendees must notify the Chair of the Examination Committee of their intent to attend. The candidate shall be excused when Committee members discuss and vote on the approval decision. The student is considered to have completed the final oral examination successfully only when the decision of the final oral examination committee is unanimously affirmative.

Ph.D.-Degree DISSERTATION

Purpose. The dissertation is a scholarly contribution to knowledge in the student's area of specialization. By researching and writing a dissertation, the student is expected to demonstrate a high level of knowledge and the capability to function as an independent scholar. Refer to the GSH for policies and procedures regarding external members, timing, draft approval, and format review. Note that the Graduate School format requirements are described in the *Guidelines for Preparing Theses, Dissertations, and D.M.A. Documents*.