Biological Systems Engineering Degree Requirements
Revised: January 2, 2006; May 31, 2006; current revision: November 6, 2014
Approved by Graduate Council on June 2, 2006
Graduate Council Approval: March 31, 2015

The Biological Systems Engineering Graduate Program offers following Graduate Degrees:

i. Integrated BS/MS degree program (IAD),
ii. Master of Science (M.S.) and Master of Engineering (M.E.)
iii. Doctor of Philosophy (Ph.D.) and Doctor of Engineering (D.E.)

The degree requirements for each of this degree are listed below:

1. Integrated Degree Program (IDP) Requirements

1. Admission Requirements

a) Application Procedure:

Highly qualified undergraduate BSE students will be encouraged to apply to the integrated program. The application will be due by the end of Winter Quarter in the students' junior year. The application procedure will be as follows:

- By the end of Fall quarter, students in their junior year with a GPA above 3.5 will be identified by the department and encouraged to apply to the integrated degree program.
- The Graduate adviser will meet with the interested student and identify a major professor, whose expertise is in the same area as that of the student’s interest.
- By the end of Winter quarter, students should apply to the program by completing the standard MS application form (http://gradstudies.ucdavis.edu/index.cfm) and paying appropriate fees.
- Students with a GPA under 3.5 who are applying to the program must take the GRE test by the end of Winter quarter.
- All students applying to the program will be required to submit three letters of recommendation.
- Upon admission to the program (Spring quarter of the Junior year) the student will work with the major professor to select an appropriate graduate course to be taken during the senior year.
- Students admitted to the IDP will be invited to the new student orientation in the Fall quarter, when the graduate adviser will explain all the degree requirements. The student will work with his/her major professor and constitute a course guidance committee early in her/his senior year to plan their program of study. S/he must submit the program of study to the Biological Systems Engineering Graduate Adviser. Applications will be
reviewed by the program Graduate Executive Committee with decision by the end of the Spring quarter of the senior year.

b) Eligibility

The program is available only to UCD students in the Biological Systems Engineering major with strong academic records. Students with a GPA above 3.5 will not be required to take the GRE test at the time of their application. However, these students will be encouraged to take the test by the end of Fall quarter of their senior year as it is required for many fellowship applications. While admission requires an undergraduate GPA of 3.0 or better consistent with University policy, students with a GPA under 3.25 are not likely to be admitted to the integrated degree program. Under some exceptional circumstances, students with a GPA below 3.0 may be conditionally admitted with a coursework only option for the purposes of demonstrating the ability to maintain a qualifying GPA at the graduate level prior to full admission.

c) Change to Graduate Status:

The students in this program are awarded a Bachelor’s degree as soon as they complete all the requirements for the BS degree. They will be advanced to graduate status in the quarter immediately following completion of their BS degree.

2. Master’s Plan:

There will be two MS degree options - MS Plan I (Thesis option) and MS Plan II (Comprehensive Examination option). Both plans satisfy the graduate degree requirements as stipulated by the Academic Senate.

http://academicsenate.ucdavis.edu/ceri/manual/dd_regs.cfm#500-

3. Course Requirements:

Requirements within the BS degree

- Students admitted to the program will take an appropriate 3-unit graduate course selected in consultation with their major professor during their senior year, in lieu of the 3-unit upper division engineering elective required for the BS degree in BSE (Figure 1).

Requirements for the MS degree

MS Plan I (Thesis option): The degree requirements under this plan are depicted in Figure 2 and summarized below:

- Total units required: 30
- At least 17 units of upper-division and graduate technical coursework in courses other than research and seminar courses (200, 290, 290C, and 299).
  - At least 12 of the 17 units must be earned in graduate engineering courses (200 series).
  - The remainder of the 17 units may be made up of upper division courses (100 series) not required for the EBS BS degree, or of other graduate courses.
- In addition to the 17 units of upper division and graduate technical coursework required, all students in the program are required to take EBS 200 “Research Methods in Biological Systems Engineering”.
- A 1-unit seminar course, EBS 290, is required during the program.
• The Master's thesis is based on at least six units of research carried out for credit under the 290C and 299 course numbers.

Students in the integrated BS/MS program are required to take a 3-unit graduate course in their senior year.

**MS Plan II (Comprehensive Examination option):** The degree requirements under this plan are depicted in Figure 3 and summarized below:

- Total units required: 36
- At least 24 units of upper-division and graduate technical coursework must be in courses other than research and seminar.
- At least 12 of the 24 units must be earned in graduate engineering courses.
- The remainder of the 24 units may be made up of upper division courses (100 series) not required of the EBS BS degree, or of other graduate courses.
- In addition to the 24 units of upper division and graduate technical coursework required, all students in the program are required to take EBS 200 “Research Methods in Biological Systems Engineering”.
- A 1-unit seminar course, EBS 290, is required during the program.
- A maximum of 9 units of research carried out for credit under the 290C and 299 course numbers may be used to satisfy the 36 unit requirement. Minimum and maximum course loads per quarter are subject to regular University policies.

An oral comprehensive examination before a committee of three faculty members is required for students in the MS Plan II program. The examination will be administered after all course requirements have been satisfied.

**4. Special Requirements:** None.

**5. Committees:**

a) Admission Committee: The graduate admission adviser and staff adviser handle all application-related issues. The admission adviser will circulate the application packet to three faculty members of the Biological Systems Engineering graduate program whose research interests match those of the applicant. Based on the evaluations of the three faculty members, the graduate admission adviser will make the admission decision.

b) Course Guidance or Advising Committee: Upon acceptance into the program, students are required to meet with an assigned major professor in their primary technical area of interest to plan their proposed plan of study. Prior to the beginning of Fall quarter of their senior year, students must submit a Program of Study for the completion of their BS and for their MS degrees. Students will meet with their major professor at least once per quarter during their senior year.
c) Thesis Committee or Comprehensive Examination Committee: Students who are pursuing the MS Plan I (Thesis option) should consult their major professor and suggest the names of three faculty members to serve on their thesis committee to the Graduate Adviser, who then recommends the thesis committee membership to the Dean of Graduate Studies for approval.

Students who are pursuing MS Plan II (Comprehensive Examination option) should consult their major professor and suggest the names of the Comprehensive Examination Committee members to the Graduate Adviser for approval. The Comprehensive Examination Committee must be formally approved by the Office of Graduate Studies.

6. Advising Structure and Mentoring: The graduate adviser will go over the degree requirements with all admitted graduate students including students in the integrated degree program. The Graduate Adviser and the staff adviser are available to discuss all matters pertinent to the graduate program. Students admitted to the Biological Systems Engineering Graduate Program work closely with their respective major professors.

7. Advancement to Candidacy: Students admitted to the MS degree program (both Plans I and II) must file the advancement to candidacy form when they finish all the coursework on their program of study. Students are expected to advance to candidacy by the end of the fifth year.

8. Typical timeline and sequence of events: The following degree checklist provides various milestones:

✓ Select a guidance committee and put together a program of study during the Fall quarter of the senior year. This program of study should be submitted to the Graduate Executive Committee for approval by the end of the senior year.

✓ Upon completion of all courses in your program of study, complete the advancement to candidacy form and submit it to Graduate Studies. Students who are pursuing MS Plan I (Thesis option) propose their thesis committee members at this time. Students who are pursuing MS Plan II (Comprehensive Examination option) must propose the comprehensive examination committee members at this time. All students should plan on one unit each quarter of EBS 290C taken with the major professor to accommodate at least a weekly discussion or consultation about the research. All students are also required to be in good academic standing with a GPA of 3.0 or better at the time of graduation.

➢ MS Plan I (Thesis Option) candidates only:
  ▪ Upon completion of your research submit your thesis rough draft to the thesis committee and schedule your public presentation with the approval of the committee members. Obtain a copy of the presentation form from the Graduate Adviser or Student Affairs Officer. With the thesis committee in attendance, make the public presentation of your research.
  ▪ Following the public presentation, the thesis committee meets to review the research and all members are to sign the presentation form. Obtain the signatures from the thesis committee members and submit the signed form to the Graduate Adviser.
  ▪ Obtain comments on the thesis from each of the thesis committee members. Finalize revisions to the thesis and obtain signatures from all members of the thesis committee. If the committee members cannot reach a unanimous
decision to accept the thesis, but a majority is favorable, the majority and minority should report their separate opinions of the thesis’ merit to the dean of Graduate Studies. The dean will refer this information to the Administrative Committee of the Graduate Council for a final decision. If the quality of the thesis is unacceptable, the committee should give the student a clearly specified period of time to improve the thesis, usually one quarter or more. If, after that period of time, the thesis is still unacceptable to a majority of the committee, the majority may recommend to the dean that the student be disqualified from further graduate study.

- Submit the signed version of the thesis to Graduate Studies.

- **MS Plan II (Comprehensive Examination Option):**
  - Schedule the comprehensive examination in consultation with the committee members. The student needs to be registered at the time of examination. Obtain a copy of the Master’s Report Form, Plan II, from the Graduate Adviser or Student Affairs Officer and carry the form to the examination. Provide this form to the chair of the examination committee.
  - Complete and pass the comprehensive examination. Graduate Studies requires the committee’s unanimous vote to pass a student on the exam. If a student does not pass the exam, the committee may recommend that the student be reexamined one time, in accordance with the program’s approved degree requirements. The student may be reexamined only if the Graduate Adviser concurs with the committee. The examination may not be repeated more than once. A student who does not pass on the second attempt is subject to disqualification from further graduate work in the program by the dean of Graduate Studies.
  - The results of the examination must be reported to Graduate Studies using the Master’s Report Form, Plan II. Following the examination, the chair of the committee should record the outcome of the examination on the form, obtain signatures from all members of the committee, and submit the form to the Graduate Adviser. The Graduate Adviser’s signature on this form signifies that the student has completed all program requirements for the degree.

9. **Thesis requirements (MS Plan I):** Students pursuing this option are required to make a public presentation of their thesis research. Upon submission of the draft of the thesis to the thesis committee, the student must select a date for the public presentation that is suitable to the thesis committee members and the department seminar coordinator.

10. **Comprehensive Examination Requirements (MS Plan II):** At the time of advancement to candidacy, students pursuing this option must set up a comprehensive examination committee of three faculty members in consultation with their major professor and submit it to the graduate adviser for approval. The chair of the examination committee and at least one other member must be in the Biological Systems Engineering Graduate Program. The format of the examination will be oral.
Integrated BS/MS Degree Program

- Minimum of one 3 unit graduate course taken during senior undergraduate year
- Completion of MS Plan I or Plan II program

**Figure 1. Course requirements for Integrated BS/MS Degree Program (see detail below for MS Plan I and II options).**
### Figure 2. Course requirements for MS Plan I (Thesis option)

<table>
<thead>
<tr>
<th>EBS 200 Research Methods (2)</th>
<th>EBS 290 Seminar (1)</th>
</tr>
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<tbody>
<tr>
<td><strong>Courses</strong></td>
<td></td>
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<tr>
<td><strong>Minimum Required Total (30)</strong></td>
<td></td>
</tr>
<tr>
<td>Courses exclusive of EBS 200, EBS 290C, and 299 (17)</td>
<td>Must meet these criteria:</td>
</tr>
<tr>
<td>Graduate or Upper Division Undergraduate Courses not required for EBS BS degree (5)</td>
<td></td>
</tr>
<tr>
<td>Graduate Engineering Courses (12)</td>
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</tr>
<tr>
<td>290C, 299 Research (minimum of 6 units required)</td>
<td>plus other Graduate or Upper Division Undergraduate Courses as needed to meet the required 30 unit minimum total</td>
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</tbody>
</table>

**Note:** Requires written thesis and public presentation of research (exit seminar) for completion of degree. May require at least one course in the life sciences depending on background. *(minimum number of course units except as noted).*
### M.S. Plan II (Comprehensive Examination)

<table>
<thead>
<tr>
<th>Minimum Required Total (36)*</th>
<th>EBS 200 Research Methods (2)</th>
<th>EBS 290 Seminar (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Courses exclusive of EBS 200, EBS 290, 290C and 299 (24)</td>
<td>Graduate or Upper Division Undergraduate Courses not required for EBS BS degree (12)</td>
<td>Graduate Engineering Courses (12)</td>
</tr>
</tbody>
</table>

290C, 299 Research (maximum of 9 units to count toward 36 unit minimum total) plus other Graduate or Upper Division Undergraduate Courses as needed to meet the required 36 unit minimum total

**Note:** Requires comprehensive oral examination for completion of degree. *(minimum number of course units except as noted)*.

**Figure 3. Course requirements for MS Plan II (Comprehensive Examination option)**
II. MASTER'S DEGREES

Two Master's degrees are available to graduate students in Biological Systems Engineering. Programs for the Master of Science emphasize the science or research features of engineering and are intended to provide the student with abilities to assist with furtherance of the fundamental knowledge of engineering. Programs for the Master of Engineering emphasize design, analysis, economics, management, and/or labor, and are intended to assist the student with training that is useful to the professional engineer.

1. Admission Requirements

Admission is based on the UC Davis online Graduate Application submitted by the applicant. Applicants can also submit the Application for Fellowships through the same system. Applications received by the priority deadline (currently 15 January) are considered for fellowship support. Applications received after this date and until the general application deadline (currently 15 May) may be considered for financial support pending availability of funds. As part of the application, applicants must submit three letters of recommendation, transcripts from all post-secondary academic institutions they have attended, and a current GRE score. International applicants must also submit a current TOEFL or IELTS score.

Application materials are processed at the time of receipt by the UC Davis Office of Graduate Studies and the Graduate Program in Biological Systems Engineering (GBSE). Once the application is complete, it is reviewed by the GBSE Graduate Admissions Adviser and made available to all faculty within the Program for consideration and to help identify a major professor interested in working with the applicant. Admission decisions are made by the Graduate Executive Committee under recommendations from the Graduate Admissions Adviser. Admission decisions are made as quickly as possible, followed by decisions to offer financial support. Admission requires an undergraduate GPA of 3.0 or better consistent with University policy, or a graduate GPA of 3.25 or better. Under some exceptional circumstances, applicants with a GPA below 3.0 may be conditionally admitted with a coursework only option for the purposes of demonstrating the ability to maintain a qualifying GPA at the graduate level prior to full admission.

2. Residency Requirements

Candidates for the Master's degree must be in residence at least three academic quarters. Two consecutive six-week summer sessions may be counted as the equivalent of one regular quarter for purposes of satisfying the residency requirement for the Master's degree.

3. Transfer Credit

Though ordinarily all work for the Master's degree is done in residence, some work taken elsewhere or through UC Davis Extension may be credited toward the degree. The normal limit for such transfers is six units provided the units were not used to satisfy the requirements of
another degree. A higher limit may apply for courses transferred from another campus of the University of California. Up to 12 units may be transferred from courses taken through UC Davis Extension while at UC Davis.

a. Units to be so counted must have been taken at an accredited institution.

b. Units of work taken elsewhere than the University of California may not be used to reduce the minimum residence requirement or the minimum requirement in the 200 series courses taken at the University.

c. Requests for transfer credit are usually done at the time of Advancement to Candidacy. The Graduate Adviser should make a request to the Office of Graduate Studies specifying the units and courses involved.

4. Program Requirements for the Master of Science (Plan I) Degree

Thirty units of credit in graduate and upper division undergraduate courses, a thesis, a public presentation and a minimum of three quarters of academic residence are required for the Master of Science degree. Please refer to the attached figure. At least 17 units of upper-division and graduate technical coursework must be in courses other than research and seminar. At least 12 of the 17 units must be earned in graduate engineering courses (200 series) exclusive of research and seminar courses (EBS 200, 290, 290C, and 299). The remainder (at least 5 units) may be made up of upper division courses (100 series) not required for the bachelor's degree at the University of California in Biological Systems Engineering, or of other graduate courses exclusive of research and seminar courses, but not restricted to engineering courses. In addition to the 17 units of upper-division and graduate technical coursework required, all students in the program are required to take EBS 200 "Research Methods in Biological Systems Engineering" and a 1-unit seminar course, EBS 290. The Master's thesis is based on at least 6 units of research carried out for credit under the 290C and 299 course numbers. Students whose academic preparation does not include any coursework in biological/life sciences during their undergraduate studies must take at least one course in life sciences. The unit requirements stated above are minima. It may be necessary to add additional courses in order to achieve suitable academic preparation for the thesis research. The thesis must demonstrate the student's proficiency in research or scientific analysis.

5. Program Requirements for the Master of Engineering Degree

Thirty-six units of coursework, a comprehensive examination, an engineering report, and a minimum of three quarters of academic residence are required for the Master of Engineering degree. Please refer to the attached figure. At least 24 units of upper-division and graduate technical coursework must be in courses other than seminar and research, and at least 12 units of the 24 must be earned in graduate engineering courses (200 series) exclusive of research and seminar courses (EBS 200, 290, 290C, and 299). The remainder (at least 12 units) is made up of upper division courses (100 series) not specifically required for the bachelor's degree at the University of California in Biological Systems Engineering or of graduate courses exclusive of research and seminar courses, but not restricted to engineering courses. In addition to the 24
units of upper-division and graduate technical coursework required, all students in the program are required to take EBS 200 "Research Methods in Biological Systems Engineering" and a 1-unit seminar course, EBS 290. The engineering report is based on at least 6 units of research carried out for credit under 290C and 299 course numbers. Students whose academic preparation does not include any coursework in biological/life sciences during their undergraduate studies must take at least one course in life sciences. The unit requirements stated above are minima. It may be desirable or even necessary to include additional course work in the program.

The Master of Engineering program may include studies in areas such as economics, psychology, and the life sciences. Breadth of program is encouraged within reasonable limits, but it is recommended that courses be selected from no more than three distinct fields.

The Master of Engineering report is based on supervised study carried out for credit under the 290C and 299 course numbers. The study may comprise library, laboratory, or field work, and is directed toward the solution of a specific engineering problem. Examples of appropriate report activities are design of components or systems, critical studies of existing systems, model studies, and field surveys. The form and quality of the report must conform to generally accepted standards of the engineering profession.

6. Sequence of Events

Students are expected to manage their own programs. They are expected to take the initiative in identifying the courses to be included in their academic program, in suggesting members for the various required committees, and in selecting the subject of investigation for their thesis or engineering report.

a. Guidance Committee Selection
   Upon arrival at Davis, the student should meet with the Graduate Adviser, who will help in the selection of a tentative major professor and two other members for a guidance committee. These individuals may be changed later if it is found that other professors are more appropriate.

b. Program of Study Development
   The student is encouraged to identify a major area of interest and outline a tentative program of study before selecting courses for the first quarter. During the first two quarters, the student should develop a detailed program of study with the assistance and approval of the guidance committee. Once approved by the guidance committee, the program of study must be submitted for approval by the Executive Committee of the Graduate Program by the end of the student’s second quarter in residence.

c. Research Topic Selection
   Students are encouraged to explore research topics as early as possible and make a final decision on the membership of the thesis or engineering report committee. The initial 299 research units may be used for literature review, topic selection and preliminary planning.

d. Advancement to Candidacy
To advance to candidacy for the master's degree, a student must be in residence for at least three quarters in full-time standing. Upon completing half of the courses in the approved program of study, and at least one quarter prior to completing all degree requirements, the student must file an application for advancement to candidacy. Students are expected to advance to candidacy at the end of the third quarter.

A thesis committee of three is proposed by the student as part of the candidacy application for the Master of Science degree after consultation with the major professor and the Graduate Adviser. The committee is formally appointed by the dean of Graduate Studies. The student is expected to contact prospective committee members and to secure their approval to serve. The committee chair should determine the wishes of the individual members regarding assistance with the research and thesis review at the time the thesis committee is formed.

A comprehensive examination committee of three is proposed by the student as part of the candidacy application for the Master of Engineering degree after consultation with the major professor and the Graduate Adviser. The student is expected to contact prospective committee members and to secure their approval to serve including one member as chair of the committee. Changes to the composition of the committee may only be made for reasons of clear necessity, such as the extended absence of a member.

e. MS Plan I (thesis):

As noted under section 4 above, graduation under the MS Plan I (thesis) option requires satisfactory completion of a minimum of 30 units of upper division and graduate coursework with minimum unit requirements in each of the areas listed, and submission of an acceptable thesis. The student should plan on one unit each quarter of EBS 290C taken with the major professor to accommodate at least a weekly discussion or consultation about the research. The student is required to be in good academic standing with a GPA of 3.0 or better at the time of graduation.

The student will prepare a draft of the thesis and submit to the committee for review. The student obtains a Presentation Form from the Graduate Adviser or Student Affairs Officer, then schedules, in agreement with the committee, a public presentation of the research. Following the presentation the committee meets to review the research and sign the Presentation Form. The signed copy of the form is submitted by the thesis committee chair to the Graduate Adviser.

Based on comments received from the committee on the draft thesis or following the presentation, the student completes the final version of the thesis. All committee members must sign the thesis title page to certify their satisfaction with the thesis. If the committee members cannot reach a unanimous decision to accept the thesis, but a majority is favorable, the majority and minority should report their separate opinions of the thesis’ merit to the dean of Graduate Studies. The dean will refer this information to the Administrative Committee of the Graduate Council for a final decision. If the quality of the thesis is unacceptable, the committee should give the student a clearly specified period of time to improve the thesis, usually one quarter or more. If, after that period of time, the thesis is still unacceptable to a majority of the committee, the majority may recommend to the dean that the student be disqualified from further graduate study.
The approved thesis is submitted by the student to Graduate Studies. The student is responsible for observing the filing dates and preparing the thesis according to the proper format.

f. Master of Engineering:
   As noted under section 5 above, the Master of Engineering degree requires satisfactory completion of 36 units of coursework, the engineering report, and the comprehensive examination. The date for the comprehensive examination is determined by the student in consultation with the committee members, and the student needs to be registered at the time of the examination. The student should plan on one unit each quarter of EBS 290C taken with the major professor to accommodate at least a weekly discussion or consultation regarding the project and preparation of the engineering report. The student is required to be in good academic standing with a GPA of 3.0 or better at the time of graduation.

   A draft version of the engineering report is prepared by the student and submitted to the comprehensive examination committee for review prior to the examination. A final version of the report is prepared by the student based on comments received from the committee either during the examination or separately.

   The student should obtain a copy of the Master's Exam Report Form from the Graduate Adviser or Student Affairs Officer prior to the exam and carry the form to the examination. The student should provide this form to the chair of the committee at the time of the examination.

   The purpose of the examination is to determine the student's ability to apply the information learned to the solution of professional engineering problems rather than to re-examine graduate course work. The recommended examining procedure is outlined below:

   The student prepares a written document and submits it to the examining committee at least three days prior to the examination. The document should contain the following:

   a. A brief summary (three pages or less) of the Master of Engineering project.
   b. A statement of the student's professional goals and the relationship of the project to the goals.

   The one- to two-hour oral examination can include:

   a. Questions and discussion relative to the project report.
   b. General questions relative to the program of study.
   c. Questions that relate to the engineering profession.

   Graduate Studies requires the committee’s unanimous vote to pass a student on the exam. If a student does not pass the exam, the committee may recommend that the student be reexamined one time, in accordance with the program’s approved degree requirements. The student may be reexamined only if the Graduate Adviser concurs with the committee. The examination may not be repeated more than once. A student who does not pass on the second attempt is subject to disqualification from further graduate work in the program by the dean of Graduate Studies.
Following the examination, the chair of the committee should record the outcome of the examination on the Master's Exam Report Form, obtain signatures from all members of the committee, and submit the form to the Graduate Adviser. When advised by the major professor that an acceptable version of the engineering report has been received from the student, the Graduate Adviser will sign the form and submit to Graduate Studies. The Graduate Adviser's signature on the form signifies that the student has completed all program requirements for the degree of Master of Engineering.

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COMPLIANCE STATEMENT - In accordance with applicable State and Federal laws and University policy, the University of California does not discriminate in any of its policies, procedures, or practices on the basis of race, color, national origin, religion, sex, sexual orientation, handicap, age, veteran status, medical condition (as defined in Section 12926 of the California Government Code), ancestry, or marital status; nor does the University discriminate on the basis of citizenship, within the limits imposed by law or University policy. In conformance with applicable law and University policy, the University of California is an affirmative action/equal opportunity employer.
M.S. (Plan I) Program of Study:

<table>
<thead>
<tr>
<th>Minimum Required Total (30)*</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Courses exclusive of EBS 200, EBS 290, 290C and 299 (17)</td>
<td>Must meet these criteria:</td>
</tr>
<tr>
<td>EBS 290 Seminar (1)</td>
<td>Graduate or Upper Division Undergraduate Courses not required for EBS BS degree (5)</td>
</tr>
<tr>
<td>EBS 200 Research Methods (2)</td>
<td>Graduate Engineering Courses (12)</td>
</tr>
<tr>
<td>290C, 299 Research (minimum of 6 units required) plus other Graduate or Upper Division Undergraduate Courses as needed to meet the required 30 unit minimum total</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Requires written thesis and public presentation of research (exit seminar) for completion of degree. May require at least one course in the life sciences depending on background. *(minimum number of course units except as noted).

**Figure 4. Course requirements for MS Plan I (Thesis option)**
### M.E. Program of Study:

<table>
<thead>
<tr>
<th>Minimum Required Total (36)*</th>
<th>EBS 200 Research Methods (2)</th>
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<tr>
<td></td>
<td>Graduate Engineering Courses (12)</td>
<td></td>
</tr>
<tr>
<td>290C, 299 Research (minimum of 6 units required)</td>
<td></td>
<td>plus other Graduate or Upper Division Undergraduate Courses as needed to meet the required 36 unit minimum total</td>
</tr>
</tbody>
</table>

**Note:** Requires written engineering report and comprehensive oral examination for completion of degree. May require at least one course in the life sciences depending on background. Requires a minimum residency of three academic quarters. *(minimum number of course units except as noted).*

**Figure 5. Course requirements for M.E. degree**
III. DOCTORAL DEGREES

1. Degrees Offered

Two doctoral degrees are available to graduate students in Biological Systems Engineering. Programs for the Doctor of Philosophy (Ph.D.) emphasize the science or research features of engineering and are intended to provide the student with abilities to assist with furtherance of the fundamental knowledge of engineering. Doctor of Engineering (D.E.) programs emphasize design, analysis, economics, management, and/or labor, and are intended to assist the student with training useful to the professional engineer.

2. Admission Requirements

Admission is based on the UC Davis online Graduate Application submitted by the applicant. Applicants can also submit the Application for Fellowships through the same system. Applications received by the priority deadline (currently 15 January) are considered for fellowship support. Applications received after this date and until the general application deadline (currently 15 May) may be considered for financial support pending availability of funds. As part of the application, applicants must submit three letters of recommendation, transcripts from all post-secondary academic institutions that they have attended, and a current GRE score. International applicants must also submit a current TOEFL or IELTS score.

Application materials are processed at the time of receipt by the UC Davis Office of Graduate Studies and the Graduate Program in Biological Systems Engineering (GBSE). Once the application is complete, it is reviewed by the GBSE Graduate Admissions Adviser and made available to all faculty within the Program for consideration and to help identify a major professor interested in working with the applicant. Admission decisions are made by the Graduate Executive Committee under recommendations from the Graduate Admissions Adviser. Admission decisions are made as quickly as possible, followed by decisions to offer financial support. Admission requires an undergraduate GPA of 3.0 or better consistent with University policy, or a graduate GPA of 3.25 or better. Under some exceptional circumstances, applicants with a GPA below 3.0 may be conditionally admitted with a coursework only option for the purposes of demonstrating the ability to maintain a qualifying GPA at the graduate level prior to full admission.

3. Residence Requirements

Doctoral candidates must be registered for a minimum of six academic quarters after admission to the graduate program. Two consecutive six-week Summer Sessions may be counted as the equivalent of one regular quarter.

4. Normative Time To Degree

A "normative time to degree" has been established for each doctoral program. It is based upon an academic assessment of how long it should take a well-prepared full-time student who
works continuously in a graduate program, to complete all requirements. For Engineering, the normative time is five years.

The normative time begins at the time of first registration as a graduate student at the University of California, Davis. All quarters spent at Davis after first registration in any graduate program (including time spent working on a Master's degree) apply toward normative time. Time spent on another campus, unless as an intercampus exchange student, does not count.

5. Requirements for the Doctor of Philosophy Degree

Formal requirements for the degree of Doctor of Philosophy include the satisfactory passing of the qualifying examination, completion of an acceptable dissertation, and a public presentation of the doctoral research. In the qualifying examination, the student is examined on the major and minor fields defined in the student's Program of Study. A high level of learning and proficiency must be demonstrated in the major field and a firm grasp of basic principles and their application in the minor field. Ability to correlate knowledge in these areas is emphasized. Preparation for the qualifying examination is done through a combination of course work and individual study. The Program (please refer to the attached figure) requires that at least 30 units of graduate courses (of which at least 15 units must be in graduate engineering courses), exclusive of seminars and research, and an additional 15 units of upper division or graduate courses be completed before taking the qualifying examination. At least 23 of the required 45 units must be in engineering courses. These figures include suitable courses taken during the Master's Program. At least 24 units of the required total must be taken at Davis. In-depth knowledge usually can be obtained by completing about 30 units in upper division and graduate courses in the major field. Study in a minor field is not expected to be as extensive as in the student's major field; it should, however, encompass the equivalent of 15 units or more in a particular field, typically 2 upper division and 3 graduate courses. In other words, the breadth requirement cannot be met by a student taking a large number of single courses in different areas. Specific names for the major and minor fields are necessary. Students whose academic preparation does not include any coursework in biological/life sciences during their undergraduate studies must take at least one course in life sciences. Moreover, students should demonstrate skills in advanced analytical techniques, and experimental design and analysis. These requirements can be met by taking an advanced engineering mathematics course such as ECH 259 Advanced Engineering Mathematics (preferred), ECH 140 Mathematical Methods in Biochemical and Chemical Engineering, EAD 205A Mathematical Methods, MAT 118B Partial Differential Equations: Eigenfunction Expansions, or MAT 185B Complex Analysis with Applications. The design and analysis of engineering experiments requirements can be satisfied by taking EBS 265 Design and Analysis of Engineering Experiments, PLP 222 Experimental Approaches in Plant Pathology or an equivalent. In addition to the 45 units of courses required as preparation for the qualifying examination, all students in the program are required to take EBS 200 Research Methods in Biological Systems Engineering and a total of 2 units of EBS 290 (two 1-unit seminar courses) taken in two separate academic years.

The doctoral dissertation must be an original and substantial contribution to knowledge in the student's major field. It must demonstrate the student's ability to carry out a program of advanced research and to report the results in accordance with standards observed in recognized
scientific journals. A public presentation of the dissertation research is required prior to the dissertation being signed.

6. Requirements for the Doctor of Engineering Degree

The formal requirements for the degree of Doctor of Engineering are the satisfactory passing of the qualifying examination, completion of an acceptable dissertation, and a public presentation of the dissertation.

The Doctor of Engineering program is fully equivalent academically to the Ph.D. program but emphasizes the professional aspects of engineering rather than research. The student prepares for a qualifying examination in a major field of study and one or two minor fields. The major field area may include a wider range of subject matter than is customary in the Ph.D. program. As a consequence, the Doctor of Engineering candidate is not expected to probe into a single field of learning as deeply as the Ph.D. candidate. Minor fields should include courses outside engineering. Examples of minor fields are bioscience, business management, economics, international agricultural development, law, sociology, statistics, mathematics, political science, psychology and operations research. The area covered by the qualifying examination is thus broadened, and the minimum course work required to prepare a student for the examination may exceed the 30 graduate units and 15 upper division or graduate units suggested for the Ph.D. candidate. The program for the major field should be composed of at least 30 units of courses that are related to the definition and solution of problems in a recognized engineering area. This group can include courses in physical sciences, engineering sciences, statistics, and mathematics, and is expected to encompass knowledge essential to high-level professional engineering performance. The program for the minor field should include at least 15 units and form a coherent body of knowledge that complements the student's major. In addition to the 45 units of courses required as preparation for the qualifying examination, all students in the program are required to take EBS 200 “Research Methods in Biological Systems Engineering” and a total of 2 units of EBS 290 (two 1-unit seminar courses) taken in two separate academic years.

The Doctor of Engineering dissertation is based on creative analysis or design rather than research. Research may be required to carry out the project, but the principal criteria of achievement are originality and creativity relative to the project. Novel and imaginative approaches to the solution of problems must be demonstrated in the dissertation. A public presentation of the dissertation is required prior to the dissertation being signed. The effort required to complete the D.E. program is fully equivalent to that required for the Ph.D.

7. Sequence of Events

Insofar as possible, doctoral students are expected to manage their own programs. They are expected to take the initiative in identifying the courses to be used in their academic program, in suggesting members for the various required committees, and in selecting the subject of investigation for their dissertation.

a. Guidance Committee Selection
   If the doctoral student has not selected a Major Professor prior to arrival at Davis, the Graduate Adviser will help the doctoral student select a Major Professor. The Major
Professor will help the student select two additional faculty members to constitute the guidance committee who will assist with the identification of the courses that will constitute the program for the degree.

b. Program of Study Development
The major area of interest should be identified and a very tentative study program outlined before selecting courses for the first quarter. Later during the first year, the doctoral student should pursue the development of the study program in more detail with the guidance committee. Courses included in the study program should be selected to provide a suitable base for dissertation research. Once approved by the Guidance Committee, the program of study must be submitted for approval by the Executive Committee of the Graduate Program by the end of the first year of residence.

c. Qualifying Examination
To be eligible for examination, the doctoral student must have satisfied all Graduate Program course work requirements, have removed all deficiencies, and must have at least a 3.25 average in all work undertaken in graduate standing. The doctoral student must be registered in the quarter in which the Qualifying Examination is taken.

An Application for Qualifying Examination (available from the Graduate Adviser or Graduate Studies) must be submitted to the Office of Graduate Studies at least eight weeks prior to the examination date. The membership of the examination committee is recommended on the application. When the committee is approved, the Office of Graduate Studies will notify the student, the committee members, the Graduate Adviser, and the Department Chairperson. THE QUALIFYING EXAMINATION CANNOT BE TAKEN BEFORE RECEIVING THE NOTICE OF APPROVAL.

The date of the examination will be arranged between the student and the committee chairperson, who will in turn advise the Office of Graduate Studies. The committee will conduct the examination, and will immediately thereafter inform Graduate Studies of the results.

Upon recommendation of the Qualifying Examination Committee, a student who received a “not pass” on the examination may repeat it once.

d. Advancement to Candidacy
Upon successful completion of the qualifying examination, the doctoral student is sent an application for advancement to candidacy by Graduate Studies. When it is filled out and signed by the Graduate Adviser and Major Professor, the candidacy fee should be paid at the Cashier's Office and the form returned to Graduate Studies. The application must be filed in order for the doctoral student to be officially advanced to candidacy.

e. Dissertation Committee Selection
On the advancement to candidacy form, the doctoral student proposes a dissertation committee of three. The student is expected to contact the potential committee members to make sure they will be able to serve. The committee chairperson should determine the wishes of the individual members regarding assistance with the research and dissertation review at the time the dissertation committee is constituted.

f. The Dissertation
Doctoral students are not expected to conduct their dissertation research until after coursework is completed and the qualifying examination is passed; however, the process of dissertation topic selection should be initiated much earlier. The student should begin consultations with the faculty on an individual basis during the first quarter relative to research prospects so that this important part of the program can be planned early.

A dissertation on a subject chosen by the candidate, bearing on the principal subject of study and of such character as to show ability to prosecute independent investigation, must be approved by the dissertation committee before the degree will be recommended.

g. The Public Presentation and Filing the Dissertation
The student submits a draft of the dissertation to the committee. The student obtains a presentation form from the Graduate Adviser or Student Affairs Officer, then schedules, in agreement with the committee, a public presentation of the research. Following the presentation, the committee meets to review the research and sign the presentation form. The signed copy of the form is submitted by the thesis committee chair to the Graduate Adviser. The student completes the final version of the dissertation, obtains the signatures of the committee members, and files the dissertation with Graduate Studies.

COMPLIANCE STATEMENT - In accordance with applicable State and Federal laws and University policy, the University of California does not discriminate in any of its policies, procedures, or practices on the basis of race, color, national origin, religion, sex, sexual orientation, handicap, age, veteran status, medical condition (as defined in Section 12926 of the California Government Code), ancestry, or marital status; nor does the University discriminate on the basis of citizenship, within the limits imposed by law or University policy. In conformance with applicable law and University policy, the University of California is an affirmative action/equal opportunity employer.
### Ph.D. Program of Study:

<table>
<thead>
<tr>
<th>Courses exclusive of EBS 200, EBS 290, 290C and 299 (45)</th>
<th>Minor (15)</th>
<th>UCD or elsewhere (21)</th>
<th>Engr. and Other Courses (22)</th>
<th>Grad or Upper Div. Undergrad as needed to meet 45 unit minimum (15)</th>
<th>Other Graduate Units as needed to meet 30 unit minimum (15)</th>
<th>Graduate Engineering Units (15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major (30)</td>
<td>Minimum units taken at UCD (24)</td>
<td>Engr. Courses (23)</td>
<td>Gradate Units (30)</td>
<td>290C, 299 Research (variable)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Requires demonstration of skills in advanced engineering mathematics and experimental design. May require at least one course in the life sciences depending on background. Also requires qualifying examination, doctoral research dissertation, and public presentation of research (exit seminar) for completion of degree. *(minimum number of course units except as noted).*

**Figure 6. Course requirements for Ph.D. degree**
D. E. Program of Study:

Note: Requires written dissertation and public presentation of research (exit seminar) for completion of degree. May require at least one course in the life sciences depending on background. *(minimum number of course units except as noted).

Figure 7. Course requirements for D.E. degree

<table>
<thead>
<tr>
<th>Minimum Required Total (30)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Courses exclusive of EBS 200,</td>
</tr>
<tr>
<td>EBS 290, 290C and 299 (17)</td>
</tr>
<tr>
<td>EBS 200 Research Methods (2)</td>
</tr>
<tr>
<td>EBS 290 Seminar (1)</td>
</tr>
<tr>
<td>Graduate or Upper Division Undergraduate Courses not required for EBS BS degree (5)</td>
</tr>
<tr>
<td>Graduate Engineering Courses (12)</td>
</tr>
<tr>
<td>290C, 299 Research (minimum of 6 units required)</td>
</tr>
<tr>
<td>plus other Graduate or Upper Division Undergraduate Courses as needed to meet the required 30 unit minimum total</td>
</tr>
</tbody>
</table>