

## **Biological Systems Engineering Degree Requirements**

Revised: January 2, 2006; May 31, 2006; March 31, 2015; current revision: May 23, 2018

Graduate Council Approval: October 19, 2018

The Biological Systems Engineering Graduate Program offers following Graduate Degrees:

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

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

### **I. Integrated Degree Program (IDP) Requirements**

#### **1. Admission Requirements**

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. Applicants are strongly advised to communicate with the major professor prior to the application process.
- 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 students will work with their major professors and constitute a course guidance committee early in their senior year to plan their program of study. The students 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.

*Note that students admitted under 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.*

**a) Prerequisites:**

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.

**b) Deficiencies:**

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.

**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/cerj/manual/dd\\_regs.cfm#500-](http://academicsenate.ucdavis.edu/cerj/manual/dd_regs.cfm#500-)

*Plan I:* This plan requires a minimum of 30 units of graduate and upper division courses (100 and 200 series only) consisting of:

- (i) Research Methods in Biological System Engineering, EBS 200 (2 units)
- (ii) Seminar, EBS 290 (1 unit)
- (iii) Graduate engineering courses (12 units)
- (iv) Additional graduate or upper division courses not required for EBS BS degree (5 units)
- (v) 290C, 299 Research (at least 6 units)
- (vi) Other graduate or upper division courses for a total of at least 30 units.
- (vii) Submission of a thesis approved by three faculty members.

Students under this plan should take 3 units of graduate course during their senior undergraduate year.

*Plan II:* This plan requires a minimum of 36 units of graduate and upper division courses (100 and 200 series only) consisting of:

- (i) Research Methods in Biological System Engineering, EBS 200 (2 units)
- (ii) Seminar, EBS 290 (1 unit)
- (iii) Graduate engineering courses (12 units)

- (iv) Additional 6 units of graduate courses for a total of at least 18 graduate units including the 12 graduate engineering units listed in # (iii) above. The remaining 6 units of courses can be either graduate or upper division courses not required for EBS BS degree
- (v) 290C, 299 Research (up to 9 units)
- (vi) Other graduate or upper division courses for a total of at least 36 units.
- (vii) Oral Comprehensive Examination before a three faculty committee members.

Students under this plan should take 3 units of graduate course during their senior undergraduate year.

### 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) - Core and Electives (30 units)

The degree requirements under this plan are depicted in Figure 1 and summarized below:

##### a) Core courses (3 units)

EBS 200 Research methods in biological systems engineering	(2 units)
EBS 290 Seminar	(1 unit)

##### b) Elective courses (27 units)

These courses should be selected in consultation with guidance committee members and should meet the requirements stated in #2 (Plan I) above.

##### c) English Language Requirement

Students who have not obtained an undergraduate or graduate degree at an approved English-medium institution, or who have not demonstrated strong English language proficiency through the TOEFL or IELTS exam are required to take appropriate English language courses, as described in Graduate Student Course Requirements – English as Second Language (GC-2018-02). Courses taken in satisfaction of this requirement do not count towards the total units required for graduation.

##### d) Summary: Figure 1 succinctly summarizes the IDP Plan I degree requirements.

##### MS Plan II (Comprehensive Examination option) – Core and Elective (36 units)

The degree requirements under this plan are depicted in Figure 2 and summarized below:

##### a) Core courses (3 units)

EBS 200 Research methods in biological systems engineering	(2 units)
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**b) Elective courses (minimum of 33 units)**

These courses should be selected in consultation with the course guidance committee members and should meet the requirements stated in #2 (Plan II) above.

c) **Summary:** Figure 1 succinctly summarizes our IDP Plan II degree requirements.

**4. Special Requirements:** None.**5. Committees:**

a) **Admission Committee:** The graduate admission adviser and staff adviser handle all application-related issues. Once the completed application, all supporting materials, and application fee have been received, 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 recommendation and forward it to the Dean of the Office of Graduate Studies for final approval of admission.

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 (MS Plan I) /Comprehensive Examination Committee (MS Plan II):** Students who are pursuing MS Plan I are required to set up a Thesis Committee at the time of Advancement to Candidacy. Students Pursuing MS Plan II are required to set up a Comprehensive Examination Committee at the time of Advancement to Candidacy. This committee of three is nominated by the student in consultation with their major professor and submitted to the Graduate Adviser for approval. These nominations are then submitted to the Office of Graduate Studies for formal appointment in accordance with Graduate Council policy. The major professor acts as Chair of the committee.

**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. The **Mentoring Guidelines** can be found at <https://grad.ucdavis.edu/sites/default/files/upload/files/grad-council/mentoring.pdf>

**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. The Candidacy for the Master's Degree form can be found online at: <http://www.gradstudies.ucdavis.edu/forms/>. A completed form along with appropriate fees

must be submitted before the thesis is submitted (Plan I) or Comprehensive Examination can be taken (Plan II). The form includes a list of courses the student has taken to complete degree requirements. If changes must be made to the student's course plan after they have advanced to candidacy, the Graduate Adviser must recommend these changes to Graduate Studies. Students must have their Graduate Adviser and committee Chair sign the candidacy form before it can be submitted to Graduate Studies. If the candidacy is approved, the Office of Graduate Studies will send a copy to the appropriate Graduate Program Coordinator and the student; the Comprehensive Examination Committee Chair will also receive a copy, if applicable. If the Office of Graduate Studies determines that a student is not eligible for advancement, the program and the student will be told the reasons for the application's deferral. Some reasons for deferring an application include: grade point average below 3.0, outstanding "I" grades in required courses, or insufficient units.

### **8. Thesis (Plan I) and Comprehensive Examination Requirements (Plan II):**

- a) Thesis Committee (MS Plan I):** The student, in consultation with the major professor and graduate adviser, nominates three (3) faculty members to serve on the Thesis Committee. These nominations are submitted to the Office of Graduate Studies for formal appointment in accordance with Graduate Council policy. The major professor serves as the chair of the committee.

The student will submit a draft of the thesis to the committee members and schedule an Exit Seminar by working with the seminar coordinator for the Biological and Agricultural Engineering Department for that quarter. If a student is presenting the seminar during the summer term, seminar coordinator for the Spring quarter should be contacted to schedule the seminar. The seminar can be scheduled only after completing the "Thesis and Dissertation Presentation Form" and getting signatures from the committee members and the Graduate Adviser. This form can be found at the site <https://bae.engineering.ucdavis.edu/graduate/graduate-forms/>

Following the seminar, the thesis committee will meet in a closed door session and discuss the research, thesis and presentation and enter specific recommendations on the Exit Seminar Form and sign it. The student should present this form to the Graduate Adviser for final approval.

Student should address all the recommendations and work with the committee for the final approval of the thesis. Once the thesis is signed by all three members of the committee, student should submit it to the Office of Graduate Studies.

There are specific deadlines for submission of thesis for each quarter, which can be found in campus General Catalog (available online at the website of the Office of the Registrar). A candidate must be a registered student or in Filing Fee status at the time the program submits the form, with the exception of the summer period between the end of the Spring Quarter and the beginning of Fall Quarter

- b) Comprehensive Examination Committee (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 major professor will help ensure participation of appropriate committee members. 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.

**i) Timing:** Students may take the comprehensive examination once they have advanced to candidacy. However, it is important that the timing of the exam satisfy the regulations as noted in the CCGA handbook<sup>1</sup>, which indicates that the capstone requirement be completed at or near the end of the coursework for the Master’s degree.

**(ii) Outcome:** The Exam committee’s unanimous vote is required to pass a student on the exam. If a student does not pass the exam, the committee may recommend that the student be reexamined a second time, but only if the Graduate Adviser concurs with the committee. The second exam must take place within one quarter of the first exam. The format of the second exam is the same as that of the first exam and may include the submission of an amended version of the report. The examination may not be repeated more than once. A student who does not pass on the second attempt will be recommended for disqualification from further graduate work to the Dean of the Office of Graduate Studies. Once passed, the Master’s Report Form is signed by the Program Graduate Adviser and then forwarded to the Office of Graduate Studies. The deadlines for completing this requirement are listed each quarter in the campus General Catalog (available online at the website of the Office of the Registrar). A candidate must be a registered student or in Filing Fee status at the time the program submits the form, with the exception of the summer period between the end of the Spring Quarter and the beginning of Fall Quarter. The program must file the report with Graduate Studies by one week before the end of the quarter in which the student’s degree will be conferred.

**9. Normative Time to Degree:** The IDP is a special program for which the normative time is 18 months for MS I and one year for MS II after graduation from the BS degree program (may include Summer term of the senior year as well as Summer following the Spring quarter of the first year as a graduate student).

**10. Typical timeline and sequence of events:**

**Plan I:**

Year	Fall	Winter	Spring	Summer
1	200 (2 units) + other graduate or upper division courses (5	graduate or upper division courses (7 units) +290C	graduate or upper division courses (6 units) +290C (1	Complete Research**

<sup>1</sup> Appendix K, page 34, of

<http://www.universityofcalifornia.edu/senate/committees/ccga/ccgahandbook.pdf>

	units) + 290C (1 unit) + 299 (4 units) Select guidance committee/submit program of study	(1 unit) + 299 (4 units)	unit) + 299 (5 units)	
2	290C (1 unit) + 299 (11 units).	Present Exit Seminar and submit the thesis.		

\*\* MS I students are encouraged to start their research early during summer following graduation from their BS degree program.

**Plan II:**

Year	Fall	Winter	Spring	Summer
1	200 (2 units) + graduate or upper division courses (6 units) + 1 unit of 290 C + 299 (3 units) Select guidance committee and submit program of study	graduate or upper division courses (10 units) + 290C (1 unit) + 299 (1 unit)	graduate or upper division courses (9 units) + 290C (1 unit) + 299 (2 units)	Take Comprehensive examination during Summer.

**11. Sources of Funding:** Almost all students in Biological Systems Engineering Graduate Program except for those in MS Plan II, are employed as Graduate Student Researchers (GSR), or Teaching Assistants (TA), or hold fellowships such as Biological Systems Engineering Fellowship, University Fellowships, or External Fellowships. These assistantships and fellowships are very competitive. Since MS Plan II does not involve a research thesis, Graduate Student Researcher (GSR) opportunities will be rare for students in the MS Plan II program. However, those in the MS Plan II program are eligible for a limited number of Teaching Assistantship (TA) positions within the department and may apply for TA positions elsewhere on campus. Furthermore, limited scholarships and fellowships are available to highly qualified students.

**12. PELP and Filing Fee Status:** The planned educational leave program (PELP) is available to students to suspend their program of studies for good cause (i.e. illness, temporary departure from the University for employment, financial problems, personal problems). Students on PELP may leave the campus and be guaranteed the right to return later to resume academic work. The minimum duration of PELP is one quarter and maximum duration is three quarters.

Additional information about PELP (Planned Educational Leave), In Absentia (reduced fees when researching out of state), and Filing Fee status can be found in the Graduate Student Resources: <https://grad.ucdavis.edu/resources/graduate-student-resources>

*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.*

**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

<b>MS Plan I</b>		<b>MS Plan II</b>	
Minimum Required Total (30)*	EBS 200 Research Methods (2)	EBS 200 Research Methods (2)	EBS 200 Research Methods (2)
	EBS 290 Seminar (1)	EBS 290 Seminar (1)	EBS 290 Seminar (1)
	Graduate or Upper Division Undergraduate Courses not required for EBS BS degree (5)	Graduate or Upper Division Undergraduate Courses not required for EBS BS degree (12)	Graduate or Upper Division Undergraduate Courses not required for EBS BS degree (12)
	Graduate Engineering Courses (12)	Graduate Engineering Courses (12)	Graduate Engineering Courses (12)
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		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	

+ thesis and exit seminar.

+ comprehensive oral examination.

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



## **II. MASTER'S DEGREES**

Three Master's degrees are available to graduate students in Biological Systems Engineering. Programs for the **Master of Science (Plan I)** 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. For students who want to strengthen their preparation either for job market or for further professional education, we offer **Master of Science (Plan II)**. This program is particularly suited to highly qualified students who plan to pursue graduate education with an opportunity to reduce overall time to graduate degree commonly associated with MS Plan I programs. 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**

Highly qualified students with or without a BS degree in engineering may apply. However, students with a non-engineering BS degree need to meet additional prerequisites for admission and should make up deficiencies in engineering core and upper division courses as listed in #1a and b below. The application procedure will be as follows:

- Students who want to be considered for fellowships, should apply to the program by the published deadline by completing the standard MS application form (<http://gradstudies.ucdavis.edu/index.cfm>) and paying appropriate fees to be considered for potential fellowships and priority consideration. However, applications will be accepted until May 31<sup>st</sup>, if the applicant does not expect to be considered for fellowships administered by UC Davis (i.e., an applicant who is self-supporting or has other sources of support such as home country fellowship, international fellowship, Graduate Assistantship from the program etc.)
- Applicants will have a minimum GPA of 3.0.
- Applicants must take the GRE test.
- All students applying to the program will be required to submit three letters of recommendation.
- International applicants must take the TOFEL test.
- Applicants are strongly encouraged to communicate with potential research advisers (major professors) prior to admission to the program.
- Students admitted to the MS program 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 their major professor and constitute a course guidance committee during the first quarter in the program to plan the program of study. Students in the MS Plan II program must submit the program of study to the Executive committee for approval by the end of the first academic quarter in residence. Students in other MS programs (Plan

II or MEngr) must submit their program of study to the Executive committee for approval by the end of second academic quarter in residence.

- a) Prerequisites:** In addition to the admission requirements stated above, applicants with non-engineering BS degree are expected to have passed with letter grades the following UC Davis equivalent science and mathematics courses:
- i. Differential and Integral Calculus (Calculus - MATH 21 A, B & C; Vector Calculus - MATH 21 D; Linear Algebra - MATH 22 A; Differential Equations - MATH 22B).
  - ii. Physics (Classical Physics - PHY 9A & B; Electricity and Magnetism - PHY 9C)
  - iii. Chemistry (General Chemistry - CHE 2A & B)

**b) Deficiencies:** Students who do not have an undergraduate degree in engineering must pass with a letter grade any missing UC Davis equivalent engineering core courses .specified by Graduate Adviser. In addition, students must take undergraduate engineering courses during their MS program to meet the following requirement.

Students must take the four courses listed below:

- i. Statics: ENG 35
- ii. Circuits: ENG 17 or ENG 100
- iii. Fluid Mechanics: ENG 103
- iv. Thermodynamics: ENG 105, and

In addition, students must take three (3) courses from the courses listed below:

- i. Circuits: ENG100
- ii. Dynamics: ENG102
- iii. Mechanics of Materials: ENG104
- iv. Heat Transfer: EBS125
- v. Kinetics and Mass Transfer: EBS127
- vi. Modeling of Biological Systems: EBS130
- vii. Bioinstrumentation and Control: EBS165

Students may receive a waiver from the Graduate Advisor for one or more of the above course requirements if they can demonstrate proficiency through equivalent coursework.

**2. Master's Plan:** There are three MS degree options – MS Plan I (Thesis option), MS Plan II (Comprehensive Examination option), M. Engr. (Project option). MS Plan I requires a research based thesis, MS Plan II requires a comprehensive examination, and M. Engr. requires a design based project, a report, and a comprehensive examination. These plans satisfy the graduate degree requirements as stipulated by the Academic Senate.

[http://academicsenate.ucdavis.edu/cerj/manual/dd\\_regs.cfm#501-](http://academicsenate.ucdavis.edu/cerj/manual/dd_regs.cfm#501-)

**MS Plan I.** This plan requires a minimum of 30 units of graduate and upper division courses (100 and 200 series only) consisting of:

- (i) Research Methods in Biological System Engineering, EBS 200 (2 units)

- (ii) Seminar, EBS 290 (1 unit)
- (iii) 12 units of graduate engineering courses
- (iv) 5 units of graduate or upper division courses not required for BSE BS degree.
- (v) At least 6 units of 290C, 299 Research
- (vi) Other graduate or upper division courses for a total of at least 30 units. For those students who did not take any life sciences classes during their undergraduate degree program, at least one course from life sciences should be included.
- (vii) Written thesis based on research and public presentation (exit seminar). Thesis should be signed by three thesis committee members.

**MS Plan II.** This plan requires a minimum of 36 units of graduate and upper division courses (100 and 200 series only) consisting of:

- (i) Research Methods in Biological System Engineering, EBS 200 (2 units)
- (ii) Seminar, EBS 290 (1 unit)
- (iii) 12 units of graduate engineering courses
- (iv) Additional 6 units of graduate courses for a total of 18 graduate units including 12 units of engineering courses listed in # (iii) above. The remaining 6 units can be graduate or upper division courses not required for EBS BS degree
- (v) At most 9 units of 290C, 299 Research (up to 9 units)
- (vi) Other graduate or upper division courses for a total of at least 36 units. For those students who did not take any life sciences classes during their undergraduate degree program, at least one course from life sciences should be included.
- (vii) Oral Comprehensive Examination before a three faculty committee members

**M.Engr:** This plan requires a minimum of 36 units of graduate and upper division courses (100 and 200 series only) consisting of:

- (i) Research Methods in Biological System Engineering, EBS 200 (2 units)
- (ii) Seminar, EBS 290 (1 unit)
- (iii) 12 units of graduate engineering courses
- (iv) Additional 6 units of graduate courses for a total of 18 graduate units including 12 units of engineering courses listed in # (iii) above. The remaining 6 units can be graduate or upper division courses not required for EBS BS degree
- (v) At most 9 units of 290C, 299 Research
- (vi) Other graduate or upper division courses for a total of at least 36 units. For those students who did not take any life sciences classes during their undergraduate degree program, at least one course from life sciences should be included.
- (vii) Written engineering report based on a project and oral comprehensive examination before a committee of three faculty members.

### 3. Course Requirements

Per UC regulations, students cannot enroll in more than 12 units of graduate level courses (200) or more than 16 units of combined undergraduate and graduate level (100, 200, 300) courses per quarter

#### MS Plan I - Core and Electives (30 units)

**a) Core courses (3 units)**

EBS 200 Research methods in biological systems engineering	2 units
EBS290 Seminar course	1 unit

**b) Elective Courses (minimum of 27 units):** These courses should be selected in consultation with the course guidance committee members and should meet the requirements stated in #2 above for MS Plan I.

**c) Summary:** Figure 2 succinctly summarizes our MS Plan I degree program requirements.

#### MS Plan II - - Core and Electives (36 units)

**a) Core courses (3 units)**

EBS 200 Research methods in biological systems engineering	2 units
EBS290 Seminar course	1 unit

**b) Elective Courses (minimum of 33 units):** These courses should be selected in consultation with the course guidance committee members and should meet the requirements stated in #2 above for MS Plan II.

**c) Summary:** Figure 3 succinctly summarizes our MS II degree program requirements.

#### M. Engr. - Core and Electives (36 units)

**a) Core courses (3 units)**

EBS 200 Research methods in biological systems engineering	2 units
EBS290 Seminar course	1 unit

**b) Elective Courses (minimum of 33 units):** These courses should be selected in consultation with the course guidance committee members and should meet the requirements stated in #2 above for M. Engr.

**c) Summary:** Figure 4 succinctly summarizes our M. Engr. degree program requirements.

### 4. Special Requirements: None.

## 5. Committees:

a) **Admission Committee:** The graduate admission adviser and staff adviser handle all application-related issues. Once the completed application, all supporting material, and the application fee have been received, the application will be submitted to the Admissions Committee. In consultation with the graduate program chair, the graduate admission adviser will make the admission recommendation and forward it to the Dean of the Office of Graduate Studies for final approval of admission

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 formulate their proposed Program of Study. A Program of Study is a list of graded courses the student is expected to take to meet degree requirements. Course Guidance Committee assists the student in developing this program of study. It should be signed by all three members of the course guidance committee before it is submitted to the Executive Committee. Students pursuing MS Plan I or M. Engr. Degree must submit their Program of Study to the Executive Committee for approval by the end of Winter quarter. Students pursuing MS Plan II program should submit their Program of Study by the end of Fall quarter to the Executive Committee for approval.

c) **Thesis Committee (MS Plan I) /Comprehensive Examination Committee (MS Plan II, M. Engr):** Students who are pursuing MS Plan I are required to set up a Thesis Committee at the time of Advancement to Candidacy. Students Pursuing MS Plan II or M. Engr degree are required to set up a Comprehensive Examination Committee at the time of Advancement to Candidacy. This committee of three is nominated by the student in consultation with their major professor and submitted to the Graduate Adviser for approval. The major professor or Graduate Adviser will facilitate faculty participation in the Thesis or Comprehensive Examination Committee, as necessary. These nominations are then submitted to the Office of Graduate Studies for formal appointment in accordance with Graduate Council policy. The major professor acts as Chair of the committee.

**6. Advising Structure and Mentoring:** The graduate adviser will go over the degree requirements with all admitted graduate students. For students entering in the Fall quarter, this is done as a part of EBS 200 course (Research methods in biological systems engineering) within the first couple of weeks of the quarter or graduate student orientation before instruction begins. For a student entering in other quarters (early or late admits), the Graduate Adviser will go over these requirements on an individual basis soon after arrival of the student. 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. Major professors are assigned to the students during the first quarter of their graduate program. When major professors can not be assigned, Graduate Adviser will provide the advising to the students.

**7. Advancement to Candidacy:** Students admitted to the Masters degree program must file the advancement to candidacy form when they finish a majority of the coursework listed on their program of study. The Candidacy for the Master's Degree form can be found from Graduate Studies. . A completed form along with appropriate fees must be submitted before the thesis

can be submitted (MS Plan I) or Comprehensive Examination can be taken (MS Plan II or M. Engr). The form includes a list of courses the student will take to complete degree requirements. If changes must be made to the student's course plan after they has advanced to candidacy, the Graduate Adviser must recommend these changes to Graduate Studies. Students must have their Graduate Adviser and committee Chair sign the candidacy form before it can be submitted to Graduate Studies. If the candidacy is approved, the Office of Graduate Studies will send a copy to the appropriate Graduate Program Coordinator and the student. If the Office of Graduate Studies determines that a student is not eligible for advancement, the program and the student will be told the reasons for the application's deferral. Some reasons for deferring an application include: grade point average below 3.0, outstanding "I" grades in required courses, or insufficient units.

## 8. Comprehensive Examination and/or Thesis Requirements

### a) Thesis requirements (MS Plan I):

Thesis: Research for the Master's thesis is to be carried out under the supervision of a faculty member of the program and must represent an original contribution to knowledge in the field. The thesis research must be conducted while the student is enrolled in the program. The thesis is submitted to the thesis committee at least one month before the student plans to make requested revisions. All committee members must approve the thesis and sign the title page before the thesis is submitted to Graduate Studies for final approval. Should the committee determine that the thesis is unacceptable, even with substantial revisions, the program may recommend to the Dean of the Office of Graduate Studies that the student be disqualified from the program.

The thesis must be filed in a quarter in which the student is registered or on filing fee. Instructions on preparation of the thesis and a schedule of dates for filing the thesis in final form are available from Graduate Studies; the dates are also printed in the UC Davis General Catalog and in the Class Schedule and Registration Guide issued each quarter. A student must have a GPA of 3.0 for the M.S. degree to be awarded.

### b) Comprehensive Examination Requirements (MS Plan II/M. Engr.):

i) **Timing:** 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 major professor will help ensure participation of appropriate committee members. 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.

ii) **Outcome:** The exam committee's unanimous vote is required for a student to pass the exam. If a student does not pass the first exam, the committee may recommend that the student be examined a second time, but only if the Graduate Adviser concurs with the committee. The second exam must take place within one quarter of the first exam. The format of the second exam is the same as that of the first exam and may include the submission of an amended version of the report. The examination may not be repeated more than once. A student who does not pass on the second attempt will be

recommended for disqualification from further graduate work to the Dean of the Office of Graduate Studies.

Once passed, the Master's Report Form is signed by the Program Graduate Adviser and then forwarded to the Office of Graduate Studies. The deadlines for completing this requirement are listed each quarter in the campus General Catalog (available online at the website of the Office of the Registrar). A candidate must be a registered student or in Filing Fee status at the time the program submits the form, with the exception of the summer period between the end of the Spring Quarter and the beginning of Fall Quarter. The program must file the report with Graduate Studies by one week before the end of the quarter in which the student's degree will be conferred.

***In addition to passing the Comprehensive Examination, the M. Engr. Students must also submit a report that is approved by the Comprehensive Examination Committee.***

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.

**9. Normative time to degree:** Normative time to degree is 2 years for MS Plan I and M. Engr. degrees. For MS Plan II normative time is 4 quarters.

**10. Typical timeline and sequence of events:**

**MS Plan I (Thesis option):**

Year	Fall	Winter	Spring	Summer
1	200 (2 units) + 3 units of graduate or upper division courses + 1 unit of 290 C + 299 (6 units) Select guidance committee	graduate or upper division courses (6 units) + 290C (1 unit) + 299 (5 units) Submit Program of Study	graduate or upper division courses (6 units)+ 290C (1 unit) + 299 (5 units)	Conduct Research
2	graduate or upper division courses (3 units) + 290C (1 unit) + 299 (1 unit).	290C (1 unit) + 299 (11 units).	290C (1 unit) + 299 (11 units).	Present exit seminar and submit thesis.

**MS Plan II (Comprehensive Exam option):**

Year	Fall	Winter	Spring	Summer
1	200 (2 units) + graduate or upper division courses (7 units) + 290 C (1 unit) + 299 (2 units)  Select guidance committee/submit program of study	graduate or upper division courses (9 units) + 290C (1 unit) + 299 (2 units)	graduate or upper division courses (9 units) + 290C (1 unit) + 299 (2 units)	Take Comprehensive examination

**M. Engr. (Project + Comprehensive Examination option):**

Year	Fall	Winter	Spring	Summer
1	200 (2 units) + graduate or upper division courses (3 units) + 1 unit of 290 C + 299 (6 units)  Select guidance committee	graduate or upper division courses (8 units) + 290C (1 unit) + 299 (3 units)  Submit Program of study	graduate or upper division courses (8 units) + 290C (1 unit) + 299 (3 units)	Pursue Engineering project
2	graduate or upper division courses (6 units) + 1 unit of 290C + 5 units of 299	290C (1 unit) + 299 (11 units)	290C (1 unit) + 299 (11 units).	Submit the report and take the comprehensive examination

**11. Sources of Funding:** Almost all students in Biological Systems Engineering Graduate Program except for those in MS Plan II, are employed as Graduate Student Researchers (GSR), or Teaching Assistants (TA), or hold fellowships such as Biological Systems Engineering Fellowship, University Fellowships, or External Fellowships. These assistantships and fellowships are very competitive. Since MS Plan II does not involve a research thesis, Graduate Student Researcher (GSR) opportunities will be rare for students in the MS Plan II program. However, those in the MS Plan II program are eligible for a limited number of Teaching Assistantship (TA) positions within the department and may apply for TA positions elsewhere on campus. Furthermore, limited scholarships and fellowships are available to highly qualified students.

**12. PELP and Filing Fee Status:** The planned educational leave program (PELP) is available to students to suspend their program of studies for good cause (i.e. illness, temporary departure



from the University for employment, financial problems, personal problems). Students on PELP may leave the campus and be guaranteed the right to return later to resume academic work. The minimum duration of PELP is one quarter and maximum duration is three quarters.

Additional information about PELP (Planned Educational Leave), In Absentia (reduced fees when researching out of state), and Filing Fee status can be found in the Graduate Student Resources: <https://grad.ucdavis.edu/resources/graduate-student-resources>

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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:**

<b>Minimum Required Total (30)*</b>	EBS 200 Research Methods (2)	
	EBS 290 Seminar (1)	
	<b>Courses exclusive of EBS 200, EBS 290, 290C and 299 (17) Must meet these criteria:</b>	Graduate or Upper Division Undergraduate Courses not required for EBS BS degree (5)
		Graduate Engineering Courses (12)
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		

**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 2. Course requirements for MS Plan I (Thesis option)**

<b>Minimum Required Total (36)*</b>	EBS 200 Research Methods (2)	
	EBS 290 Seminar (1)	
	<b>Courses exclusive of EBS 200, EBS 290, 290C and 299 (24) Must meet these criteria:</b>	Graduate or Upper Division Undergraduate Courses not required for EBS BS degree (12)
		Graduate Engineering Courses (12)
	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	

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)**

**M.Engr. Program of Study:**

Minimum Required Total (36)*	EBS 200 Research Methods (2)	
	EBS 290 Seminar (1)	
	Courses exclusive of EBS 200, EBS 290, 290C and 299 (24) Must meet these criteria:	Graduate or Upper Division Undergraduate Courses not required for EBS BS degree (12)
		Graduate Engineering Courses (12)
290C, 299 Research (minimum of 6 units required) plus other Graduate or Upper Division Undergraduate Courses as needed to meet the required 36 unit minimum total		

**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 4 . Course requirements for M.Engr. 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**

Highly qualified students with or without a BS or MS degree in engineering may apply. However, students with a non-engineering BS degree need to meet additional prerequisites for admission and should make up deficiencies in engineering core and upper division courses as listed in #1b and c below. The application procedure will be as follows:

- Students who want to be considered for fellowships, should apply to the program by the published deadline by completing the standard doctoral application form (<http://gradstudies.ucdavis.edu/index.cfm>) and paying appropriate fees to be considered for potential fellowships and priority consideration. However, application will be accepted until May 31<sup>st</sup>, if the applicant does not expect to be considered for fellowships administered by UC Davis (i.e., applicant who is self-supporting or has other sources of support such as home country fellowship, international fellowship, Graduate Assistantship from the program etc.)
- Applicants will have a minimum undergraduate GPA of 3.0 or a graduate GPA of 3.25. Under some exceptional circumstances, students who only hold an undergraduate degree 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.
- Applicants must take the GRE test.
- All students applying to the program will be required to submit three letters of recommendation.
- International applicants must take the TOFEL or IELTS test.
- Applicants are strongly encouraged to communicate with potential research advisers (major professors) prior to admission to the program.
- Students admitted to the doctoral program 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 their major professor and constitute a course guidance committee in the first quarter of the program to plan the program of study. Students in the doctoral

program must submit the program of study to the Executive committee for approval by the end of the third academic quarter in residence.

- a) **Prerequisites:** In addition to the admission requirements stated above, applicants with non-engineering BS degree are expected to have passed with letter grades the following UC Davis equivalent science and mathematics courses:
- i. Differential and Integral Calculus (Calculus - MAT 21 A, B & C; Vector Calculus - MAT 21 D; Linear Algebra - MAT 22 A; Differential Equations - MAT 22B).
  - ii. Physics (Classical Physics - PHY 9A & B; Electricity and Magnetism - PHY 9C)
  - iii. Chemistry (General Chemistry - CHE 2A & B)
- b) **Deficiencies:** Students who do not have a B.S. in engineering must pass with letter grade any missing UC Davis equivalent engineering core courses specified by Graduate Adviser. In addition, students will take upper division engineering courses during their doctoral program to meet the following requirement.

Students must take the courses listed below:

- i. Statics: ENG (35)
- ii. Circuits: ENG 17 or ENG 100
- iii. Fluids: ENG 103
- iv. Thermodynamics: ENG 105

In addition, students must take three (3) courses from the courses listed below:

- i. Circuits: ENG100
- ii. Dynamics: ENG102
- iii. Mechanics of Materials: ENG104
- iv. Heat Transfer: EBS125
- v. Kinetics and Mass Transfer: EBS127
- vi. Modeling of Biological Systems: EBS130
- vii. Bioinstrumentation and Control: EBS165

Please visit <http://bae.engineering.ucdavis.edu/graduate/admission-requirements/> for more information.

- 2. Dissertation Plan :** Biological Systems Engineering Graduate Program offers Dissertation Plan described under section 520 in the Davis Division Academic Senate Regulations: <https://grad.ucdavis.edu/sites/default/files/upload/files/grad-council/c.4.davis-division-reg-520c-2008.pdf>

This plan requires a minimum of three members on the dissertation committee and an Exit Seminar or Public Presentation of the dissertation research. The Exit Seminar is scheduled after the student submits a rough draft to the Dissertation Committee on a date suitable to all members of the committee with the approval of the Graduate Adviser. The Thesis and Dissertation Presentation form can be found from the Graduate Adviser/Graduate Coordinator or at the website: <https://bae.engineering.ucdavis.edu/graduate/graduate-forms/>

### 3. Course Requirements

## **Ph. D. - Core and Electives (49 units):**

### **a) Core Courses (4 units)**

- (i) EBS 200: Research methods in biological systems engineering 2 units
- (ii) EBS 290 Seminar 2 units

### **b) Elective Courses (45 units). Note 8 of these 45 units have to meet Advanced Math and Advanced Experimental Design and Analysis requirements.**

#### (iii) Major:

ECH 259 or equivalent (Advanced engineering mathematics), EBS 265 (Design and analysis of engineering experiments), and other graduate and upper division courses in the major field 30 units

- (iv) Minor: A minimum of 15 units of graduate and undergraduate courses in a particular field to enhance student's breadth of knowledge. To achieve this breadth student typically takes 3 graduate and 2 upper division courses in a coherent subject (i.e., 5 courses randomly selected from different areas will not constitute a minor) 15 units

#### **c) Summary:** Figure 5 succinctly summarizes our Ph. D. degree program requirements.

Note that course Guidance Committee, in concurrence with the student, may suggest ECH 140 (Mathematical methods in biochemical and chemical engineering), EAD 205A (mathematical methods), MAT 118A (Partial differential equations: Elementary methods), or (MAT 118 B (Partial differential equations: Eigenfunction expansions) as a substitution for ECH 259. Similarly, PLP 222 (Experimental approaches in plant pathology) may be suggested as a substitution to EBS 265. However, EBS 265 and ECH 259 are the preferred courses and any recommended changes will have to be approved by the Executive Committee. Note also that any such changes may lead to a change in the total number of core units. However, such changes need to be compensated in major courses, which must total a minimum of 30 units including Advancement engineering mathematics and Design and analysis of engineering experiments or with their respective substitutions.

In selecting the courses, students should be very careful to make sure that in the major and minor fields, which amount to a total of 45 units, there are at least 30 graduate units of which at least 15 are engineering graduate units. Moreover, at least 23 units must be in engineering. Note that students holding a MS degree may be able to transfer up to 21 units from elsewhere. To be able to transfer these units students must provide an extended outline of the course (s) taken at other institutions. In any case, at least 24 units and core courses (EBS 200 and EBS 290) must be taken here at UC Davis to satisfy major and minor requirements. Figure 5 summarizes our Ph. D. degree course requirements succinctly.

## **D. Engr.: Core and Electives (49 units)**

Course requirements for D. Engr. are academically equivalent to Ph.D. program but emphasize 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 an additional 15 upper division or graduate units suggested for the Ph.D. candidate.

**a) Core courses (4 units)**

- (i) EBS 200: Research methods in biological systems engineering 2 units
- (ii) EBS 290: Seminar 2 units

**b) Elective courses (45 units)**

- (iii) Major: A minimum of 30 units of graduate and upper division courses.  
 These courses should prepare the student to define and solve problems in recognized engineering area. These courses may come from physical sciences, mathematics, statistics, and engineering to provide knowledge necessary for high-level professional engineering performance  
 30 units
- (iv) Minor: A minimum of 15 units of graduate and undergraduate courses in particular field to enhance students breadth of knowledge. To achieve this breadth student typically takes 3 graduate and 2 upper division courses in a coherent subject (i.e., about 5 courses randomly selected from different areas)  
 15 units

**c) Summary:** Figure 6 succinctly summarizes our D. Engr. degree program requirements.

In selecting the courses, students should be very careful to make sure that in the major and minor fields, which amount to a total of 45 units, there are at least 30 graduate units of which at least 15 are engineering graduate units. Moreover, at least 23 units must be in engineering. Note that students holding a MS degree may be able to use up to 21 units from elsewhere. To be able to use these units students must provide an extended outline of the course (s) taken at other institutions. In any case, at least 24 units and core courses (EBS 200 and EBS 290) must be taken here at UC Davis to satisfy major and minor requirements. Figure 6 summarizes our D. Engr. degree course requirements succinctly.

**4. Special requirements:** None.

**5. Committees:**

- a) **Admission Committee:** The graduate admission adviser and staff adviser handle all application-related issues. Once the completed application, all supporting material, and the application fee have been received, the application will be submitted to the Admissions



Committee. In consultation with the graduate program chair, the graduate admission adviser will make the admission recommendation and forward it to the Dean of the Office of Graduate Studies for final approval of admission

- 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 formulate their proposed Program of Study. A Program of Study is a list of graded courses the student is expected to take to meet degree requirements. Course Guidance Committee assists the student in developing this program of study. It should be signed by all three members of the course guidance committee before it is submitted to the Executive Committee. Doctoral students must submit their Program of Study to the Executive Committee for approval by the end of third quarter in residence (i.e, Spring quarter for students entering in Fall quarter).
- c) **Qualifying Examination Committee:** The student, in consultation with their major professor and Graduate Adviser, nominates five faculty to serve on the Examination Committee. At least one, but no more than two members, on the committee should be from outside the program. The major professor cannot serve on the QE committee. These nominations are submitted to the Office of Graduate Studies for formal appointment in accordance with Graduate Council policy. Students are encouraged to submit the form well in advance (4 to 6 weeks) of the proposed QE date. The QE cannot be taken until the committee appointment is approved by the Office of Graduate Studies. The QE Committee conducts the exam and submits results to the Office of Graduate Studies.
- d) **Dissertation Reading Committee:** This committee of three is nominated by the student in consultation with their major professor and submitted to the Graduate Adviser for approval. The composition of the committee is entered on the Advancement to Candidacy Form and are then submitted to the Office of Graduate Studies for formal appointment in accordance with Graduate Council policy. The role of the Dissertation Committee is to advise the doctoral student on the research topic and methods, and then to review the final completed dissertation for acceptance. The major professor acts as the chair of the committee. The Committee Chairperson should determine the desires of the individual members regarding assistance with the research and dissertation review at the time the dissertation committee is constituted. Students are expected to meet with the Chair of their dissertation committee regularly. Dissertation committee members are expected to read and comment on a dissertation within four weeks from its submission. This time limit policy does not apply to summer periods for faculty holding nine-month appointments. The student and faculty will coordinate a timeline for the student to present the thesis to the dissertation committee. This timeline must allow all dissertation committee members enough time to fulfill their responsibilities within the four-week deadline. Please note the Exit Presentation requirement listed in #2 above.

**6. Advising Structure and Mentoring:** The graduate adviser will go over the degree requirements with all admitted graduate students. For students entering in the Fall quarter, this is done as a part of EBS 200 course (Research methods in biological systems engineering) within the first couple of weeks of the quarter or at Graduate Orientation before instruction begins. For a student entering in other quarters (early or late admits), the Graduate Adviser will go over these requirements on an individual basis soon after arrival of the student. 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. Major professors are normally assigned to students during

the first quarter of their graduate program. Graduate Adviser will provide advising to students when major professors are not assigned.

**7. Advancement to candidacy:** Before advancing to candidacy for a doctoral degree, a student must have satisfied all requirements set by the graduate program, must have maintained a minimum GPA of 3.0 in all coursework undertaken (except those courses graded S or U), and must have passed a Qualifying Examination before a committee appointed to administer that examination. Normally, students who enter directly after a BS degree in Engineering, advance in three years. However, students who enter with a MS degree with substantial amount of units used (say 18 to 21) from their MS program, are expected to Advance to Candidacy in two years. Students with non-engineering BS degree may require an additional year to Advance to candidacy. The student must file the appropriate paperwork with the Office of Graduate Studies and pay the Candidacy Fee in order to be officially promoted to Ph.D. candidacy. Refer to the Graduate Council website for additional details regarding the Doctoral Qualifying Examination at <http://gradstudies.ucdavis.edu/gradcouncil/policiesall.html>.

#### **8) Preliminary Examination, Qualifying Examination and Dissertation**

**a) Preliminary Examination: None.**

**b) Qualifying Examination:**

**(i) General Information**

All students will complete all course requirements before taking their Qualifying Examination. Passing this exam makes the student eligible for advancement to candidacy. A student entering with a BS degree in engineering should take the qualifying examination within 9 quarters (excluding summer) and no later than 12 quarters (excluding summer) after admission to the Ph.D. program. Students with MS degree with significant number of units (18 to 21) used from their MS program, should take qualifying examination in 6 quarters (excluding summer) and no later than 9 quarters (excluding summer) after admission to the Ph. D. program. Students with non-engineering BS degree would be allowed an additional year for taking the qualifying examination.

The primary purpose of the Qualifying Examination (QE) is to validate that the student is academically qualified to conceptualize a research topic, undertake scholarly research and successfully produce the dissertation required for a doctoral degree. The QE must evaluate the student's command of the field, ensuring that the student has both breadth and depth of knowledge, and must not focus solely on the proposed dissertation research. In addition, the QE provides an opportunity for the committee to provide important guidance to the student regarding their chosen research topic.

**(ii) Written Portion of the Exam – Dissertation Prospectus**

At a minimum the written portion of the exam consists of a research proposal called the Dissertation Prospectus. The Prospectus should be provided to members of the qualifying examination committee at least 10 days before the oral portion of the exam.

The Prospectus is an independently prepared proposal of 10-12 pages describing the student's dissertation-specific research aims, hypotheses, progress to date, and experimental approach. Concepts within the research proposal can be discussed with others (such as the student's major professor and peers), but the writing of the proposal should be solely the student's work (i.e., no editorial assistance is allowed) as the proposal will serve as evidence of the student's proficiency in scientific writing.

The qualifying exam committee will be responsible for assessing that the student's writing proficiency is satisfactory before advancement to candidacy. Furthermore, the Prospectus will provide information that may be discussed during the oral exam.

**(iii) Oral Portion of the Exam**

The oral portion of the qualifying exam will be 3 hours in length and is intended to demonstrate the student's critical thinking ability, powers of imagination and synthesis, and broad knowledge of the field of study. Typically, the examination will start off with student making a brief (20 to 25 minutes) presentation of the research prospectus. The committee may examine the student on various aspects of the prospectus to evaluate student's depth of understanding. This part of the examination will take approximately half of the allotted time. The second part of the examination will focus on students' breadth of knowledge in their chosen field (major and minor areas).

The committee will evaluate the student's general qualifications for a respected position as an educator or leader as well as the student's preparation in a special area of study based upon relevant portions of the student's previous academic record, performance on specific parts of the examination, and the student's potential for scholarly research as indicated during the examination.

**(iv) Outcome of the Exam**

The committee will reach a decision on the student's performance immediately after the oral exam. The committee, having reached a unanimous decision, shall inform the student of its decision to:

- “Pass” (no conditions may be appended to this decision),
- “Not Pass” (the Chair's report should specify whether the student is required to retake all or part of the examination, list any additional requirements, and state the exact timeline for completion of requirements to achieve a “Pass”), or
- “Fail”.

If a unanimous decision takes the form of “Not Pass” or “Fail”, the Chair of the QE committee must include in its report a specific statement, agreed to by all members of the committee, explaining its decision and must inform the student of its decision. In the event that the committee is unable to reach a unanimous decision, the outcome will be resolved through the Dean of Graduate Studies as well as the Graduate Council, in accordance with the procedures detailed in the Graduate Advisers Handbook GS-202. If the committee decision results in a

“Not Pass”, the student may attempt the QE one additional time; the QE report must list the specific conditions and timing for the second exam. After a second examination, a vote of “Not Pass” is unacceptable; only “Pass” or “Fail” is recognized. Only one retake of the qualifying examination is allowed. Should the student receive a “Fail” on the first or second attempt at the exam, the student will be recommended for disqualification from the program to the Dean of the Office of Graduate Studies.

### **c) The Dissertation**

#### **(i) Exit Seminar:**

Biological Systems Engineering Graduate Program follows Dissertation Plan B and requires an exit seminar. As listed in # 2 above, the Exit Seminar is scheduled after the student submits a rough draft to the Dissertation Committee on a date suitable to all members of the committee with the approval of the Graduate Adviser. The Thesis and Dissertation Presentation form can be found from the Graduate Adviser/Graduate Coordinator or at the website: <https://bae.engineering.ucdavis.edu/graduate/graduate-forms/>. Scheduling of the Exit Seminar is the responsibility of the student.

#### **(ii) Dissertation: General Requirements**

Filing of a Ph.D. dissertation with the Office of Graduate Studies is normally the last requirement satisfied by the candidate. The deadlines for completing this requirement are listed each quarter in the campus General Catalog (available online at the website of the Office of the Registrar or from the Bookstore). A candidate must be a registered student or in Filing Fee status at the time of filing a dissertation, with the exception of the summer period between the end of the Spring Quarter and the beginning of Fall Quarter. The Ph.D. Dissertation will be prepared, submitted and filed according to regulations instituted by the Office of Graduate Studies <http://gradstudies.ucdavis.edu/students/filing.html>. Satisfaction of this requirement must be verified by the Dissertation Committee Chair.

#### **(iii) Dissertation**

The research conducted by the student must be of such character as to show ability to pursue independent research. The dissertation reports a scholarly piece of work of publishable quality that solves a significant scientific problem in the field and is carried out under the supervision of a member of program while the student is enrolled in the program. The chair of the dissertation committee must be a member of the program and must be immediately involved with the planning and execution of the work related to the dissertation.

Students should meet regularly with their dissertation committee. The dissertation must be submitted to each member of the dissertation committee at least one month before the student expects to make requested revisions; committee members are expected to respond within 4 weeks, not including summer months for nine month faculty. Informing committee members of progress as writing proceeds helps the members to plan to read the dissertation and provide feedback within this time frame. The dissertation must be approved and signed by the dissertation committee before it is submitted to Graduate Studies for final approval.

**9. Normative time to degree:** Normative time to degree is 5 years for those entering the program with a BS degree in Engineering. A student with a MS degree may require one year less to complete all degree requirements (i.e., 4 years) as they are able to use several units (up to 22) from their MS program. An additional year may be needed for a student who enters with a non-engineering degree to makeup the deficiencies listed in #2C.

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

**Ph. D. Degree (For students entering with BS degree in Engineering):**

Year	Fall	Winter	Spring	Summer
One	200 (2 units) + ECH 259 (4 units) + 1 unit of 290 C + 299 (5 units)  Select guidance committee	graduate or upper division courses (8 units) + 290C (1 unit) + 299 (3 units)	265 (5 units) + graduate or upper division courses (3 units)+ 290C (1 unit) + 299 (3 units)  Submit Program of study.	Conduct Research
Two	graduate or upper division courses (6 units) + 290C (1 unit)+ 299 (5 units).	graduate or upper division courses (6 units)+ 290C (1 unit) + 299 (5 units).	graduate or upper division courses (6 units)+ 290C (1 unit) + 299 (5 units).	Conduct Research
Three	upper graduate or upper division courses (5 units) + 290C (1 unit) + 299 (6 units)	graduate or upper division courses (4 units)+ 290 C (1 unit)+ 299 (7 units)	290C (1 unit) + 299 (11 units)  Prepare for Qualifying Exam (QE)	Take QE and Advance to candidacy
Four	290 C (1 unit) + 299 (11 units)	290 C (1 unit) + 299 (11 units)	290 C (1 unit) + 299 (11 units)	Conduct Research
Five	290 C (1 unit) + 299 (11 units)	290 C (1 unit) + 299 (11 units)	290 C (1 unit) + 299 (11 units)	Present Exit Seminar and submit the dissertation

**D. Engr. Degree (For students entering with BS degree in Engineering):**

Year	Fall	Winter	Spring	Summer
One	200 (2 units) + Graduate or upper division courses (4	graduate or upper division courses (8 units) + 290C	graduate or upper division courses (8 units) + 290C	Pursue engineering Project

	units)+ 290 C (1 unit) + 299 (5 units) Select guidance committee	(1 unit) + 299 (3 units)	(1 unit) + 299 (3 units) Submit Program of study.	
Two	graduate or upper division courses (6 units) + 290C (1 unit)+ 5 units of 299.	graduate or upper division courses (6 units)+ 290C (1 unit) + 299 (5 units).	graduate or upper division courses (6 units) + 290C (1 unit) + 299 (5 units).	Pursue engineering Project
Three	upper graduate or upper division courses (5 units) + 1 unit of 290C + 299 (6 units)	graduate or upper division courses (4 units)+ 290 C (1 unit)+ 299 (7 units)	290C (1 unit) + 299 (11 units) Prepare for Qualifying Exam (QE)	Pursue the Engineering project, Take QE and Advance to candidacy.
Four	290 C (1 unit) + 299 (11 units)	290 C (1 unit) + 299 (11 units)	290 C (1 unit) + 299 (11 units)	Pursue engineering Project
Five	290 C (1 unit) + 299 (11 units)	290 C (1 unit) + 299 (11 units)	290 C (1 unit) + 299 (11 units)	Present Exit Seminar and submit the dissertation

**11. Sources of Funding:** Almost all doctoral students in Biological Systems Engineering Graduate Program are employed as Graduate Student Researchers (GSR), or Teaching Assistants (TA), or hold fellowships such as Biological Systems Engineering Fellowship, University Fellowships, or External Fellowships. These assistantships and fellowships are very competitive.

**12. PELP and Filing Fee Status:** The planned educational leave program (PELP) is available to students to suspend their program of studies for good cause (i.e. illness, temporary departure from the University for employment, financial problems, personal problems). Students on PELP may leave the campus and be guaranteed the right to return later to resume academic work. The minimum duration of PELP is one quarter and maximum duration is three quarters.

Additional information about PELP (Planned Educational Leave), In Absentia (reduced fees when researching out of state), and Filing Fee status can be found in the Graduate Student Guide: <http://www.gradstudies.ucdavis.edu/publications/>

**Ph.D. Program of Study:**

Minimum Required Total (49)*	EBS 200 Research Methods (2)					
	EBS 290 Seminar (2)					
	Courses exclusive of EBS 200, EBS 290, 290C and 299 (45)  Must meet these criteria:	Minor (15)	UCD or elsewhere (21)	Engr. and Other Courses (22)	Grad or Upper Div. Undergrad as needed to meet 45 unit minimum (15)	
		Major (30)			Minimum units taken at UCD (24)	Engr. Courses (23)
			Graduate Engineering Units (15)			
290C, 299 Research (variable)						

**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 5. Course requirements for Ph.D. degree**

**D. Engr. Program of Study:**

Minimum Required Total (30)*	EBS 200 Research Methods (2)	
	EBS 290 Seminar (1)	
	Courses exclusive of EBS 200, EBS 290, 290C and 299 (17) Must meet these criteria:	Graduate or Upper Division Undergraduate Courses not required for EBS BS degree (5)
		Graduate Engineering Courses (12)
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		

**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 6. Course requirements for D.E. degree**