

 <b>FLORIDA ATLANTIC UNIVERSITY</b>	<b>PROGRAM CHANGE REQUEST</b> <b>Graduate Programs</b>	UGPC Approval _____ UFS Approval _____ Banner Posted _____ Catalog _____
	<b>Department</b> Computer & Electrical Eng. and Computer Sci. <b>College</b> Engineering and Computer Science	
<b>Program Name</b> MS in Computer Science, MS in Computer Engineering, MS in Electrical Engineering, MS in Bioengineering	<b>Effective Date</b> <small>(TERM &amp; YEAR)</small> SUMMER 2018	
<b>Please explain the requested change(s) and offer rationale below or on an attachment</b>  This proposal requests updating the catalog with specifications about the chair of the MS committee, for MS thesis option programs. More specifically: <ul style="list-style-type: none"> <li>MS in Computer Science/Computer Engineering/Electrical Engineering thesis option: The MS committee is chaired by the student's thesis advisor. The chair of the committee must be a graduate faculty member from the Department of Computer &amp; Electrical Engineering and Computer Science</li> <li>MS in Bioengineering thesis option: The MS committee is chaired by the student's thesis advisor. The chair of the committee must be a graduate faculty member from any department within the College of Engineering &amp; Computer Science</li> </ul>		
<b>Faculty Contact/Email/Phone</b> Dr. Mihaela Cardei, mcardei@fau.edu	<b>Consult and list departments that may be affected by the change(s) and attach documentation</b> NA	
<b>Approved by</b> Department Chair <u>Theresa Enders</u> College Curriculum Chair <u>M. Cardei</u> College Dean <u>Chris R. ...</u> UGPC Chair _____ Graduate College Dean _____ UFS President _____ Provost _____	<b>Date</b> <u>10/26/2017</u> <u>10/26/2017</u> <u>11/7/2017</u> _____ _____ _____	

Email this form and attachments to [UGPC@fau.edu](mailto:UGPC@fau.edu) one week before the UGPC meeting so that materials may be viewed on the UGPC website prior to the meeting.

# Computer & Electrical Engineering and Computer Science

## Computer Science and Computer Engineering

### Master of Science with Major in Computer Engineering

The non-thesis option for this degree requires a minimum of 33 credits. The thesis option requires a minimum of 30 credits, including 6 credits of thesis. All students must take at least one course from each of the three groups listed in **Option A**.

With approval of the advisor, substitution can sometimes be made among similar courses. See the Department of Computer & Electrical Engineering and Computer Science [website](#) for updates.

#### Admission Requirements

Applications for admission to the master's program are approved by the University upon the recommendation of the department. All applicants must submit with their applications the official transcripts from previous institutions attended and have official GRE scores forwarded to the University. Applications for admission are evaluated on an individual basis. As a minimum, applicants are expected to meet the following requirements. Students with non-engineering bachelor's degrees, click [here](#) for additional requirements.

1. A baccalaureate degree in Engineering or a related field. (Students who do not have a computer engineering background will be expected to take additional courses; see link above);
2. At least a 3.0 (of a 4.0 maximum) GPA in the last 60 credits attempted prior to graduation;
3. A combined score (verbal + quantitative) of at least 295 on the Graduate Record Examination (GRE). GRE scores more than five years old are normally not acceptable. The GRE requirement is waived for any student who has a baccalaureate degree from FAU's Department of Computer & Electrical Engineering and Computer Science with a GPA of at least 3.25 (out of a possible 4.0) in the last 60 credits attempted prior to graduation;
4. International students from non-English-speaking countries must be proficient in written and spoken English as evidenced by a score of at least 500 (paper-based test) or 213 (computer-based test) or 79 (Internet-based test) on the Test of English as a Foreign Language (TOEFL) or a score of at least 6.0 on the International English Language Testing System (IELTS).

Applicants are expected to have taken the following prerequisite courses (or equivalents) before pursuing a master's degree. In some cases, prerequisite courses may be taken after admission to the graduate program. Equivalent FAU courses follow.

Introduction to Microprocessor Systems	CDA 3331C
Structured Computer Architecture	CDA 4102 <b>or</b>
CAD-Based Computer Design	CDA 4204
Electronics 1	EEE 3300 <b>or</b>
Introduction to VLSI	CDA 4210
Data Structures and Algorithm Analysis	COP 3530
Calculus with Analytic Geometry 1	MAC 2311
Calculus with Analytic Geometry 2	MAC 2312
Stochastic Models for Computer Science	STA 4821

#### Submission of Plan of Study

Students are required to submit a Plan of Study when they have completed between 9 and 15 credits of coursework

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with a minimum cumulative GPA of 3.0. All courses must be approved by the student's advisor. A student may not register for thesis credits prior to submitting a Plan of Study.

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### **Degree Requirements**

Students must satisfy all of the University graduate requirements. In addition, the following specific degree requirements apply, depending on the choice of degree programs.

#### **Master of Science with Major in Computer Engineering, Thesis Option (30 credits)**

1. Requires 6 credits of orally defended written thesis. The MS committee is chaired by the student's thesis advisor. The chair of the committee must be a graduate faculty member from the Department of Computer & Electrical Engineering and Computer Science.

2. Requires 24 credits of approved coursework with the following constraints:

- a. A minimum of 3 credits must be selected from each of the three groups listed in Option A.
- b. A minimum of 18 credits of 6000-level courses must be completed.
- c. No more than 3 credits of directed independent study may be taken
- d. No course can be counted toward the degree that is more than 10 years old at the time the degree is awarded.
- e. No 4000-level course is allowed toward the degree. Courses taken to make up for the deficiencies will not be counted toward the degree.

3. Must have a GPA of 3.0 (out of 4.0) or better.

4. All courses in the degree program must be completed with a grade of "C" or better.

5. Every thesis student must maintain a Research Portfolio containing research papers (book chapter, conference or journal contributions accepted or published, patents, directed independent study-based research papers, technical reports) done throughout the student's master's degree studies. The master's thesis is added to the Research Portfolio prior to graduation. The portfolio must be approved by a graduate advisor prior to graduation certification.

#### **Master of Science with Major in Computer Engineering, Non-Thesis Option (33 credits)**

1. Requires 33 credits of approved coursework with the following constraints:

- a. A minimum of 3 credits must be selected from each of the three groups listed in Option A.
- b. A minimum of 18 credits of 6000-level courses must be completed.
- c. No more than 6 credits of directed independent study may be taken.
- d. One 3-credit, research-oriented directed independent study course must be taken after completion of 18 credits of coursework. At the end of the directed independent study course, the student is expected to submit a paper or technical report to be placed in the student's Research Portfolio.
- e. No course can be counted toward the degree that is more than 10 years old at the time the degree is awarded.
- f. A maximum of one 4000-level course may be allowed toward the degree with prior approval of the student's advisor. This course must be passed with a minimum grade of "B." Courses taken to make up for the deficiencies will not be counted toward the degree.

2. Must have a GPA of 3.0 (out of 4.0) or better.

3. All courses in the degree program must be completed with a grade of "C" or better.

4. Every non-thesis student must maintain a Research Portfolio containing research papers (book chapter, conference or journal contributions accepted or published patents, directed independent study-based research papers, technical reports) done throughout the student's master's degree studies. Every non-thesis student is expected to have at least one research paper in the Research Portfolio prior to graduation. The portfolio must be approved by a graduate advisor prior to graduation certification.

#### **Transfer Credits**

Any transfer credits toward the requirements for a master's degree in Computer Engineering must be approved by the department, the College and the University. The transfer credits must correspond to equivalent requirements and performance levels expected for the degree. Normally, no more than 6 credits of coursework (that have not been applied to a degree) can be transferred from another institution.

#### **Option A**

<b>Group 1: Computer Architecture and Design</b>	
Advanced Computer Architecture	CDA 6155
Embedded System Design 1	CDA 6316
Multiprocessor Architecture	CDA 6132
Structured VLSI Design	CDA 6214

<b>Group 2: Software Development</b>	
Multimedia Programming	CAP 6018
Software Engineering	CEN 5035
Software Maintenance and Evolution	CEN 6027
Software Requirements Engineering	CEN 6075
Software Testing	CEN 6076
Software Architecture and Patterns	CEN 6085
Object-Oriented Software Design	COP 5339

<b>Group 3: Computer Systems</b>	
Computer Performance Modeling	CEN 6405
Computer Data Security	CIS 6370
Theory and Implementation of Database Systems	COP 6731
Mobile Computing	CNT 6517
Data Mining and Machine Learning	CAP 6673
Multimedia Systems	CAP 6010
Evaluation of Parallel and Distributed Systems	CDA 6122
Introduction to Neural Networks	CAP 5615
Wireless Networks	EEL 6591
Advanced Data Mining and Machine Learning	CAP 6778
Video Communication	CNT 6885
Foundations of Vision	CAP 6411



Advanced Computer Networking	CNT 6516
Vehicular Networks	CNT 6528

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### Master of Science with Major in Computer Science

The non-thesis option for this degree requires a minimum of 33 credits. The thesis option requires a minimum of 30 credits, including 6 credits of thesis. All master's degree students must take at least one course from each of the three groups listed in **Option B**.

With approval of the advisor, substitution can sometimes be made among similar courses. See the Department of Computer & Electrical and Computer Science [website](#) for updates.

#### Admission Requirements

Applicants for admission to the master's program are approved by the University upon the recommendation of the department. All applicants must submit with their applications the official transcripts from previous institutions attended and have official GRE scores forwarded to the University. Applications for admission are evaluated on an individual basis. As a minimum, applicants are expected to meet the following requirements. Students with non-engineering bachelor's degrees, click [here](#) for additional requirements.

1. A baccalaureate degree in Computer Science or a related field (Students without a computer science background will be expected to take additional courses);
2. At least a 3.0 (of a 4.0 minimum) GPA in the last 60 credits attempted prior to graduation;
3. A combined score (verbal + quantitative) of at least 295 on the Graduate Record Examination (GRE). GRE scores more than five years old are normally not acceptable. The GRE requirement is waived for any student who has a baccalaureate degree from FAU's Department of Computer & Electrical Engineering and Computer Science with a GPA of at least 3.25 (out of a possible 4.0) in the last 60 credits attempted prior to graduation; and
4. International students from non-English-speaking countries must be proficient in written and spoken English as evidenced by a score of at least 500 (paper-based test) or 213 (computer-based test) or 79 (Internet-based test) on the Test of English as a Foreign Language (TOEFL) or a score of at least 6.0 on the International English Language Testing System (IELTS).

Applicants are expected to have taken the following prerequisite courses (or equivalents) before pursuing a master's degree. In some cases, prerequisite courses may be taken after admission to the graduate program. Equivalent FAU courses follow.

Structured Computer Architecture	CDA 4102 <b>or</b>
Introduction to Microprocessor Systems	CDA 3331C <b>or</b>
CAD-Based Computer Design	CDA 4204
Data Structures and Algorithm Analysis	COP 3530
Computer Operating Systems	COP 4610
Design and Analysis of Algorithms	COT 4400
Calculus with Analytic Geometry 1	MAC 2311
Calculus with Analytic Geometry 2	MAC 2312
Stochastic Models for Computer Science	STA 4821

#### Submission of Plan of Study

Students are required to submit a Plan of Study when they have completed between 9 and 15 credits of coursework

with a minimum cumulative GPA of 3.0. All courses must be approved by the student's advisor. A student may not register for thesis credits prior to submitting a Plan of Study.

### **Degree Requirements**

Students must satisfy all of the University graduate requirements. In addition, the following specific degree requirements apply, depending on the choice of degree programs.

#### **Master of Science with Major in Computer Science, Thesis Option (30 credits)**

1. Requires 6 credits of orally defended written thesis. The MS committee is chaired by the student's thesis advisor. The chair of the committee must be a graduate faculty member from the Department of Computer & Electrical Engineering and Computer Science.

2. Requires 24 credits of approved coursework with the following constraints:

- a. A minimum of 3 credits must be selected from each of the three groups listed in Option B.
- b. A minimum of 18 credits of 6000-level courses must be completed.
- c. No more than 3 credits of directed independent study may be taken.
- d. No course can be counted toward the degree that is more than 10 years old at the time the degree is awarded.
- e. No 4000-level course is allowed toward the degree. Courses taken to make up for the deficiencies will not be counted toward the degree.

3. Must have a GPA of 3.0 (out of 4.0) or better.

4. All courses in the degree program must be completed with a grade of "C" or better.

5. Every thesis student must maintain a Research Portfolio containing research papers (book chapter, conference or journal contributions accepted or published, patents, directed independent study-based research papers, technical reports) done throughout the student's master's degree studies. The master's thesis is added to the Research Portfolio prior to graduation. The portfolio must be approved by a graduate advisor prior to graduation certification.

#### **Master of Science with Major in Computer Science, Non-Thesis Option (33 credits)**

1. Requires 33 credits of approved coursework with the following constraints:

- a. A minimum of 3 credits must be selected from each of the three groups listed in Option B.
- b. A minimum of 18 credits of 6000-level courses must be completed.
- c. No more than 6 credits of directed independent study may be taken.
- d. One 3-credit, research-oriented directed independent study course must be taken after completion of 18 credits of coursework. At the end of the directed independent study course, the student is expected to submit a paper or technical report to be placed in the student's Research Portfolio.
- e. No course can be counted toward the degree that is more than 10 years old at the time the degree is awarded.
- f. A maximum of one 4000-level course may be allowed toward the degree with prior approval of the student's advisor. This course must be passed with a minimum grade of "B." Courses taken to make up for the deficiencies will not be counted toward the degree.

2. Must have a GPA of 3.0 (out of 4.0) or better.



3. All courses in the degree program must be completed with a grade of "C" or better.

4. Every non-thesis student must maintain a Research Portfolio containing research papers (book chapter, conference or journal contributions accepted or published patents, directed independent study-based research papers, technical reports) done throughout the student's master's degree studies. Every non-thesis student is expected to have at least one research paper in the Research Portfolio prior to graduation. The portfolio must be approved by a graduate advisor prior to graduation certification.

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**Transfer Credits**

Any transfer credits toward the requirements for a master's degree in Computer Science must be approved by the department, the College and the University. The transfer credits must correspond to equivalent requirements and performance levels expected for the degree. Normally no more than 6 credits of coursework (that have not been applied to a degree) can be transferred from another institution.

**Option B**

<b>Group 1: Theory</b>	
Analysis of Algorithms	COT 6405
Queueing Theory	MAP 6264
Theory and Philosophy of Computation	COT 6200
Randomized Algorithms	COT 6446

<b>Group 2: Software Development</b>	
Multimedia Programming	CAP 6018
Software Engineering	CEN 5035
Software Maintenance and Evolution	CEN 6027
Software Requirements Engineering	CEN 6075
Software Testing	CEN 6076
Software Architecture and Patterns	CEN 6085
Object-Oriented Software Design	COP 5339

<b>Group 3: Computer Systems</b>	
Computer Performance Modeling	CEN 6405
Computer Data Security	CIS 6370
Theory and Implementation of Database Systems	COP 6731
Mobile Computing	CNT 6517
Data Mining and Machine Learning	CAP 6673
Multimedia Systems	CAP 6010
Evaluation of Parallel and Distributed Systems	CDA 6122
Introduction to Neural Networks	CAP 5615
Wireless Networks	EEL 6591

Advanced Data Mining and Machine Learning	CAP 6778
Video Communication	CNT 6885
Foundations of Vision	CAP 6411
Advanced Computer Networking	CNT 6516
Vehicular Networks	CNT 6528

## Electrical Engineering

### Master of Science with Major in Electrical Engineering

The department offers thesis and non-thesis options at the master's level. Students may specialize in several areas: telecommunications; digital signal processing; systems and robotics, including control systems and machine vision; electromagnetics and RF, antennas, microwave systems, EMC/EMI and HF RF circuit design; alternative energy systems, including photovoltaic and fuel cell systems; bioengineering; neural networks; and optics and photonics.

#### Admission Requirements

All applicants must submit GRE scores and official transcripts from all previous postsecondary institutions attended. Applicants for admission will be evaluated on an individual basis and must satisfy the following requirements. Students with non-engineering bachelor's degrees, click [here](#) for additional requirements.

1. International students from non-English-speaking countries must be proficient in written and spoken English as evidenced by a score of at least 500 (paper-based test) or 213 (computer-based test) or 79 (Internet-based test) on the Test of English as a Foreign Language (TOEFL) or a score of at least 6.0 on the International English Language Testing System (IELTS).
2. A baccalaureate degree in Engineering, Natural Science or Mathematics;\*
3. A minimum GPA of 3.0 (of a possible 4.0 maximum) in the last 60 credits of undergraduate work;
4. A combined score (verbal + quantitative) of at least 295 on the Graduate Record Examination (GRE). GRE scores more than five years old are normally not acceptable. The GRE requirement is waived for any student who has a baccalaureate degree from FAU's Department of Computer & Electrical Engineering and Computer Science with a GPA of at least 3.25 (of a possible 4.0) in the last 60 credits attempted prior to graduation.

\* Students whose backgrounds are not in electrical or computer engineering should expect to take additional coursework to satisfy deficiencies.

#### Admission to Candidacy

Graduate students are required to submit a Plan of Study when they have completed between 9 and 15 credits of coursework with a minimum cumulative GPA of 3.0. A student may not register for thesis credits prior to approval of a submitted Plan of Study.

#### Degree Requirements

Students must satisfy all of the University graduate requirements. In addition, the following specific degree requirements apply, depending on the choice of degree program:

#### Master of Science Degree Thesis Option (30 credits)

1. Requires 6 credits of orally defended written thesis. The MS committee is chaired by the student's thesis advisor. The chair of the committee must be a graduate faculty member from the Department of Computer & Electrical Engineering and Computer Science.

2. Requires 24 credits of approved coursework with the following constraints:



- a. Minimum of 15 credits at the 6000 level;
- b. Minimum of 12 credits in EE courses;
- c. No 4000-level course may be counted toward the degree;
- d. A 3-credit course with math prefix or one of the following courses: EEL 5613, Modern Control; EEE 5502, Digital Processing of Signals; EEL 6482, Electromagnetic Theory 1; EOC 5172, Mathematical Methods in Ocean Engineering 1;

3. Every master's student must maintain a Research Portfolio containing research papers (book chapter, conference or journal contributions accepted or published, patents, directed independent study-based research papers, technical reports) done throughout the student's M.S. degree studies. The M.S. thesis will be added to the Research Portfolio prior to graduation. The Portfolio must be approved by a graduate advisor prior to graduation certification.

**Note:** No more than 3 credits of directed independent study may be applied toward the master's degree.

**Master of Science Degree Non-Thesis Option (33 credits)**

1. Requires 33 credits of approved coursework with the following constraints:

- a. Minimum of 18 credits at the 6000 level;
- b. Maximum of 3 credits at the 4000 level;
- c. A 3-credit course with math prefix or one of the following courses: EEL 5613, Modern Control; EEE 5502, Digital Processing of Signals; EEL 6482, Electromagnetic Theory 1; EOC 5172, Mathematical Methods in Ocean Engineering 1;
- d. A minimum of 18 credits must be completed in EE;

2. One 3-credit research-oriented directed independent study course must be taken after completion of 18 credits of coursework. At the end of the directed independent study course, the student is expected to submit a paper or a technical report to be placed in the student's Research Portfolio;

3. Every non-thesis student must maintain a Research Portfolio containing research papers (book chapter, conference or journal contributions accepted or published, patents, directed independent study-based research papers, technical reports) done throughout the student's M.S. degree studies. Every non-thesis student is expected to have at least one research paper in the Research Portfolio prior to graduation. The Portfolio must be approved by a graduate advisor prior to graduation certification.

**Note:** No more than 6 credits of directed independent study may be applied toward the master's degree.

**Deficiency Requirements**

From the following list of deficiency EE courses, students must take the Electronics Laboratory 1 course and at least four more courses.

Introduction to Microprocessor Systems	CDA 3331C
Electromagnetic Fields and Waves	EEL 3470
Electronics 2	EEE 4361
Introduction to Digital Signal Processing	EEE 4510
Communications Systems	EEL 4512
Controls Systems 1	EEL 4652
Analysis of Linear Systems	EEL 4656
Electronics Laboratory 1	EEL 3118L

An insufficient number of the above courses will be considered a deficiency. Students are expected to take the necessary deficient courses during their course program as an extra load beyond the regular graduate coursework.

Students with engineering technology degrees are expected to first satisfy the FAU EE undergraduate graduation requirements before being admitted to the graduate program.

## Bioengineering

### Master of Science with Major in Bioengineering

#### Admission Requirements

All applicants must submit GRE scores and official transcripts from all previous postsecondary institutions attended. Applicants for admission will be evaluated on an individual basis and must satisfy the following requirements. Students with non-engineering bachelor's degrees, click [here](#) for additional requirements.

1. International students from non-English-speaking countries must be proficient in written and spoken English as evidenced by a score of at least 500 (paper-based test) or 213 (computer-based test) or 79 (Internet-based test) on the Test of English as a Foreign Language (TOEFL) or a score of at least 6.0 on the International English Language Testing System (IELTS);
2. A baccalaureate degree in Biology, Chemistry, Physics, Computer Science or Engineering with a mathematics background through Calculus 2 or calculus with basic differential equations; \*
3. A minimum GPA of 3.0 (of a possible 4.0 maximum) in Science, Mathematics and Engineering courses;
4. A combined score (verbal + quantitative) of at least 295 on the Graduate Record Examination (GRE) or an MCAT score of 500 or higher. GRE scores more than five years old normally are not acceptable. The GRE requirement is waived for any student who has a baccalaureate degree from FAU's Department of Computer & Electrical Engineering and Computer Science with a GPA of at least 3.25 (out of a possible 4.0) in the last 60 credits attempted prior to graduation.

\* Students whose backgrounds are not in the disciplines noted should expect to take additional coursework.

#### Submission of Plan of Study

Graduate students are required to submit a Plan of Study when they have completed between 9 and 15 credits of coursework with a minimum cumulative GPA of 3.0. A student may not register for thesis credits prior to submitting a Plan of Study.

#### Degree Requirements

Students must satisfy all of the University graduate requirements. In addition, the following specific degree requirements apply, depending on the choice of degree program:

#### Master of Science Degree Thesis Option (30 credits)

1. Requires 6 credits of orally defended thesis. The MS committee is chaired by the student's thesis advisor. The chair of the committee must be a graduate faculty member from any department within the College of Engineering & Computer Science.
2. Requires 24 credits of approved graduate coursework (5000 level or higher) of which 12 credits are program core courses and the remaining 12 credits are approved elective courses offered by the College of Engineering and Computer Science and the Charles E. Schmidt College of Science.
3. Every student must maintain a Research Portfolio containing research papers (book chapter, conference or journal contributions accepted or published, patents, directed independent study-based research papers, technical reports) done throughout the student's M.S. degree studies. The M.S. thesis will be added to the Research Portfolio prior to graduation. The Portfolio must be approved by a graduate advisor prior to graduation certification.

**Note:** No more than 3 credits of directed independent study may be applied toward the master's degree with thesis option.



**Master of Science Degree Non-Thesis Option (33 credits)**

1. Requires 3 credits of research project taken as directed independent study with one of the College of Engineering and Computer Science faculty. As a minimum the student must submit a technical report at the conclusion of the course. The technical report will be added to the Research Portfolio.

2. Requires 24 credits of approved coursework of which 12 credits are program core courses and the remaining 12 credits are approved elective courses offered by the College of Engineering and Computer Science and the Charles E. Schmidt College of Science.

**Note:** No more than 6 credits of directed independent study may be applied toward the master's degree non-thesis option.

3. Every non-thesis student must maintain a Research Portfolio containing research papers (book chapter, conference or journal contributions accepted or published, patents, directed independent study-based research papers, technical reports) done throughout the student's M.S. degree studies. Every non-thesis student is expected to have at least one research paper in the Research Portfolio prior to graduation. The Portfolio must be approved by a graduate advisor prior to graduation certification.

**Deficiency Requirements in the M.S. in Bioengineering Program**

It is expected that students successfully complete a course in Genetics or Molecular Genetics (PCB 4522 or PCB 3063 at FAU or equivalent) at any time during their MSBE studies. The lack of this course will be considered a deficiency. Students are expected to take the necessary course during their course program as an extra load beyond the regular graduate coursework. A genetics course must be completed prior to enrollment into the Special Topics (Advanced Biotechnology Lab) core course.

Students who have had no computer programming coursework during their B.S. studies are required to take any undergraduate programming course (such as COP 2220, Introduction to Programming in C, to satisfy this deficiency. The requirement must be satisfied prior to taking any of the following core courses: BME 5742, Biosystems Modeling and Control or BME 6762, Bioinformatics: Bioengineering Perspectives.

Furthermore, an advisor's approval is required for students not having the required mathematics background.

**Program Core Courses (12 credits)**

Introduction to Bioengineering	BME 5000
Biosystems Modeling and Control	BME 5742
Bioinformatics: Bioengineering Perspectives	BME 6762
Special Topics (Advanced Biotechnology Lab)	BSC 6936

Students who pursue a non-thesis option must take 3 credits of research-oriented directed independent study (BME 6905).

**Deficiency Requirements (not counted in the total program credits)**

Genetics	PCB 3063
Introduction to Programming in C	COP 2220

**Electives**

**Thesis Option:** 12 credits of elective courses as follows.

At least 9 credits from the Advising Sheet list of Engineering and Computer Science or Science Bioengineering courses (such as Tissue Engineering, Stem Cell Engineering, Biomaterials, Introduction to Microfluidics and BioMEMS, Introduction to Robotics, NanoBiotechnology, Robotic Applications and Orthopedic Biomechanics, Medical Imaging, Bio-Signal Processing and Bioinformatics).

Up to 3 elective credits of approved Engineering and Computer Science or Science coursework may be added (courses such as Digital Signal Processing, Digital Image Processing, Machine Learning and Artificial Intelligence, Modern Control, Advanced Database Systems, Nanotechnology, Neuroscience 1 and 2, or a directed independent study course).

No 4000-level courses are permitted for Thesis Option students.

**Non-Thesis Option:** 18 credits of elective courses as follows.

At least 9 credits from the Advising Sheet of Engineering and Computer Science or Science Bioengineering courses (such as Tissue Engineering, Stem Cell Engineering, Biomaterials, Introduction to Microfluidics and BioMEMSs, Introduction to Robotics, NanoBiotechnology, Robotic Applications and Orthopedic Biomechanics, Medical Imaging, Bio-Signal Processing and Bioinformatics).

Up to 9 elective credits of approved Engineering and Computer Science or Science coursework may be added (courses such as Digital Signal Processing, Digital Image Processing, Machine Learning and Artificial Intelligence, Modern Control, Advanced Database Systems, Nanotechnology, Neuroscience 1 and 2, Immunology, Biology of Cancer, or an additional directed independent study course). Non-thesis students may take no more than one 4000-level elective.

Up to 6 elective credits may be free elective courses (not included on the Bioengineering Advising Sheet) subject to approval of the Bioengineering Program Advisor.