FAU
FLORIDA ATLANTIC UNIVERSITY

NEW/CHANGE PROGRAM REQUEST
Graduate Programs

Department Computer and Electrical Eng. and Computer Science

College Engineering and Computer Science

UGPC Approval _____
UFS Approval _____
Banner Posted _____
Catalog _____

Program Name		Effective Date *(TERM & YEAR)*
MS CS, MS CE, MS EE, MS Bioengineering PhD CS, PhD CE, PhD EE	☐ New Program ☑ Change Program	Spring 2019

Please explain the requested change(s) and offer rationale below or on an attachment

For the MS non-thesis programs, we request the following changes:
- reduce the maximum number of credits of directed independent study from 6 to 3
- delete the requirement of one 3-credit, research-oriented directed independent study course
- delete the Research Portfolio requirement

For the MS thesis programs and the PhD programs, we request the following change:
- delete the Research Portfolio requirement

Faculty Contact/Email/Phone

Dr. Valentine Aalo / aalo@fau.edu / 561-297-3485

Consult and list departments that may be affected by the change(s) and attach documentation

NA

Approved by		Date
Department Chair	*Nurgun, Erdol*	9/20/18
College Curriculum Chair	*[signature]*	9-24-2018
College Dean	*M Cardin*	9/24/2018
UGPC Chair		
UGC Chair		
Graduate College Dean		
UFS President		
Provost		

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

GRADUATE COLLEGE

FAUprogramchangeGR, created December 2017

SEP 2 5 2018

Received

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 **or**
CAD-Based Computer Design	CDA 4204
Electronics 1	EEE 3300 **or**
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 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 Engineering, Thesis Option (30 credits)
1. Requires 6 credits of orally defended written thesis. The M.S. 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 and 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 3 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. No 4000-level course is allowed toward the degree. 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

Group 1: Computer Architecture and Design	
Advanced Computer Architecture	CDA 6155
Embedded System Design 1	CDA 6316
Multiprocessor Architecture	CDA 6132
Structured VLSI Design	CDA 6214
Embedded Networked Sensor Systems	CNT 6108

Group 2: Software Development	
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

Group 3: Computer Systems	
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

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 **or**
Introduction to Microprocessor Systems	CDA 3331C **or**
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 M.S. 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 and 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 3 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. No 4000-level course is allowed toward the degree. 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 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

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

Group 2: Software Development	
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

Group 3: Computer Systems	
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

Prerequisites
Same as for master's degree in Computer Science or master's degree in Computer Engineering.

Degree Requirements for Non-Thesis Option
Requires a minimum of 33 credits as follows:

1. Same requirements as specified in degree requirements for non-thesis option for master's degree with major in Computer Engineering or master's degree with major in Computer Science;

2. At least four elective courses (12 credits) selected from a group of Internet-based courses that include (a) Internet software, (b) Internet networking and (c) Internet technologies, as specified by academic advisor.

Degree Requirements for Thesis Option
Requires a minimum of 30 credits as follows:

1. Same requirements as specified in degree requirements for non-thesis option for master's degree with major in Computer Engineering or master's degree with major in Computer Science;

2. At least three elective courses (9 credits) selected from a group of Internet-based courses that include (a) Internet software, (b) Internet networking and (c) Internet technologies, as specified by academic advisor;

3. A minimum of 6 credits of thesis work.

Software Engineering Graduate Specialty
An Option in Computer Science

Prerequisites
Same as non-thesis programs plus:

Principles of Software Engineering (CEN 4010)
Introduction to Object-Oriented Design and Programming (COP 4331)

Students who have not had COP 4331 may take COP 5339 to satisfy this requirement.

Group 1 Fundamentals
Courses in this group emphasize general fundamentals of software engineering. Included in this group are courses in object-oriented methods, software testing and requirements engineering.

Group 2 Development
Courses in this group address specific issues and techniques more closely related to actual software development. Included in this group are courses in user-interface design, CASE, formal methods and advanced object-oriented topics.

Group 3 Quantitative and Experimental
Courses in this group deal with quantitative and experimental approaches. Included in this group are courses in the areas of reliability, metrics and modeling.

For specific course numbers that belong to the above three groups, consult an advisor in the department.

Thesis option students must take at least six of the above software engineering courses, two from each group.

Non-thesis-option students must take at least eight of the above software engineering courses, at least two from each group. Appropriate special topics courses may also be used to meet these requirements with approval of the student's advisor.

Other Electives
Thesis option students: Two other 5000-level or 6000-level Computer Science and Computer Engineering courses and 6 credits of COT 6970 (Thesis). No 4000-level course is counted toward the degree.

Non-thesis-option students: Three other 5000-level or 6000-level Computer Science and Computer Engineering courses. ~~Also, one 4000-level course may count toward the degree with approval of the student's advisor.~~

All students must complete at least one-half of their credits at the 6000 level.

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Master of Science with Major in Computer Science with Focus in Internet and Web Technologies

This program is designed specifically for working professionals. Students attend formal classes for two Saturdays per month for 11 months. The remaining instruction is delivered through the latest distance-learning technologies, including FAU's Blackboard system.

The program requires the 11 FAU courses below, totaling 33 credits categorized as software, networking and applications. Special review modules can be arranged for students who lack the required prerequisites. Admission requirements and prerequisites are the same as for the master's degree with major in Computer Science.

Multimedia Systems	CAP 6010
Data Mining and Machine Learning	CAP 6673
Computer Networks	CNT 5008
Mobile Computing	CNT 6517
Computer Data Security	CIS 6370
Theory and Implementation of Database Systems	COP 6731
Wireless Networks	EEL 6591
Social Networks and Big Data Analytics	CAP 6315
Queueing Theory	MAP 6264
Topics in Computer Science (Topics include Web Services, Web Project Development, Network Programming)	COT 5930
Topics in Computer Science (Topics include Advanced Internet Engineering, Ad Hoc Networks, Video Communications)	COT 6930

For fees and other details, contact the department at 561-297-3855 or visit the Computer & Electrical Engineering and Computer Science website.

DOCTORAL PROGRAMS

Doctor of Philosophy with Major in Computer Engineering or in Computer Science

The department offers a program of advanced graduate study leading to the Doctor of Philosophy degrees in Computer Engineering and in Computer Science. The graduate of this program will be able to meet the highest standards of preparation for leadership in the computer science or engineering profession, including research, teaching and leadership in high-technology industry and governmental agencies. A Ph.D. Applicant's Guide is available from the department.

Admission Requirements
Application for admission to doctoral study will be evaluated on an individual basis by the department's graduate

programs committee. Usually, the following four criteria must be met:

1. The applicant should have a combined score (verbal + quantitative) of at least 300 on the Graduate Record Examination (GRE) and a GPA of at least 3.3 (out of 4.0 maximum) in previous graduate work. GRE scores more than five years old are normally not acceptable. The GRE requirement is waived for any student who has an M.S. degree without thesis from FAU's Department of Computer & Electrical Engineering and Computer Science with a GPA of at least 3.8 and for any student who has an M.S. degree with thesis from FAU's Department of Computer & Electrical Engineering and Computer Science with a GPA of at least 3.7.

2. The applicant must have a master's degree in Engineering, Computer Science or a related discipline awarded by a recognized institution. Thesis option is preferred. This requirement may be waived under exceptional circumstances (see B.S. to Ph.D. programs earlier in the College of Engineering and Computer Science section of the catalog).

3. The applicant must provide three reference letters (at least two from academia) that address the student's research potential, motivation, relative academic achievement and personality. Forms are supplied with applications for admission.

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 the Ph.D. degree. In some cases, prerequisite requirements may be satisfied after admission to the Ph.D. program. In such a case, proficiency in the prerequisite courses must be shown before the student takes dissertation credits.

Prerequisite courses for Ph.D. with Major in Computer Science:

Introduction to Microprocessor Systems	CDA 3331C	3 or
Structured Computer Architecture	CDA 4102	3 or
CAD-Based Computer Design	CDA 4204	3
Data Structures and Algorithm Analysis	COP 3530	3
Computer Operating Systems	COP 4610	3
Design and Analysis of Algorithms	COT 4400	3
Calculus with Analytic Geometry 1	MAC 2311	4
Calculus with Analytic Geometry 2	MAC 2312	4
Stochastic Models for Computer Science	STA 4821	3

Prerequisite courses for Ph.D. with Major in Computer Engineering:

Introduction to Microprocessor Systems	CDA 3331C	3
Structured Computer Architecture	CDA 4102	3 or
CAD-Based Computer Design	CDA 4204	3
Electronics 1	EEE 3300	3 or
Introduction to VLSI	CDA 4210	3
Data Structures and Algorithm Analysis	COP 3530	3
Calculus with Analytic Geometry 1	MAC 2311	4
Calculus with Analytic Geometry 2	MAC 2312	4
Stochastic Models for Computer Science	STA 4821	3

Qualifying Examination
Note: The qualifying exams for the Ph.D. in Computer Science and Computer Engineering are the same except for the course selections (see the application form).

The qualifying exam is a written exam intended to assess whether or not a student is ready to conduct research at the doctoral level and is able to publish in international conferences and journals. The exam must be passed for formal admission into the doctoral program. Students seeking the Ph.D. degree are expected to take the exam during the second semester of their doctoral studies, excluding the summer semester.

The exam addresses the student's knowledge of graduate and undergraduate course material and basic mathematical concepts and engineering methods required for research and professional practice at the doctoral level. The exam consists of six problems (one from each course) related to material covered in recent FAU graduate and undergraduate CS/CE courses. The exam is administered two times a year in the fall and spring semesters. Two 3-hour sessions, morning and afternoon, cover tree courses each. The student can bring three 2-sided pages of notes and a simple calculator to each session, but no books, computers or phones. An overall minimum score of 70 percent or better is required to pass. A student failing the written exam may, upon re-application, take it a second time. Normally two failures will result in the student's dismissal from the Ph.D. program.

Application for Qualifying Exam
Students need to fill out and submit an application for the qualifying exam. In filling out the form, the student should list six courses, at most four of which may be at the graduate level and at least two of which must be at the undergraduate level and selected from one of the lists below. Students can select at most one graduate course outside the CEECS department with the approval of the advisor. All other courses must have been offered by the CEECS department during the preceding three years, but the student may have taken them anywhere or prepared for them on their own. The student will also list a primary area of research and at least one secondary area.

The application must be approved by the student's advisor and then submitted to the graduate committee. Upon approving the application, the graduate committee will arrange for the exam preparation.

Undergraduate courses for Computer Engineering students:

Introduction to Logic Design	CDA 3201C
Introduction to Microprocessor Systems	CDA 3331C
Structured Computer Architecture	CDA 4102
Data Structures and Algorithm Analysis	COP 3530
Computer Operating Systems	COP 4610
Stochastic Models for Computer Science	STA 4821

Undergraduate courses for Computer Science students:

Introduction to Logic Design	CDA 3201C **or**
Structured Computer Architecture	CDA 4102
Data Structures and Algorithm Analysis	COP 3530
Computer Operating Systems	COP 4610
Design and Analysis of Algorithms	COT 4400
Formal Languages and Automata Theory	COT 4420
Stochastic Models for Computer Science	STA 4821

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Admission to Candidacy
Students should apply for candidacy as soon as they become eligible. To be eligible, a student must:

1. Have passed the Qualifying Exam, and

2. Have maintained a minimum of 3.0 GPA in all courses attempted as a doctoral student.

Students may not register for dissertation credits until their admission to candidacy.

Degree Requirements

A minimum of 84 graduate credits (including a minimum of 33 dissertation credits) is required beyond a bachelor's degree. No 4000-level courses may be counted in the Ph.D. degree. A master's degree in a related field is considered equivalent to 30 credits. A minimum of 21 credits of coursework is required beyond a master's degree. All courses must be approved by the student's advisor. Students lacking proper background may have to take additional courses to make up for the deficiencies. In addition to meeting the course requirement, a doctoral student must pass the Qualifying Examination, complete the dissertation under the supervision of the student's advisor and dissertation committee and pass the oral dissertation examination. Also a written dissertation proposal must be accepted by the dissertation committee at least six months prior to the oral dissertation examination. A doctoral candidate is expected to have at least one research paper published or accepted for publication in a fully refereed conference or journal prior to graduation. ~~Every doctoral student must maintain a Research Portfolio containing research papers (book chapter, conference or journal contributions accepted or published, patents, non-refereed publications) done throughout the student's Ph.D. degree studies. The dissertation will be added to the Research Portfolio prior to graduation. The Portfolio must be approved by a graduate advisor prior to graduation certification.~~ The following rules apply to the courses taken (beyond the master's degree):

1. Of the 21-credit minimum of coursework, a minimum of 15 credits must be in Computer Science and Engineering courses and a minimum of 15 credits of 6000-level courses must be completed.

2. No more than 3 credits of directed independent study may be used to satisfy the minimum of 21 credits. In that case, the subject matter may not overlap the student's dissertation.

3. A course that is more than 10 years old at the time the degree is awarded cannot be counted toward the degree. This rule does not apply to the courses transferred from the master's degree.

4. No 4000-level course may be counted toward the degree. Courses taken to make up for deficiencies will not be counted toward the degree.

5. Students must register for a minimum of 33 credits of dissertation.

6. Students must have a GPA of 3.0 (out of 4.0 maximum) or better.

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

Transfer Credits

Any transfer credits (from other institutions) toward the requirements for the Ph.D. degree 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. A maximum of 30 credits can be transferred from a master's degree. In addition to the credits for a master's degree, no more than 6 credits of coursework can be transferred from another institution.

Residency Requirements

After passing the Qualifying Examination, a doctoral student must spend two consecutive semesters at FAU, i.e., must register for a minimum of 9 credits for each of those semesters, and at least one of those semesters must occur while the student holds candidacy status.

Time Limitation

A Ph.D. student who enters the program with a master's degree has no more than 10 years to complete all requirements for the Ph.D. degree.

Dissertation Committee

Students are encouraged to interact with faculty members of the department to select a dissertation advisor and research area/topic for their dissertation. After a student has passed both parts of the Qualifying Examination, a dissertation committee shall be formed to supervise the student's research work. The committee will consist of at

least four faculty members who are familiar with the research area, at least three of whom are regular faculty members of the department. At least one member of the committee must be from outside the department (could also be from another institution or industry), and this member should have an academic or professional level compatible with the rest of the committee. The committee is chaired by the student's dissertation advisor. The chair of the committee must be a faculty member from the CEECS department. Students are expected to work in close cooperation with their dissertation committee and to keep the committee members informed about their progress on a regular basis. The dissertation committee should meet with the student at least once a semester to review the progress of the research work.

Dissertation and Oral Defense
The dissertation must be written in the format specified by the Graduate College. A copy of the dissertation must be submitted to the Graduate College for approval of the dissertation format. Dissertations must be defended orally. A dissertation should be submitted to the members of the dissertation committee for their review at least two weeks before the oral defense. After an oral defense, the members of the dissertation committee vote on acceptance or rejection of the dissertation. The committee may also suggest that the student do some additional work so as to make the dissertation acceptable. The decision of the dissertation committee will be reported in the form of a satisfactory/unsatisfactory grade for dissertation credits.

Electrical Engineering

MASTER'S PROGRAM

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 M.S. 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 and 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. No 4000-level course is allowed toward the degree. Courses taken to make up for the deficiencies will not be counted toward the degree;

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 3 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.

DOCTORAL PROGRAM

Doctor of Philosophy with Major in Electrical Engineering

Admission Requirements
Applicants for admission to doctoral study will be evaluated on an individual basis by the departmental graduate admissions committee. As a rule, the applicant must have:

1. At least a 3.3 (of a possible 4.0 maximum) grade point average in the last 60 credits attempted in the relevant field;

2. A combined score (verbal + quantitative) of at least 300 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 an M.S. degree without thesis from FAU's Department of Computer & Electrical Engineering and Computer Science with a GPA of at least 3.8 and for any student who has an M.S. degree with thesis from FAU's Department of Computer & Electrical Engineering and Computer Science with a GPA of at least 3.7;

3. A master's degree in Engineering or a related discipline awarded by a recognized institution (thesis options are preferred);

4. Two reference forms that document the applicant's research potential, motivation, relative academic achievement and personality;

5. 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 the Ph.D. degree. In some cases, prerequisite requirements may be satisfied after admission to the Ph.D. program. In such a case, proficiency in the prerequisite courses must be shown before the student takes dissertation credits.

Students must take EEL 3118L, Electronics Laboratory 1, and at least four more courses from the table.

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

Qualifying Exam

The qualifying exam is a written exam intended to assess whether or not a student is ready to conduct research at the doctoral level and is able to publish in international conferences and journals. The exam must be passed for formal admission into the doctoral program. Students seeking the Ph.D. degree are expected to take the exam during the second semester of their doctoral studies, excluding the summer semester.

The exam addresses the student's knowledge of graduate and undergraduate course material and basic mathematical concepts and engineering methods required for research and professional practice at the doctoral level. The exam consists of six problems (one from each course) related to material covered in recent FAU graduate and undergraduate courses. The exam is administered twice a year in the fall and spring semesters. Two, three-hour sessions, morning and afternoon, cover three courses each. The student can bring three, two-sided pages of notes and a simple calculator to each session, but no books, computers or phones. An overall minimum score of 70 percent or better is required to pass. A student failing the written exam may, upon re-application, take it a second time. Normally two failures result in dismissal from the Ph.D. program.

Application for Qualifying Exam

Students fill out and submit an application for the qualifying exam. In filling out the form the student should list six courses, at most four of which may be at the graduate level and at least two of which must be at the undergraduate level, selected from the list below. Students can select at most one graduate course outside the CEECS department with the approval of the advisor. All other courses must have been offered by the CEECS department during the preceding three years, but the student may have taken them anywhere or prepared for them on their own. The student also lists a primary area of research and at least one secondary area.

The application must be approved by the student's advisor and then submitted to the graduate committee. Upon approval, the graduate committee arranges for exam preparation.

Undergraduate courses for Electrical Engineering students

Electromagnetic Fields and Waves	EEL 3470
Electronics 2	EEE 4361
Introduction to Digital Signal Processing	EEE 4510
Stochastic Processes and Random Signals	EEE 4541 **or**
Stochastic Models for Computer Science	STA 4821
Communications Systems	EEL 4512
Controls Systems 1	EEL 4652
Analysis of Linear Systems	EEL 4656

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Admission to Candidacy

To be considered for the doctoral candidacy:

1. The student must pass the Qualifying Examination (QE) administered semiannually by the department. The examination is based on electrical engineering coursework as outlined in the brochure: CEECS/EE Program Ph.D. Qualifying Examination. This QE must be taken by all students after completion of 9 credits of Ph.D. coursework. A student who fails the examination may be allowed a second attempt subject to departmental approval.

2. Following successful completion of the QE, the student must find a qualified faculty member in the department willing to chair the doctoral (dissertation) committee. The dissertation committee chair will then consult with the student to form the complete committee. Working with this dissertation committee chair, the student must complete the official Admission to Candidacy application along with the approved Plan of Study.

Candidacy approval will be based on:

1. The academic record of the student;

2. An approved (tentative) dissertation topic.

A student may not register for dissertation credit until the application for candidacy has been approved.

Degree Requirements
1. A minimum total of 84 credits, including 33 dissertation credits, is required beyond the bachelor's degree level. These must include at least 21 credits of coursework beyond the master's degree. At least 12 of these credits should be taken in the Electrical Engineering program at FAU.

2. No 4000-level course may be counted toward the degree.

3. At least 21 credits above the master's program requirement should be at the 5000 and 6000 levels.

4. Specific Focus Area coursework will be required. At least 12 of these credits should be taken in the Electrical Engineering program at FAU.

5. At least 6 credits in courses with math prefix are required as part of coursework beyond the bachelor's degree. These may include EEL 5613, Modern Control; EEE 5502, Digital Processing of Signals; EEL 6482, Electromagnetic Theory 1; EOC 5172, Mathematical Methods in Ocean Engineering 1.

6. A written dissertation proposal must be accepted by the dissertation committee, at least six months prior to defending the dissertation.

7. When the candidate submits the Application for Graduation, he/she must indicate the following as a check list: (a) Date of QE taken and candidacy filed; (b) Date of dissertation proposal presented and approved by the Ph.D. Committee and (c) Status of the Plan of Study.

8. Draft copy of the dissertation must be submitted for review by the Ph.D. Committee at least 15 days prior to the date of defending the dissertation. And the dissertation must be completed and orally defended.

It is expected that all doctoral candidates have at least one research paper published or accepted for publication in a fully refereed conference or journal prior to graduation. A patent relevant to the Ph.D. research topic/dissertation as approved by the U.S. Patent Office with an assigned number can substitute for the journal or conference publication requirement. ~~Every doctoral student must maintain a Research Portfolio containing research papers (book chapter, conference or journal contributions accepted or published, patents, non-refereed publications) done throughout the student's Ph.D. degree studies. The dissertation will be added to the Research Portfolio prior to graduation. The Portfolio must be approved by a graduate advisor prior to graduation certification.~~

Transfer Credits
Any transfer credit toward requirements for the Ph.D. program must be approved by the department and the University. A maximum of 30 credits (which may include credits taken toward the master's degree with no more than 6 credits for the M.S. thesis) can be transferred into the student's program of study.

Residency Requirements
A student must spend at least two consecutive semesters as a full-time student at Florida Atlantic University registered for a minimum of 9 credits each semester.

Time Limitation
A Ph.D. student who enters the program with a master's degree has no more than 10 years to complete all requirements for the Ph.D. degree.

Dissertation Committee
Students are encouraged to interact with faculty members of the department to select a dissertation advisor and research area/topic for their dissertation. After a student has passed both parts of the qualifying exam, a dissertation committee shall be formed to supervise the student's research work. The committee should consist of at least four

faculty members who are familiar with the research area, three of whom are regular faculty members of the department. At least one member of the committee must be from outside the department (could be from another institution or industry), and this member should have an academic or professional level compatible with the rest of the committee. The committee is chaired by the student's dissertation advisor. The chair of the committee must be a faculty member from the CEECS department. Students are expected to work in close cooperation with their dissertation committee and keep the committee members informed about their progress on a regular basis. The dissertation committee should meet with the student at least once a semester to review the progress of the research work.

Dissertation and Oral Defense

The dissertation must be written in the format specified by the Graduate College. A copy of the dissertation must be submitted to the Graduate College for approval of the dissertation format. Dissertations must be defended orally. A dissertation should be submitted to the members of the dissertation committee for their review at least two weeks before the oral defense. After an oral defense, the members of the committee vote on acceptance or rejection of the dissertation. The committee may also suggest that the student do additional work to make the dissertation acceptable. The decision of the dissertation committee is reported in the form of a satisfactory/unsatisfactory grade for dissertation credits.

Bioengineering

Bioengineering stands at the intersection of the revolution taking place in advanced medical treatments as a result of applying the principles and practice of the engineering and computer science disciplines to the biological, biomedical and medical sciences. Bioengineering is a broad and emerging field that impacts drug delivery, surgery, diagnosis, prevention and treatment. Students successfully completing the Master of Science in Bioengineering degree program will be prepared for professional careers in businesses related to medical diagnostics, prosthetic devices and neural and other implants; the pharmaceutical and biotechnology industries; and consulting in health-related fields, as well as other positions in industry, commerce, education and government. Students will also be prepared to continue their formal education at the Ph.D. level in a variety of science and engineering disciplines and at the M.D. level in certain cases.

**Combined Bachelor of Science in any major in the College/
Master of Science with Major in Bioengineering**
Bachelor of Science candidates in any College of Engineering and Computer Science program with a cumulative GPA of at least 3.25 at the end of their junior year are eligible to apply to the combined program, which allows students to complete their bachelor's, as well as a master's in Bioengineering, within approximately five years. After application and admittance to the graduate program at the beginning of their senior year, up to 9 credits of approved graduate-level courses (5000 level or higher) may be taken and counted toward both the B.S. and M.S. degrees as long as the combined program totals a minimum of 150 credits:

1. The student has met the minimum 120 credits for the bachelor's degree; and

2. The student has taken a minimum of 30 credits in 5000 level or higher courses for the master's program.

Students must retain a cumulative GPA of 3.25 by the time of graduation. Thesis and Non-Thesis options are available. See below for master's program admission and degree requirements.

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 M.S. 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 and 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. No 4000-level course is allowed toward the degree. Courses taken to make up for deficiencies will not be counted toward the degree.

4. 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.

3. No 4000-level course is allowed toward the degree. Courses taken to make up for deficiencies will not be counted toward the degree.

Note: No more than 6 3 credits of directed independent study may be applied toward the master's degree non-thesis option.

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).

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 BioMEMS,

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).

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.