FLORIDA ATLANTIC UNIVERSITY™

Graduate Programs—PROGRAM CHANGE REQUEST

UGPC APPROVAL _____

UFS APPROVAL _____

CATALOG _____

DEPARTMENT: COMPUTER/ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

COLLEGE: ENGINEERING AND COMPUTER SCIENCE

PROGRAM NAME:

PHD IN COMPUTER SCIENCE, COMPUTER ENGINEERING, AND ELECTRICAL ENGINEERING

EFFECTIVE DATE
(PROVIDE TERM/YEAR)

_____ FALL 2017 _____

PLEASE EXPLAIN THE REQUESTED CHANGE(S) AND OFFER RATIONALE BELOW AND/OR ATTACHED:

THIS PROPOSAL UPDATES THE CATALOG:
- ADD ALL OPTIONS FOR TOEFL/IELTS REQUIREMENTS: PBT 500, CBT 213, IBT 79 FOR TOEFL AND IELTS 6.0
- LIST PREREQUISITE COURSES FOR PHD PROGRAMS
- QUALIFYING EXAM : AT MOST ONE GRADUATE COURSE CAN BE SELECTED FROM ANOTHER DEPARTMENT
- THE CHAIR OF THE PHD COMMITTEE MUST BE A FACULTY MEMBER OF THE DEPARTMENT
- PHD IN EE: ADD SPECIFICATIONS FOR THE QUALIFYING EXAM AND DISSERTATION, TO BE CONSISTENT WITH PHD IN CS AND PHD IN CE

Faculty contact, email and complete phone number:

Frederick Bloetscher, Ph.D., P.E.

239-250-2423

Consult and list departments that might be affected by the change and attach comments.

NA

Approved by:

Department Chair: _Nurgun Erdol_

College Curriculum Chair: _____

College Dean: _____

UGPC Chair: _____

Graduate College Dean: _____

UFS President: _____

Provost: _____

Date:

_10/19/2016_

_11-17-16_

_11/17/2016_

Email this form and syllabus to *UGPC@fau.edu* **one week before** the University Graduate Programs Committee meeting so that materials may be viewed on the UGPC website prior to the meeting.

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; and

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 CEECS with GPA at least 3.25 (of a 4.0 maximum) in the last 60 credits attempted prior to graduation; and

4. A score of 213 or higher in the Test of English as a Foreign Language (TOEFL). 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.

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Degree Requirements
The degree without thesis option requires a minimum of 33 credits of coursework in relevant technical areas. The following rules apply to the selection of courses:

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.

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. 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.

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

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

5. 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, graduate course-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.

Master of Science Degree 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 a 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 maximum) 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, graduate course-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.

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

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
Component Programming with .NET	COP 5595

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

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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 CEECS with GPA at least 3.25 (of a 4.0 maximum) in the last 60 credits attempted prior to graduation; and

4. A score of 213 or higher in the Test of English as a Foreign Language (TOEFL). 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
The **degree without thesis option** requires a minimum of 33 credits of coursework in relevant technical areas. The following rules apply to the selection of courses.

1. A minimum of 3 credits must be selected from each of the three groups listed in **Option B.**

2. A minimum of 18 credits of 6000-level courses must be completed.

3. No more than 3 credits of directed independent study may be taken.

4. No course can be counted toward the degree that is more than 10 years old at the time the degree is awarded.

5. 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.

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

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

The **degree with thesis option,** in addition to the above rules, requires a minimum of 24 credits of coursework and a minimum of 6 credits of thesis work.

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.

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. 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.

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

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

5. 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, graduate course-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.

Master of Science Degree 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 a 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 max.) 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, graduate course-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.

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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

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

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
Component Programming with .NET	COP 5595

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

Internet Engineering Graduate Specialty
An Option in Computer Science or Computer Engineering

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).
Non-thesis-option students: Three other 5000-level or 6000-level Computer Science and Computer Engineering courses.

All students must complete at least one-half of their credits at the 6000 level. Also, one 4000-level course may be allowed toward the degree with approval of the student's advisor.

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
Internet Application Programming	ISM 4052
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.

Master of Science with Major in Computer Science or Computer Engineering with a Business Minor

Those students electing to receive a minor in Business must complete 36 credits, of which 21 are to be from the Computer Science and Engineering courses described in this section of the catalog and 15 are to be from the courses approved by the College of Business for the Business minor. Such students will have to satisfy the prerequisite and core requirements of the appropriate degree program of the department. In addition, students should also satisfy the University requirements for graduate programs. For more information, students should consult their faculty advisor.

Master of Science with Major in Information Technology and Management

The Master of Science with Major in Information Technology and Management (MSITM) is jointly offered by the Department of Computer & Electrical Engineering and Computer Science (CEECS) in the College of Engineering and Computer Science and the Department of Information Technology and Operations Management (ITOM) in the College of Business. Designed for highly motivated individuals with computing and/or managerial backgrounds, the program aims to prepare students for a management career in the area of information technology in organizations. To allow for maximum flexibility in career aspirations, students can select from two options: Advanced Information Technology, emphasizing the technical aspect of organizational IT systems; and Information Technology Management, focusing on the management issues of IT in organizations.

Admission Requirements

To be admitted to the MSITM program applicants must have:

1. An undergraduate degree in Computer Science, Information Engineering Technology or an IT-related field of study. Applicants with another undergraduate degree and documented work experience of two or more years in an IT function will be evaluated as well;

2. An undergraduate GPA of 3.0 or higher;

3. A combined score (verbal + quantitative) of at least 295 on the Graduate Record Examination (GRE) or a GMAT score of 500 or higher. GRE scores more than five years old are normally not acceptable;

4. ~~A satisfactory score on the Test of English as a Foreign Language (TOEFL) or the International Language Testing System (IELTS) for international students;~~ 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).

5. Met other requirements of the FAU Graduate College.

Curriculum Requirements

Students are required to complete 33 graduate-level credits, or 11 three-credit courses, with a 3.0 GPA or better to graduate. Students in Advanced Information Technology will be awarded the degree by the College of Engineering and Computer Science, while those in Information Technology Management will have their degrees awarded by the College of Business. For more information about the Master of Science in Information Technology and Management degree program, call the Department of Computer & Electrical Engineering and Computer Science at 561-297-3482, or email ceecs@fau.edu.

Advanced Information Technology

Students are required to take the following four courses:

Software Engineering	CEN 5035
Object-Oriented Software Design	COP 5339
Data Mining and Machine Learning	CAP 6673
Management of Information Systems and Technology	ISM 6026

In addition, students need to take five electives from the following CEECS courses:

Data Mining and Machine Learning	CAP 6673
Software Maintenance and Evolution	CEN 6027
Software Testing	CEN 6076
Computer Data Security	CIS 6370
Mobile Computing	CNT 6517
Component Programming with .NET	COP 5595
Topics in Computer Science	COT 5930
Topics in Computer Science	COT 6930
Computer Performance Modeling	CEN 6405
Video Communication	CNT 6885
Software Architecture and Patterns	CEN 6085
Wireless Networks	EEL 6591

Information Retrieval	CAP6776
Cloud Computing	CEN 5086
Cyber Security: Measurement and Data Analysis	CTS 6319
Theory and Implementation of Database Systems	COP 6731

The last two electives can be chosen from the following ITOM courses:

Information Technology Project and Change Management	ISM 6316
Information Security Management	ISM 6328
Enterprise Information Technology Service Management	ISM 6368
Web-Based Business Development	ISM 6508
Information Technology Sourcing Management	ISM 6509

Information Technology Management
Students are required to take the following eight courses offered by the College of Business:

Management of Information Systems and Technology	ISM 6026
Information Technology Project and Change Management	ISM 6316
Advanced Business Analytics	ISM 6405
Information Security Management	ISM 6328
Enterprise Information Technology Service Management	ISM 6368
Electronic Commerce and Internet Business Applications	ISM 6508
Information Technology Sourcing Management	ISM 6509
Graduate Business Communication Applications	GEB 6215

In addition, students need to take three electives from the following courses offered by the College of Engineering and Computer Science:

Data Mining and Machine Learning	CAP 6673
Software Maintenance and Evolution	CEN 6076
Software Testing	CEN 6076
Computer Data Security	CIS 6370
Computer Network Programming	CNT 5715

Mobile Computing	CNT 6517
Object-Oriented Software Design	COP 5339
Component Programming with .NET	COP 5595
Theory and Implementation of Database Systems	COP 6731
Topics in Computer Science	COT 5930
Wireless Networks	EEL 6591
Information Retrieval	CAP 6776
Cloud Computing	CEN 5086
Cyber Security: Measurement and Data Analysis	CTS 6319

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Big Data Analytics Graduate Certificate

The digital age is here to stay. Organizations now own and have access to unfathomable amounts of data. New technologies and efforts are needed to move on to the next phase of the digital revolution - the data revolution. To provide students with the knowledge necessary in this age of Big Data, the Department of Computer and Electrical Engineering and Computer Science (CEECS) and the Department of Information Technology and Operations Management (ITOM) have jointly designed the Big Data Analytics graduate certificate. This 12-credit certificate allows graduate students to expand their knowledge and skills in the concepts, technologies, and tools of business intelligence, data analytics and business analytics and be recognized for their achievement. The certificate program has two tracks: Computer Science (CS) and Business (BU).

Tracks

CS Track: The Big Data Analytics certificate with a track in Computer Science will be granted to a student who completes three 3-credit courses from the CS Data Analytics course list and one 3-credit course from the ITOM Business Analytics course list.

BU Track: The Big Data Analytics certificate with a track in Business will be granted to a student who completes three 3-credit courses from the ITOM Business Analytics course list and one 3-credit course from the CS Data Analytics course list.

Admission

CS Track: Open to students who have a B.S. degree in Computer Science or in a related field of science or engineering and a GPA of at least 3.0. Students must satisfy the prerequisites for each course in the program. All four courses must be completed with a GPA of 3.0 or better. All course materials are in English; all international students must demonstrate proficiency in English to enter the program.

BU Track: Open to students who have a bachelor's degree in Business or in a related field and a GPA of at least 3.0. Students must satisfy the prerequisites for each course in the program. All four courses must be completed with a GPA of 3.0 or better. All course materials are in English; all international students must demonstrate proficiency in English to enter the program.

Big Data Analytics Courses by Track

CS Data Analytics Courses (Select three from this list and one from the list of ITOM courses.)		
Introduction to Neural Networks	CAP 5615	3
Social Networks and Big Data Analytics	CAP 6315	3
Data Mining for Bioinformatics	CAP 6546	3

Data Mining and Machine Learning	CAP 6673	3
Information Retrieval	CAP 6776	3
Web Mining	CAP 6777	3
Advanced Data Mining and Machine Learning	CAP 6778	3
Big Data Analytics with Hadoop	CAP 6780	3
Computer Performance Modeling	CEN 6405	3
ITOM Business Analytics Courses *(Select three from this list and one from the list of CS courses.)*		
Data Mining and Data Warehousing	ISM 6136	3
Database Management Systems	ISM 6217	3
Introduction to Business Intelligence	ISM 6404	3
Advanced Business Analytics	ISM 6405	3
Social Media and Web Analytics	ISM 6555	3
Data Analysis for Managers	QMB 6603	3

Cyber Security Graduate Certificate

Cybercrime-related issues especially impact the State of Florida because a significant part of the state's economic development comes from tourism, international banking and high-tech industries. The number of scientists, engineers and experts needed with special skills in cyber security exceeds the number available. The Cyber Security certificate provides opportunities for graduate students to expand their knowledge and skills to meet the needs of the cyber security field. Due to their extensive expertise and facilities, the departments of Computer and Electrical Engineering and Computer Science and Mathematical Sciences have jointly designed the Cyber Security certificate. This 12-credit certificate program has two tracks: Computer Science (CS) and Mathematics (Math).

Tracks

CS Track: The Cyber Security certificate with a track in Computer Science will be granted to a student who completes four 3-credit courses as follows: three 3-credit courses from the CS Cyber Security course list and one 3-credit course from either the CS or the Math Cyber Security course list.

Math Track: The Cyber Security certificate with a track in Mathematics will be granted to a student who completes four 3-credit courses as follows: three 3-credit courses from the Math Cyber Security course list and one 3-credit course from either the Math or the CS Cyber Security course list.

Admission

CS Track: Open to students who have a B.S. degree in Computer Science or in a related field of Science or Engineering and a GPA of at least 3.0. Students must satisfy the prerequisites for each course in the program. All four courses must be completed with a GPA of 3.0 or better. All course materials are in English; all international students must demonstrate proficiency in English to enter the program.

Math Track: Open to students who have a bachelor's degree in Mathematics or in a related field and a GPA of at least 3.0. Students must satisfy the prerequisites for each course in the program. All four courses must be completed with a GPA of 3.0 or better. All course materials are in English; all international students must demonstrate proficiency in English to enter the program.

Cyber Security Courses by Track

CS Cyber Security Courses *(Select three from this list and one more from this list or the list of Math courses.)*		
Computer Data Security	CIS 6370	3
Distributed Systems Security	CIS 6375	3

Secret Sharing Protocols	COT 6427	3
Cyber Security: Measurement and Data Analysis	CTS 6319	3
Math Cyber Security Courses (Select three from this list and one more from this list or the list of CS courses.)		
Introduction to Cryptology and Information Security	MAD 5474	3
Cryptanalysis	MAD 6478	3
Coding Theory	MAD 6607	3
Number Theory and Cryptography	MAS 6217	3

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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.

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. Applicants whose native language is not English must produce evidence of proficiency in written and spoken English. A score of 213 or more on the Test of English as a Foreign Language (TOEFL) is considered satisfactory. 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. Equivalent FAU courses follow.

Prerequisite courses for Ph.D. in Computer Science

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

Prerequisite courses for Ph.D. in Computer Engineering

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

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 CEECS department, with the approval of the advisor. All other courses must have been offered by the ~~Department of Computer and Electrical Engineering and Computer Science~~ CEECS department during the preceding three years (courses from other departments may be accepted if approved by the student's advisor and the graduate committee), 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. 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 Ddirected Iindependent Sstudy 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. A maximum of one 4000-level course may be allowed toward the degree with the approval of the student's advisor. This course must be passed with a minimum grade of "B." The courses taken to make up the 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.

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. ~~An applicant whose native language is not English must obtain a score of 550 or more (CBT-213) on the Test of English as a Foreign Language (-TOEFL);~~ 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 CEECS with GPA at least 3.25 (of a 4.0 maximum) 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.

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. Maximum of 6 credits at the 4000 level with a maximum of 6 EE credits and 3 credits in math;

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, graduate course-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 Ddirected Iindependent Sstudy 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 6 credits at the 4000 level with a maximum of 3 credits in EE and a maximum of 3 credits in math;

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 Ddirected Iindependent Sstudy course must be taken after completion of 18 credits of coursework. At the end of the Ddirected Iindependent Sstudy 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, graduate course-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 Ddirected Iindependent Sstudy may be applied toward the master's degree.

Deficiency Requirements in both M.S. and Ph.D. Programs
From the following list of deficiency EE courses, students must take the Electronics Laboratory 1 course and at least four more courses.

Intro. 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.

Master of Science with Major in Electrical Engineering with a Business Minor

Those students electing to receive a minor in Business must complete 36 credits, of which 21 are to be from the Electrical Engineering courses described in this section of the catalog and 15 are to be from the courses approved by the College of Business for the Business minor. Such students will have to satisfy the prerequisite and core requirements of the appropriate degree program of the department. In addition, students should also satisfy the University requirements for graduate programs. For more information, students should consult their faculty advisor.

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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;

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. Applicants whose native language is not English must be proficient in written and spoken English as evidenced by a score of 550 or more (CBT-213) on the Test of English as a Foreign Language (TOEFL). 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).

It is possible that access to the program may be limited by available resources in the department.

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. Equivalent FAU courses follow.

Students must take the Electronics Laboratory 1 course and at least four more courses from the table:

Intro. 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

Qualifying Examination

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 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 CEECS department, with the approval of the advisor. All other courses must have been offered by the CEECS department during the preceding three years (courses from other departments may be accepted if approved by the student's advisor and the graduate committee), 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 Electrical Engineering students:

Electromagnetic Fields and Waves	EEL 3470
Introduction to DSP	EEL 4510
Communication Systems	EEL 4512
Stochastic Processes and Random Signals	EEL 4541
Electronics 2	EEL 4361
Control Systems 1	EEL 4652
Analysis of Linear Systems	EEL 4656

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 more than two courses at the 4000 level may be taken as part of the overall 84-credit Ph.D. program, limited to the following:

a. No more than one 4000 math course as approved by the CEECS department;
b. No more than one 4000 EE elective from the list of approved courses;
c. No more than one of any 4000-level courses, excluding EE undergraduate core courses.

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

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 Engineering and Computer Science/ 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 five years. After application and admittance to the graduate program at the beginning of their senior year, nine credits of approved graduate-level courses may be taken and counted toward both the B.S. and M.S. degrees. Students must retain a cumulative 3.25 GPA 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. An applicant whose native language is not English must obtain a score of 550 or more (CBT 213) on the Test of English as a Foreign Language (TOEFL); 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).

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.

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.

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 CEECS with GPA at least 3.25 (of a 4.0 maximum) 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.

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. 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, graduate course-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 Scienc 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, graduate course-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, or EEL 2161, C for Engineers) 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 or
C for Engineers	EEL 2161

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 BioMEMSs, 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, Immunology, Biology of Cancer, 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 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).

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.

Bioengineering Certificate

The College offers a graduate non-degree-seeking certificate in Bioengineering. This certificate program is a practice-oriented, part-time graduate program designed to assist engineers, scientists, technical professionals and qualified senior undergraduates in the launch and/or development of their careers and to provide the technical expertise needed in the rapidly changing business, government and industrial environments.

Program Highlights

This is a 15-credit graduate non-degree-seeking certificate program focused on the application of engineering and computer science principles to biotechnology, bioinformatics and biosystems. It is designed for engineers and scientists working in the biotechnology, pharmaceutical, health care, drug discovery, biomedical, medical instrumentation and allied sectors.

Admission Requirements

The applicant must satisfy the following criteria:

1. A bachelor's degree in biology, chemistry, physics or engineering with a mathematics background through Calculus 2 or calculus with basic differential equations. Qualified senior undergraduates may be accepted into the graduate certificate program with appropriate committee recommendation;

2. GPA of 3.0 in science, mathematics and engineering courses;

3. No GRE scores are necessary. Student transcripts should demonstrate competency in science, mathematics and engineering coursework.

Certificate Requirements

1. PCB 3063, Genetics, (or an equivalent course) as a deficiency requirement with a minimum grade of "C";

2. 9 credits of Bioengineering courses such as Introduction to Bioengineering, Biosystems Modeling and Control, Bioinformatics: Bioengineering Perspectives, Tissue Engineering, Stem Cell Engineering, Biomaterials, Introduction to Microfluidics and BioMEMS, Introduction to Robotics, NanoBiotechnology, Robotic Applications and Orthopedic Biomechanics, Medical Imaging and Bio-Signal Processing;

3. 6 credits of Science courses relevant to Bioengineering such as Special Topics (Advanced Biotechnology Lab), Bioinformatics and Neuroscience 1 and 2;

4. The grade point average of the above 15 credits must be 3.0 or better.