Electrical and Computer Engineering

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luis galarza, Undergraduate Program Advisor
Stavros Georgakopoulos, Assistant Professor
Faisal Kaleem, Instructor
Sakhrat Khizroev, Professor
Grover Larkins, Professor
Behrooz Mirafzai, Assistant Professor
Osama Mohammed, Professor
Nezih Pala, Assistant Professor
Gang Quan, Associate Professor
Gustavo Roig, Professor
Mario Sanchez, Associate Director for Undergraduate Advising
Frank Urban, Associate Professor
Herman Watson, Lecturer and Undergraduate Program Director

Bachelor of Science in Electrical Engineering

Program Educational Objectives

The Electrical Engineering Educational Objectives are:

1. Depth: To provide students with an understanding of the fundamental knowledge necessary for the practice of, or for advanced study in electrical engineering including its scientific principles, rigorous analysis, and creative design,

2. Breadth: To provide students with the broad education necessary for productive careers, or for the pursuit of graduate education, including knowledge of important current issues in engineering with emphasis on electrical engineering,

3. Professionalism: To develop skills for clear communication and responsible team work, and to instill professional attitudes and ethics, so that students are prepared for the complex global work environment,

4. Educational Renewal: To prepare students with an ability to continually renew their education in a rapidly developing discipline, including recognition of the importance of lifelong learning.

Program Educational Outcomes

a) an ability to apply knowledge of mathematics, science, and engineering
b) an ability to design and conduct experiments, as well as to analyze and interpret data
c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political ethical, health and safety, manufacturability, and sustainability
d) an ability to function on multi-disciplinary teams
e) an ability to identify, formulate, and solve engineering problems
f) an understanding of professional and ethical responsibility

g) an ability to communicate effectively

h) the broad education necessary to understand the impact of engineering solution in a global, economic, environmental, and societal context

i) a recognition of the need for and an ability to engage in life-long learning

j) a knowledge of contemporary issues
k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

l) an ability to apply probability and statistics, including applications to electrical engineering program

m) an ability to apply knowledge of advanced math (D.E., Linear Algebra, Complex Variables, Discrete Mathematics)

Common Prerequisite Courses and Equivalencies

FIU Course(s) Equivalent Course(s)
CHM 1045, CHM 1045L CHMX045/X045L or CHMX045C or CHSX440 and CHMX045L¹
MAC 2311 MACX311 or MACX281
MAC 2312 MACX312 or MACX282
MAC 2313 MACX313 or MACX283
MAP 2302 MAPX302 or MAPX305
PHY 2048 PHYX048/X048L² or PHYX048C or PHYX043 and PHYX048L
PHY 2049, PHY 2049L PHYX049/X049L or PHYX049C or PHYX044 and PHYX049L

¹or CHSX440 if 4 credit hours with included laboratory
²PHY2048L is not required at FIU

Courses which form part of the statewide articulation between the State University System and the Community College System will fulfill the Lower Division Common Prerequisites. For generic course substitutions/equivalencies for Common Program Prerequisites offered at community colleges, state colleges, or state universities, visit: http://facts.org. See Common Prerequisite Manual.

Common Prerequisites

CHM 1045 General Chemistry
CHM 1045L General Chemistry Lab I
MAC 2311 Calculus I
MAC 2312 Calculus II
MAC 2313 Multivariable Calculus
MAP 2302 Differential Equations
PHY 2048 Physics with Calculus I
PHY 2049 Physics with Calculus II
PHY 2049L General Physics Lab II

Additional lower division courses required:
EEL 2880 Applied Software Techniques in Engineering
**Degree Program Hours: 129**

Students applying to Electrical Engineering should have good communication skills in English (verbal and written) and exhibit logical thinking, creativity, imagination, and persistence. They should have proven academic background in mathematics, chemistry, engineering drawing and physics. Missing courses may be taken at FIU, with advisor approval.

At the undergraduate level, the basic required program of instruction in fundamental theory and laboratory practice is balanced by a broad range of electives in such fields as computers, communication systems, control systems, power systems, and bio-engineering. Students, with the counsel and guidance of faculty advisers, design their electives program around their own special interest.

Any course taken without the required prerequisites and corequisites will be dropped automatically before the end of the term, resulting in a grade of "DR" or "DF". The student will not be eligible for a refund.

Students must earn a minimum grade of "C-", and a minimum GPA of 2.0 in all EEE and EEL courses required for graduation.

Students, who have been dismissed for the first time from the University due to low grades, may appeal to the department for reinstatement. A second dismissal results in no possibility of reinstatement.

**Lower Division Preparation**

Lower division requirements include at least 60 credit hours of pre-engineering courses (see the Undergraduate Studies portion of this catalog for specific requirements). These courses include high level programming language (EEL 2880 for Freshman and students who are transferring in without C programming), common prerequisite courses, 2 semesters of English composition, and 2 other Gordon rule writing courses, and Engineering Graphics or CAD (unless previously taken in high school).

A minimum grade of "C" is required in all writing courses, all calculus courses, differential equations, both physics classes, and chemistry. In addition, both transfer students and FIU freshman must take a combination of social sciences and humanities that fulfill the FIU University Core Curriculum requirements and those topics also complement the goals and objectives of the College of Engineering and Computing (including economic, environmental, political, and/or social issues. See semester-by-semester sample program for courses that fulfill this requirement). Students who have not satisfactorily met the social science/humanities requirements will be required to take additional (advanced) humanities/social science course(s).

In addition students may transfer a pre-approved engineering Statics course if it meets the proper prerequisites for the course (speak to an FIU engineering advisor to see if your community college offers an acceptable statics course). Students must make up any missing prerequisites before they will be allowed to begin taking certain engineering courses (see the course listing on the following page for the complete list of required courses. Required pre/corequisites are listed in the section on Course Descriptions).

**Other Requirements**

Students must meet the University Foreign Language Requirement, must achieve the competencies of the CLAS requirement, must have a minimum 2.0 GPA, must complete all required classes, and must otherwise meet all of the state and university requirements in order to graduate. Students who enter the university with fewer than 60 transferred credits must take 9 summer credits. Also see the Undergraduate Studies portion of this catalog for additional information.

**Upper Division Program**

The program includes Statics, Dynamics, Materials in Engineering, Signals and Systems, Engineering Economy, Probability and Statistics, Advanced Humanities/Social Science and the following:

### Electrical Engineering Curriculum (Major only): (56)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>EEL 3110</td>
<td>Circuits Analysis</td>
<td>3</td>
</tr>
<tr>
<td>EEL 3110L</td>
<td>Circuits Lab</td>
<td>1</td>
</tr>
<tr>
<td>EEL 3120</td>
<td>Introduction to Linear Systems</td>
<td>3</td>
</tr>
<tr>
<td>EEE 3303</td>
<td>Electronics I</td>
<td>3</td>
</tr>
<tr>
<td>EEE 3303L</td>
<td>Electronics I Lab</td>
<td>1</td>
</tr>
<tr>
<td>EEE 3396</td>
<td>Introduction to Solid State Devices</td>
<td>3</td>
</tr>
<tr>
<td>EEL 3514</td>
<td>Communication Systems</td>
<td>3</td>
</tr>
<tr>
<td>EEL 3657</td>
<td>Control Systems</td>
<td>3</td>
</tr>
<tr>
<td>EEL 3712</td>
<td>Logic Design I</td>
<td>3</td>
</tr>
<tr>
<td>EEL 3712L</td>
<td>Logic Design I Lab</td>
<td>1</td>
</tr>
<tr>
<td>EEL 4920</td>
<td>Senior Design I: Ethics, Communications and Constraints</td>
<td>2</td>
</tr>
<tr>
<td>EEL 4921C</td>
<td>Senior Design II: Project Implementation</td>
<td>2</td>
</tr>
<tr>
<td>EEL 4213</td>
<td>Power Systems I</td>
<td>3</td>
</tr>
<tr>
<td>EEL 4213L</td>
<td>Energy Conversion Lab</td>
<td>1</td>
</tr>
<tr>
<td>EEE 4304</td>
<td>Electronics II</td>
<td>3</td>
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<tr>
<td>EEE 4304L</td>
<td>Electronics II Lab</td>
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<tr>
<td>EEE 4314</td>
<td>Integrated Circuits and Systems</td>
<td>3</td>
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<tr>
<td>EEE 4314L</td>
<td>Integrated Circuits Lab</td>
<td>1</td>
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<tr>
<td>EEL 4410</td>
<td>Introduction to Fields and Waves</td>
<td>3</td>
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<tr>
<td>EEL 4611L</td>
<td>Systems Lab</td>
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<tr>
<td>EEL 4709C</td>
<td>Computer Design</td>
<td>3</td>
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<tr>
<td>EEL 4740</td>
<td>Embedded Computing Systems</td>
<td>3</td>
</tr>
<tr>
<td>EEE 4743</td>
<td>Introduction to Digital Electronics</td>
<td>3</td>
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</table>

**Areas of Specialization:**

Electrical Engineering students must choose an area of specialization from the following list and take the corresponding courses as their Elective I and Elective II.

### Power:

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>EEL 4214</td>
<td>Power II</td>
<td>3</td>
</tr>
<tr>
<td>EEL 4215</td>
<td>Power III</td>
<td>3</td>
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### Communications:

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>EEL 4140</td>
<td>Filter Design</td>
<td>3</td>
</tr>
<tr>
<td>EEL 4510</td>
<td>Introduction to Digital Signal Processing</td>
<td>3</td>
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### Controls:

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>EEL 4140</td>
<td>Filter Design</td>
<td>3</td>
</tr>
<tr>
<td>EEL 4611</td>
<td>Control Systems II</td>
<td>3</td>
</tr>
</tbody>
</table>

### Bio-Engineering:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>EEE 4202C</td>
<td>Medical Instrumentation Design</td>
<td>4</td>
</tr>
<tr>
<td>EEL 4140</td>
<td>Filter Design</td>
<td>3</td>
</tr>
</tbody>
</table>

### Computers:

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>EEL 4746</td>
<td>Microcomputers I</td>
<td>3</td>
</tr>
<tr>
<td>EEL 4746L</td>
<td>Microcomputers Lab I</td>
<td>1</td>
</tr>
<tr>
<td>EEL 4510</td>
<td>Introduction to Digital Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>EEE 4343</td>
<td>Introduction to Digital Electronics</td>
<td>3</td>
</tr>
</tbody>
</table>
Electrical Engineering Program Freshman to Senior

First Semester: (17)
CHM 1045 General Chemistry I 3
CHM 1045L General Chemistry I Lab 1
EGN 1102 Engineering Orientation 2
ENC 1101 Writing and Rhetoric I 3
MAC 2311 Calculus I 4
SLS 1501 Freshman Experience 1
EGN 1033 Technology, Humans, and Society 3

Second Semester: (17)
CRW 2001 Creative Writing 3
or
MUH 1011 Music Appreciation 3
or
MUH 2116 Evolution of Jazz 3
or
TPP 2100 Introduction to Acting 3
or
THE 2000 Theatre Appreciation 3
ENC 1102 Writing and Rhetoric II 3
MAC 2312 Calculus II 4
PHY 2048 Physics with Calculus I 4
EEL 2880 Applied Software Techniques in Engineering 3

Third Semester: (18)
MAC 2313 Multivariable Calculus 4
PHY 2049 Physics with Calculus II 4
PHY 2049L General Physics Lab II 1
EIN 3235 Evaluation of Engineering Data I 3
MAP 2302 Differential Equations 3
EEL 3120 Introduction to Linear Systems 3

Fourth Semester: (17)
EEL 3135 Signals and Systems 3
EEL 3110 Circuits Analysis 3
EEL 3111 Circuits I 3
EEL 3712 Logic Design I 3
EEL 3712L Logic Design Lab I 1
EIN 3354 Engineering Economy 3
Humanities and Writing I 3

Fifth Semester: (18)
ECO 2013 Macroeconomics 3
or
ECO 2023 Microeconomics 3
or
INP 2002 Introductory Industrial/Organization Psychology 3
or
INR 2001 Intro to International Relations 3
or
GEO 2000 Intro to Geography 3
or
SYG 2010 Social Problems 3
EEE 3396 Intro to Solid State Devices 3
EEL 4709C Computer Design 3
EEL 3514 Communication Systems 3
EEL 4410 Introduction to Fields and Waves 3
Humanities and Writing II 3

Sixth Semester: (17)
EEE 3303 Electronics I 3
EEE 3303L Electronics Lab I 1
EEL 3657 Control Systems I 3
EEL 4213 Power Systems I 3

Eighth Semester: (9)
EEL 4921C Senior Design II: Project Implementation 2
EEE 4314 Integrated Circuits and Systems 3
EEE 4314L Integrated Circuits Lab 1
EE Elective (same specialization as EE Elective I) 3

*Humanities and Writing I & II: Choose 2 from the following ARC 2701, HUM 3306, PHI 2600, WOH 2001, EUH 2030, AMH 2042. At least 1 of the courses must have a history component.

Combined BS/MS in Electrical Engineering

Students who pursue a BSEE degree and are in their first semester of the senior year, with at least a 3.3 GPA on both overall and upper division courses may apply to the department to enroll in the combined BS/MS program. To be considered for admission to the combined bachelor’s/master’s degree program, students must have completed at least 75-90 credits in the bachelor’s degree program at FIU and meet the admissions criteria for the graduate degree program to which they are applying. Students need only apply once to the combined degree program, but the application must be submitted to Graduate Admissions before the student starts the last 30 credits of the bachelor’s degree program. A student admitted to the combined degree program will be considered to have undergraduate status until the student applies for graduation from their bachelor’s degree program. Upon conferral of the bachelor’s degree, the student will be granted graduate status and be eligible for graduate assistantships. Only 5000-level or higher courses, and no more than the number of credits specified by the program catalog, may be applied toward both degrees. In addition to the admission requirements of the combined BS/MS program, students must meet all the admission requirements of the University Graduate School.

Students enrolled in the program may count up to six hours of ECE graduate courses as credits for both the BS and MS degrees. The combined BS/MS program has been designed to be a continuous program. During this combined BS/MS program, upon completion of all the requirements of the undergraduate program, students will receive their BS degree. Students in this program have up to one year to complete the master’s degree after receipt of the bachelor’s degree. Students who fail to meet this one year post BS requirement or who elect to leave the combined program at any time and earn only the BS degree will have the same access requirements to regular graduate programs as any other students, but will not be able to use the six credits in both the bachelor’s and master’s degrees.
For each of the graduate courses counted as credits for both BS and MS degree, a minimum grade of “B” is required. Students enrolled in the program may count up to six credit hours of EE graduate courses toward the elective engineering BSEE requirements as well as toward the MSEE degree. Only graduate courses with formal lectures can be counted for both degrees. Students are responsible for confirming the eligibility of each course with the undergraduate advisor.

Students interested in the program should consult with the undergraduate advisor regarding their eligibility to the program. They should also meet the graduate advisor to learn about the graduate program and available courses before completing the application form and submitting it to the undergraduate advisor. Applicants will be notified by the department and the University Graduate School of the decision on their applications.

**Combined BS in Electrical Engineering/MS in Biomedical Engineering**

The Electrical Engineering Department and the Biomedical Engineering Department at FIU offer a 5 year, 150 credit combined BS/MS degree program. Students who wish to be admitted must have completed at least 90 credits toward their BS degree and have earned at least a 3.25 GPA in those courses required for a BS in Electrical Engineering with a minor in Biomedical Engineering. All requirements for the electrical engineering program applies to the combined BS/MS program. See an advisor and/or the Biomedical Engineering section of this catalog for more details.

**Combined BS in Electrical Engineering/MS in Engineering Management (BSEE/MSEM)**

Students, who are pursuing a Bachelor of Science degree in Electrical Engineering and have completed at least 75-90 credits with a minimum of a 3.3 overall GPA may, upon recommendation from three ECE faculty members, apply to enroll in the combined BSEE/MSEM program. Students need only apply once to the combined degree program, but the application must be submitted to Graduate Admissions before the student starts the last 30 credits of the bachelor’s degree program. In addition to the admission requirements of the MSEM program, students must meet all the admission requirements of the University Graduate School.

Students enrolled in the combined degree program could count up to two Electrical Engineering graduate courses for both the BSEE electives and the MSEM electives, for a total saving of 6 credit hours. A minimum grade of “B” is required graduate courses counted as credits for both BSEE and MSEM degrees. Only 5000-level or higher courses may be applied toward both degrees. Only graduate courses with formal lecture can be counted for both degrees.

The combined BSEE/MSEM program has been designed to be a continuous program. Students will receive their BSEE degree upon completion of all the requirements of the BSEE program. A student admitted to the combined degree program will be considered to have undergraduate status until the student applies for graduation from his/her bachelor's degree program. Upon conferral of the bachelor’s degree, the student will be granted graduate status and be eligible for graduate assistantships.

Students may elect to permanently leave the combined program and earn only the BSEE degree. Students who elect to leave the combined program and earn only the BS degree will have the same access requirements to regular graduate programs as any other student but will not be able to use the 6 credit hours in both the BSEE and MSEM degrees.

Students interested in the combined program should consult with their undergraduate advisor on their eligibility to the program. The student should also meet the MSEM Program Director to learn about the graduate program and available tracks/courses before completing the application form and submitting it to their undergraduate advisor. Final decision for admission to the MSEM program will be made by the University Graduate School upon recommendation by the Engineering Management program director. Applicants will be notified by the Engineering Management Program and the University Graduate School of the decision on their applications.

**Combined BS in Electrical Engineering/MS in Telecommunications and Networking**

Students who pursue a BS degree and are in their first semester of the senior year, with at least a 3.3 GPA on both overall and upper division courses may apply to enroll in the combined BS/MS program. To be considered for admission to the combined bachelor’s/master’s degree program, students must have completed at least 75-90 credits in the bachelor’s degree program at FIU and meet the admissions criteria for the graduate degree program to which they are applying. Students need only apply once to the combined degree program, but the application must be submitted to Graduate Admissions before the student starts the last 30 credits of the bachelor’s degree program. A student admitted to the combined degree program will be considered to have undergraduate status until the student applies for graduation from their bachelor’s degree program. Upon conferral of the bachelor’s degree, the student will be granted graduate status and be eligible for graduate assistantships. Only 5000-level or higher courses, and no more than the number of credits specified by the program catalog, may be applied toward both degrees. In addition to the admission requirements of the combined BS/MS program, students must meet all the admission requirements of the University Graduate School.

Students enrolled in the program may count up to six credit hours of Telecommunications and Networking graduate courses as credits for both the BS and MS degrees. The combined BS/MS program is a continuous program and upon completion of all the requirements of the undergraduate program, students will receive their BS degree. Students in this program have one year to complete the master’s degree after receipt of the bachelor’s degree. Students who fail to meet this one year post B.S. requirement or who elect to leave the combined program at any time and earn only the BS degree will have thereafter the same access requirements to regular graduate programs as any other student, but will not be
Program Educational Objectives

The Computer Engineering Educational Objectives are:
1. That our graduates are employed as computer engineers, or in another profession using their computer engineering skills,
2. That our graduates stay current in their field of expertise,
3. That our graduates attain supervisory/leadership positions in their respective organizations.

Program Educational Outcomes

a) an ability to apply knowledge of mathematics, science, and engineering
b) an ability to design and conduct experiments, as well as to analyze and interpret data
c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political ethical, health and safety, manufacturability, and sustainability
d) an ability to function on multi-disciplinary teams
e) an ability to identify, formulate, and solve engineering problems
f) an understanding of professional and ethical responsibility
g) an ability to communicate effectively
h) the broad education necessary to understand the impact of engineering solution in a global, economic, environmental, and societal context
i) a recognition of the need for and an ability to engage in life-long learning
j) a knowledge of contemporary issues
k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
l) an ability to apply probability and statistics, including applications to computer engineering program
m) an ability to apply knowledge of advanced math (Discrete Mathematics, D.E., Linear Algebra, Complex Variables)

Bachelor of Science in Computer Engineering

Common Prerequisite Courses and Equivalencies

<table>
<thead>
<tr>
<th>FIU Course(s)</th>
<th>Equivalent Course(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM 1045, CHM 1045L</td>
<td>CHMXO45/XO45L² or CHMXO45C²</td>
</tr>
<tr>
<td>MAC 2311</td>
<td>MACX311¹</td>
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<td>MAC 2312</td>
<td>MACX312¹</td>
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<td>MAP 2302</td>
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<tr>
<td>PHY 2048</td>
<td>PHYX048/X048L or PHYX048C</td>
</tr>
<tr>
<td>PHY 2049, PHY 2049L</td>
<td>PHYX049/X049L or PHYX049C</td>
</tr>
</tbody>
</table>

Courses which form part of the statewide articulation between the State University System and the Community College System will fulfill the Lower Division Common Prerequisites.


Common Prerequisites**

CHM 1045 General Chemistry I
CHM 1045L General Chemistry Lab I
MAC 2311 Calculus I
MAC 2312 Calculus II
MAC 2313 Multivariable Calculus
MAP 2302 Differential Equations
PHY 2048 Physics with Calculus I
PHY 2049 Physics with Calculus II
PHY 2049L General Physics Lab II

Additional lower division courses required:

MAD 3401 Numerical Analysis
(May be substituted for MAC 2313)
MAD 2104 Discrete Mathematics

**PHY 2048L is not a requirement for this program.

Degree Program Hours: 128

Any course taken without the required prerequisites and corequisites will be automatically dropped before the end of the term, resulting in a grade of “DR” or “DF”.

Students must earn a minimum grade of “C” in all calculus, physics, chemistry and differential equations classes. Students must earn at least a “C-” in all CEN, COP, as well as EEE and EEL courses required for graduation.

Also, a student must have a minimum GPA of 2.0 in all EEE and EEL courses. Computer Engineering students must take either Multivariable Calculus or Numerical Analysis and receive a minimum grade of “C”.

Students, who have been dismissed for the first time from the University due to low grades, may appeal to the department for reinstatement. A second dismissal results in no possibility of reinstatement.

Sections titled “Other Requirements” and “Lower Division Preparation” in the Electrical Engineering section are also requirements for the Computer Engineering students. Knowledge of “C” is required as a prerequisite for the computer software curriculum and Discrete Math.
Upper Division Program

The upper division program includes Discrete Math, Probability & Statistics, Engineering Economy, Signals and Systems, and the following:

**Computer Software Curriculum:** (12)
- EEL 2880 Applied Software Techniques in Engineering 3
- COP 3337 Computer Programming II 3
- COP 3530 Data Structures 3
- COP 4610 Operating Systems Principles 3

**Electrical Engineering Curriculum:** (22)
- EEL 3110 Circuits Analysis 3
- EEL 3110L Circuits Lab 1
- EEE 3303 Electronics I 3
- EEE 3303L Electronics I Lab 1
- EEL 3514 Communication Systems 3
- EEL 3657 Control Systems I 3
- EEE 4343 Introduction to Digital Electronics 3
- EEE 4314 Integrated Circuits and Systems 3
- EEE 4314L Integrated Circuits Lab 1
- EEL 4611L Systems Lab 1

**Computer Hardware Curriculum:** (28)
- EEL 3712 Logic Design I 3
- EEL 3712L Logic Design I Lab 1
- EEL 4920 Senior Design I: Ethics, Communications and Constraints 2
- EEL 4921C Senior Design II: Project Implementation 2
- EEL 4799C Computer Design 3
- EEL 4746 Microcomputers I 3
- EEL 4746L Microcomputers I Lab 1
- EEL 4747C Microcomputers II 4
- EEL 4740 Embedded Computing Systems 3
- Computer Engineering Elective 6

**Areas of Specialization**

Computer Engineering students must choose an area of specialization from the following list and take the corresponding courses as their Elective I and Elective II.

**Hardware-Software Integration**
- EEL 4714 Introduction to Hardware Description Languages (HDL) 3
- EEL 4410 System-on-a-Chip Design Methodologies 3

**Signal and Image Processing**
- EEL 4510 Introduction to Digital Signal Processing 3
- EEL 4798 Special Topics (cross-listed with EEL 5820 Image Processing) 3

**Instrumentation and Filter Design**
- EEL 4202C Medical Instrumentation Design 4
- EEL 4140 Filter Design 3

**Software Engineering**
- CEN 4010 Software Engineering I 3
- COP 4604 Advanced Unix Programming 3
- COP 4226 Advanced Windows Programming 3
- COP 4338 Programming III 3

**Networking**
- TCN 4211 Telecommunication Networks 3
- TCN 4212 Telecommunication Network Analysis and Design 3

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**Computer Engineering Program**

**Freshman to Senior**

**First Semester:** (17)
- CHM 1045 General Chemistry I 3
- CHM 1045L Gen. Chemistry Lab I 1
- EGN 1002 Engineering Orientation 2
- ENC 1101 Writing and Rhetoric I 3
- MAC 2311 Calculus I 4
- SLS 1501 First Year Experience 1
- EGN 1033 Technology, Humans, and Society 3

**Second Semester:** (17)
- ENC 1102 Writing and Rhetoric II 3
- MAC 2312 Calculus II 4
- PHY 2048 Physics with Calculus I 4
- EEL 2880 Applied Software Techniques in Engineering 3
- CRW 2001 Creative Writing 3
- MUH 1011 Music Appreciation 3
- MUH 2116 Evolution of Jazz 3
- THE 2000 Theatre Appreciation 3
- TPP 2100 Introduction to Acting 3

**Third Semester:** (17)
- MAD 2104 Discrete Math 3
- MAP 2302 Differential Equations 3
- PHY 2049 Physics with Calculus II 4
- PHY 2049L General Physics Lab II 1
- COP 3337 Intermediate Programming 3
- EIN 3235 Evaluation of Engineering Data I 3

**Fourth Semester:** (17)
- EEL 3110 Circuits Analysis 3
- EEL 3110L Circuits Lab 1
- EEL 3712 Logic Design I 3
- EEL 3712L Logic Design I Lab 1
- EEL 3120 Introduction to Linear Systems 3
- EEL 4740 Embedded Computing Systems 3
- COP 3530 Data Structures 3

**Fifth Semester:** (16)
- EIN 3354 Engineering Economy 3
- EEL 3135 Signals and Systems 3
- EEE 3303 Electronics I 3
- EEE 3303L Electronics I Lab 1
- Humanities and Writing II* 3
- COP 4610 Operating Systems 3

**Sixth Semester:** (15 or 16)
- MAC 2313 Multivariable Calculus 4
- MAD 3401 Numerical Analysis 3
- EEL 3514 Communication Systems 3
- EEL 4709 Computer Design 3
- EEE 4343 Introduction to Digital Electronics 3
- ECO 2013 Macroeconomics 3
- ECO 2023 Microeconomics 3
- INP 2002 Introductory Industrial/Organization Psychology 3
- INR 2001 Intro to International Relations 3
Combined BS/MS in Computer Engineering

Students who have completed a minimum of 90 hours towards their Bachelors of Science degree in Computer Engineering and have earned at least a 3.3 GPA on both overall and upper division courses may, upon recommendation from three ECE faculty members, apply to enroll in the combined BS/MS program. To be considered for admission to the combined bachelor's/master’s degree program, students must have completed at least 75-90 credits in the bachelor's degree program at FIU and meet the admissions criteria for the graduate degree program to which they are applying. Students need only apply once to the combined degree program, but the application must be submitted to Graduate Admissions before the student starts the last 30 credits of the bachelor's degree program. A student admitted to the combined degree program will be considered to have undergraduate status until the student applies for graduation from their bachelor's degree program. Upon conferral of the bachelor’s degree, the student will be granted graduate status and be eligible for graduate assistantships. Only 5000-level or higher courses may be applied toward both degrees. In addition to the admission requirements of the combined program, students must meet all the admission requirements of the University Graduate School. Students enrolled in the program may count up to six hours of ECE graduate courses as credits for both the BS and MS degrees. The combined BS/MS program is a continuous program and upon completion of all the requirements of the undergraduate program, students will receive their BS degree. Students in this program have one year to complete the master’s degree after receipt of the bachelor’s degree. Students who fail to meet this one year post B.S. requirement or who elect to leave the combined program at any time and earn only the BS degree will have the same access requirements to regular graduate programs as any other students, but will not be able to use the six credits in both the bachelor’s and master’s degrees.

For each of the graduate courses counted as credits for both BS and MS degree, a minimum grade of “B” is required. Students enrolled in the program may count up to six credit hours of CpE graduate courses toward the elective engineering BScpE requirements as well as toward the MSCpE degree. Only graduate courses with formal lectures can be counted for both degrees. The students are responsible for confirming the eligibility of each course with the undergraduate advisor. Students interested in the program should consult with the undergraduate advisor on their eligibility to the program. The students should also meet the graduate coordinator to learn about the graduate program and available courses before completing the application from and submitting it to the undergraduate advisor. Applicants will be notified by the department and the University Graduate School of the decision on their applications.

Combined BS in Computer Engineering/MS in Engineering Management (BScpE/MSEM)

Students, who are pursuing a Bachelor of Science degree in Computer Engineering and have completed at least 75-90 credits with a minimum of a 3.3 overall GPA may, upon recommendation from three ECE faculty members, apply to enroll in the combined BScpE/MSEM program. Students need only apply once to the combined degree program, but the application must be submitted to Graduate Admissions before the student starts the last 30 credits of the bachelor's degree program. In addition to the admission requirements of the MSEM program, students must meet all the admission requirements of the University Graduate School.

Students enrolled in the combined degree program could count up to two Electrical Engineering graduate courses for both the BScpE electives and the MSEM electives, for a total saving of 6 credit hours. A minimum grade of “B” is required graduate courses counted as credits for both BScpE and MSEM degrees. Only 5000-level or higher courses may be applied toward both degrees. Only graduate courses with formal lecture can be counted for both degrees.

The combined BScpE/MSEM program has been designed to be a continuous program. Students will receive their BScpE degree upon completion of all the requirements of the BScpE program. A student admitted to the combined degree program will be considered to have undergraduate status until the student applies for graduation from his/her bachelor’s degree program. Upon conferral of the bachelor’s degree, the student will be granted graduate status and be eligible for graduate assistantships.

Students may elect to permanently leave the combined program and earn only the BScpE degree. Students who elect to leave the combined program and earn only the BS degree will have the same access requirements to regular graduate programs as any other student but will not be able to use the 6 credit hours in both the BScpE and MSEM degrees.

Students interested in the combined program should consult with their undergraduate advisor on their eligibility.
to the program. The student should also meet the MSEM Program Director to learn about the graduate program and available tracks/courses before completing the application form and submitting it to their undergraduate advisor. Final decision for admission to the MSEM program will be made by the University Graduate School upon recommendation by the Engineering Management program director. Applicants will be notified by the Engineering Management Program and the University Graduate School of the decision on their applications.

Course Descriptions

Definition of Prefixes
CDA - Computer Design/Architecture; EGN - Engineering: General; EEE - Engineering: Electrical and Electronics; EEL - Engineering: Electrical; TCN – Telecommunications/Networks
F-Fall semester offering; S-Spring semester offering; SS-Summer semester offering.

CDA 4400 Computer Hardware Analysis (3). The study of hardware functions of a basic computer. Topics include logic elements, arithmetic logic units, control units, memory devices, organization and I/O devices (for non-EE majors only). Prerequisites: CDA 4101 and MAD 2104.

EGN 1002 Engineering Orientation (2). Introduction to aspects of the engineering profession. Computer tools and basic engineering science. Team-based engineering projects. (F,S)

EEE 3303 Electronics I (3). Introductory course dealing with basic electronic devices such as diodes, BJTs, FETs, Op-Amps, and their circuit applications. Prerequisites: EEL 3111 or EEL 3110, EEE 3396. Corequisite: EEE 3303L. (F,SS)

EEE 3303L Electronics I Laboratory (1). Design, build and test electronic circuits that use diodes, BJTs, FETs and Op-Amps. Prerequisite: EEL 3110L. Corequisite: EEE 3303L. (F,SS)

EEE 3396 Introduction to Solid State Devices (3). Introduction to the physics of semiconductors; charge carrier statistics and charge transport in crystalline solids. Basic operations of solid state devices including p-n junction diode, the bipolar junction transistor and field effect transistors. Prerequisites: PHY 2049, EGN 3365, EIN 3235. Corequisites: EEL 3111, MAP 2302. (F,S)

EEE 4202C Medical Instrumentation Design (4). Concepts of transducers and instrumentation systems; origins of bio-potentials; electrical safety; therapeutic and prosthetic devices. Prerequisites: EEL 3003 or EEL 3110 or EEL 3111.

EEE 4304 Electronics II (3). Second course in electronics with particular emphasis on equivalent circuit representation and analysis of electronic analog circuits and systems, their frequency response and behavior under feedback control. Prerequisites: EEL 3112 and EEE 3303. Corequisite: EEL 4304L. (F,S)

EEE 4304L Electronics II Laboratory (1). Design and measurement experiments of advanced electronics, including applications of integrated circuits. Prerequisite: EEE 3303L. Corequisite: EEL 4304. (F,S)

EEE 4314 Integrated Circuits and Systems (3). Continuation of Electronics II with major emphasis on applications of integrated circuits and design of analog, control, communication and digital electronic systems. Prerequisites: EEL 4304 or EEL 4343. Corequisite: EEE 4314L. (F,S,SS)

EEE 4314L Integrated Circuits Laboratory (1). Laboratory experiments in integrated circuits. Includes design of filters, analog systems, A/D and D/A systems. Prerequisites: EEE 3303L (for CpE majors) or EEE 4304L (for EE majors). Corequisite: EEE 4314. (F,S,SS)

EEE 4343 Introduction to Digital Electronics (3). This course focuses on digital electronics. BJTs as a switch, CMOS and other advanced logic-gate circuits, data converters, switched capacitor filters, semiconductor memories. Prerequisite: EEE 3303.

EEE 4410 System-on-a-Chip and Design Methodologies (3). Study of FPGA based System-on-a-Chip (SoC) design by understanding the essentials of FPGA and VLSI, including fabrication, circuits, interconnect, logic design, and system architectures. Prerequisites: EEE 4343, EEL 4709C, or permission of the instructor.

EEL 2880 Applied Software Techniques in Engineering (3). Engineering problem solving process, overview of a generalized computing system, software development, real-life engineering applications, computational implications. (F,S)

EEL 3003 Electrical Engineering I (3). For non-EE majors. Basic principles of DC and AC circuit analysis, electronic devices and amplifiers, digital circuits, and power systems. Prerequisites: MAC 2312, PHY 2049. Corequisite: MAP 2302. (F,S,SS)

EEL 3110 Circuit Analysis (3). Introductory circuit analysis dealing with DC, AC, and transient electrical circuit analysis and the general excitation of circuits using the Laplace transform. Not for Electrical Engineering majors. Prerequisites: MAC 2312, PHY 2049, (EGN 1002 or EGN 1100). Corequisites: MAP 2302, EEL 2880, and EEL 3110L.

EEL 3110L Circuits Lab (1). This lab introduces basic test equipment; oscilloscopes, multimeters, power supplies, function generator, etc., and uses this equipment in various experiments on resistors, capacitors, and inductors. Prerequisite: PHY 2049L. Corequisites: EEL 3111 or EEL 3110L. (F,S)

EEL 3111 Circuits I (3). Introductory circuits course dealing with DC, AC and transient electrical circuit analysis, involving passive elements such as resistors, capacitors, inductors, transformers, etc. Prerequisites: MAC 2312, PHY 2049, (EGN 1002 or EGN 1100). Corequisites: MAP 2302, EEL 2880, and EEL 3110L. (F,S)

EEL 3112 Circuits II (3). Application of operational methods to the solution of electrical circuits. Effect of poles and zeroes on the response. Transfer function of electrical networks. Laplace and Fourier transforms; network parameters. Prerequisites: MAP 2302, EEL 3111, and EEL 3135. (S,SS)
EEL 3120 Introduction to Linear Systems in Engineering (3). Introductory course on linear systems, deals with the use of linear algebra to analyze resistive and dynamic electric circuits. Prerequisites: MAC 2312, PHY 2049, EGN 1002.

EEL 3135 Signals and Systems (3). Use of Fourier analysis in electrical and electronic systems. Introduction to probability theory, linear algebra and complex variables. Prerequisite: MAP 2302. (F,S)

EEL 3160 Computer Applications in Electrical Engineering (3). Interactive techniques of computers to simulate and design electrical engineering circuits and systems. Prerequisite: Permission of the instructor.

EEL 3514 Communication Systems (3). An introductory course in the field of analog communication systems. Transmitters, receivers, and different modulation and demodulation techniques are studied. A basic treatment of noise is also included. Prerequisites: (EEL 3112 or EEL 3110), EEL 3135, EIN 3235. (F,S)

EEL 3657 Control Systems I (3). Analysis of linear time-invariant feedback control systems. System modeling, time and frequency-domain response, stability and accuracy. Analysis by use of Root- Locus, Bode plots, Nyquist diagram. Prerequisites: EEL 3112 or EEL 3110 and EEL 3135. (F,SS)

EEL 3712 Logic Design I (3). Boolean Algebra. Binary number systems. Combinational logic design using SSI, MSI and LSI. Sequential logic design. Corequisites: EEL 3712L, EEL 3111 or EEL 3110. (S,SS)

EEL 3712L Logic Design I Lab (1). Laboratory experiments, using gates, combinational networks, SSI, MSI, LSI. Sequential logic design. Corequisites: EEL 3110L and EEL 3712. (S,SS)

EEL 4006 Development of Dynamic Web Sites (3). Techniques for the development of dynamic web sites, which will generate individualized web pages, according to data supplied by the user or retrieved from data stores available to the web server. Prerequisites: EEL 2880 or permission of instructor.

EEL 4015 Electrical Design in Buildings I (3). Application of electrical codes and regulations. Design of loads, circuits, surge protectors, feeders, panels, and breakers. Prerequisites: EEL 3111 or EEL 3110.

EEL 4016 Electrical Design in Buildings II (3). Electrical design of industrial buildings, size and design of distribution rooms, switchboards, transformers, bus ducts, motor control centers, starters, voltage drop calculations, lighting distribution. Prerequisite: EEL 4015.

EEL 4140 Filter Design (3). Approximation techniques. Active RC second order modules. Low pass filters, bandpass filters, high pass filters, notch filters are studied in detail. Sensitivity and high order filters. Design and laboratory implementation. Prerequisite: EEL 4015.

EEL 4213 Power Systems I (3). Introductory course to power systems components; transformers, induction machines, synchronous machines, direct current machines, and special machines. Prerequisite: EEL 4410. Corequisites: EEL 3112 and EEL 4213L. (F,SS)

EEL 4213L Energy Conversion Lab (1). Operation, testing, and applications of energy conversion machines including AC and DC motors and generators. Experiments on magnetic circuits and transformers. Prerequisite: EEL 4410. Corequisite: EEL 4213. (F,SS)

EEL 4214 Power Systems II (3). Transmission line models, the bus admittance matrix, load flow studies and solution techniques, economic dispatch with and without losses, computer applications related to power system operations. Prerequisite: EEL 4213.

EEL 4215 Power Systems III (3). Short circuit calculations, symmetrical and unsymmetrical fault analysis, transient stability and dynamic studies as well as power system control. Computer applications. Prerequisite: EEL 4213.

EEL 4241 Power Electronics (3). Power semiconductor devices, power supplies, DC choppers, AC voltage controller, power inverter, AC and DC drives. Prerequisites: EEL 4213 and EEL 4304.

EEL 4410 Introduction to Fields and Waves (3). Electric and magnetic fields. The relation between field and circuit theory: waves and wave polarization, reflection, refraction, and diffraction. Electromagnetic effects in high-speed digital systems. Prerequisites: MAC 2313 and EEL 3111. (F,SS)

EEL 4461C Antennas (3). Introduction to linear antennas, linear arrays and aperture antennas. Far field pattern calculation and measurement techniques. Prerequisites: EEL 3514 or permission of the instructor.

EEL 4510 Introduction to Digital Signal Processing (3). Modeling of DSP systems, Z transform, Algorithms for convolution, correlation functions, DFT, and FFT computation. Digital filters design, engineering applications. Prerequisites: EEL 3514 or permission of the instructor.

EEL 4515 Advanced Communication Systems (3). Advanced senior level course designed for those students who desire to enhance their engineering knowledge in communication systems. State-of-the-art techniques in FM, digital communication, phase locked loops, noise treatment, threshold improvement, etc. Prerequisites: EEL 3514, EEL 4304 or permission of the instructor.

EEL 4611 Control Systems II (3). Design by Root-Locus, Bode plot, and Guillin-Truxal approach; characteristics of some typical industrial controllers and sensors. Computer simulation and other modern topics are included. Prerequisites: EEL 3657 or permission of the instructor.

EEL 4611L Systems Laboratory (1). Laboratory experiments in various systems. Includes position and velocity control systems, zeroth order, first order, and second order systems. Communication Systems. Prerequisites: EEL 3514, EEL 3657. (F,S)

EEL 4709C Computer Design (3). Computer architecture, arithmetic units, RAM, DRAM, ROM, disk, CPU, memory systems, data, input/output devices. Distributed and centralized control. Prerequisites: EEL 3712, EEL 3712L, EIN 3235. (F,SS)
EEL 4714 Introduction to Hardware Description Languages (HDL) (3). Introduction to Hardware Description Languages (HDL) such as VHDL, Verilog in the design of Digital Systems. These software designed systems will be implemented with CPLD and FPGA hardware units. Prerequisites: EEL 3712 or permission of the instructor.

EEL 4740 Embedded Computing Systems (3). Principles of embedded computing systems: architecture, hardware/software components, interfacing, hardware/software co-design, and communication issues. Prerequisite: EEL 4709C.


EEL 4746L Microcomputers I Laboratory (1). Hands-on design experience with microcomputer systems and applications including buses, interfaces, and in-circuit emulation. Prerequisite: EEL 4709C. Corequisite: EEL 4746. (F)

EEL 4747C Microcomputers II (4). Design of interfacing schemes of microcomputers such as video, disk, etc., and state-of-the-art hardware and software features of advanced micro-processors’ architectures, real-time systems, hardware-software trade-offs. Prerequisites: EEL 4746 or permission of the instructor.

EEL 4798 Special Topics in Computer Engineering (1-3). Special topics in computer engineering not covered in other courses. Prerequisite: Permission of the instructor.

EEL 4905 Individual Problems in Electrical Engineering (1-3). Selected problems or projects in the student's major field of electrical engineering. It can be extended to a maximum of six hours. Student works independently with a minor advisement from designated faculty member. Prerequisites: Senior level and permission of the instructor.

EEL 4920 Senior Design I: Ethics, Communications, and Constraints (2). Professional ethics, oral communications, project feasibility study, proposal writing, system design methodology, human factors, intellectual property, liability and schedules. Prerequisites: EEE 3303, EEL 3514, EEL 3657. Corequisites: EEL 4213 or EEL 4746. (S,F,SS)

EEL 4921C Senior Design II: Project Implementation (2). Design of a complete EE or CpE system including use of design methodology, formulation, specifications, alternative solutions, feasibility, economic, reliability, safety ethics, and social impact. Prerequisite: EEL 4920. (S,F,SS)

EEL 4930 Special Topics in Electrical Engineering (1-3). Special topics in electrical engineering not covered in other courses. Prerequisite: Permission of the instructor.

EEL 4949 Co-Op Work Experience (1-3). Practical Co-op engineering work under approved industrial supervision.

TCN 4081 Telecommunication Network Security (3). Introduction and overview of security issues for engineering applications. Topics include design, implementation and management of security in networks. Prerequisites: CNT 4403 or permission of the instructor.

TCN 4211 Telecommunication Networks (3). Underlying engineering principles of computer and digital networks. Topics include physical, link and network layers; telecommunication and switching technologies. Prerequisites: EEL 3514 or permission of the instructor.

TCN 4212 Telecommunication Network Analysis and Design (3). The principle and practice of telecommunication and computer networks with emphasis on telecommunication network protocols, datagram services, routing and QoS. Prerequisites: EEL 3514 or permission of the instructor.

TCN 4431 Principles of Network Management and Control Standards (3). Problems, principles and technologies in network management. General challenges in management of modern data and telecommunication networks. Prerequisites: EEL 3514 or permission of the instructor.