

**MICHIGAN STATE**  
**UNIVERSITY**

November 6, 2009

**MEMORANDUM**

**TO:** Dr. Douglas Estry, Associate Provost for Undergraduate Education  
and Dean of Undergraduate Studies

**FROM:** Dr. Linda O. Stanford, Associate Provost for Academic Services

**RE:** Request to Establish a Bachelor of Science Degree in Electrical and  
Computer Engineering which requires 128 credits

For Transmittal to the University Committee on Academic Policy (UCAP)

The request referenced above is being sent to the University Committee on Academic Policy (UCAP) in accordance with the *Bylaws for Academic Governance*, 4.4.

UCAP Response Requested:

Please ask the UCAP to consider the request referenced above at its meeting on November 19, 2009. Please mail the related materials referenced under the heading Attachments at the end of this memorandum to the members of the UCAP.

The academic program and course requests referenced above will be included on the agenda for the November 12, 2009 meeting of Subcommittee A, University Committee on Curriculum (UCC). Requests that are approved by Subcommittee A on November 12 will be before the Full Committee, UCC, for action on December 3, 2009. Requests that are approved by the Full Committee on December 3 will be included in the January 26, 2010, Report of the UCC to the Academic Council.

If you have any questions, please call Joy Speas, University Curriculum Administrator at 5-8420.

Thank you for your help.

Attachments:

1. Request to Establish a New Academic Program form dated November 2, 2009: Bachelor of Science Degree in Electrical and Computer Engineering and attachments.



**UNIVERSITY  
CURRICULUM  
and CATALOG**

Michigan State University  
176 Administration Building  
East Lansing, Michigan  
48824-1046

PH: 517/355-8420  
FAX: 517/353-1935

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<b>View a Program</b>		<b>Main Menu</b>
Joy Speas, RO	Monday, 11/2/2009	
<b>Program Name: Electrical and Computer Engineering Dubai Program</b> <b>Degree: BS Sequence Number: 1</b>		Program Request ID: 1496
<b>Effective Dates: Fall 2010 - Open Status: Interim Initial Action: New</b>		
<b>Requested Date: 7/30/2009 2:50:37 PM</b>		
<p><b>1. Department/School/College:</b> 16250 .... Department of Electrical and Computer Engineering</p> <p><b>2. Name of Program:</b> Electrical and Computer Engineering Dubai Program</p> <p><b>3. Name of Degree:</b> BS</p> <p><b>4. Type of Program:</b> Major</p> <p><b>5. Effective Start Semester:</b> Fall 2010</p> <p><b>6. Target student audience for the program:</b></p> <p><b>7. Enrollment:</b> <b>What is the expected enrollment per year:</b> 40 <b>What is the minimum enrollment acceptable:</b> 0</p> <p><b>8. Source of budget for the program:</b> To align academic planning and curricular change, ALL requests for NEW funds must be included in the College's annual planning letter. Provost approval of new funds and the effective date for the new program must align. If funding is not approved, then the program request will not be forwarded to Academic Council.  Internal reallocation  If new funds, was this request included in the College's annual planning letter? Indicate yes or no. If no, then this is a department or college fund reallocation (If the program is implemented, no additional resources are required.). Reallocation from Computer Engineering Dubai Program</p> <p><b>9. Projected Costs as compared to other programs in unit:</b> Same</p> <p><b>10. Staff requirement:</b> How many additional staff will be required: 0  Who will provide the primary instruction. Describe any external linkages(industry, government, etc.):</p>		

**11. Will additional equipment be required:**

Approximate cost: 0

Source of funding:

**12. Will additional library materials be required:**

Approximate cost: 0

Source of funding: None

**13. Will additional space be required:**

Type:

Approximate amount:

**14. If the program requirements contain a named concentration, do you wish for the concentration to be noted on the student's transcript?:**

No

**15. Detailed Description:**

**College of Engineering  
Department of Electrical and Computer Engineering  
Undergraduate Programs  
Electrical and Computer Engineering**

The Electrical and Computer Engineering program is offered only at the Dubai instructional site and is designed to combine the most relevant opportunities of our Electrical Engineering and Computer Engineering programs including both software and hardware components.

**Requirements for the Bachelor of Science Degree in Electrical and Computer Engineering**

1. The University requirements for bachelor's degrees as described in the Undergraduate Education section of this catalog; 128 credits, including general elective credits, are required for the Bachelor of Science degree in Electrical and Computer Engineering.

The University's Tier II writing requirement for the Electrical and Computer Engineering major is met by completing Electrical and Computer Engineering 480. That course is referenced in item 3.b. below

Students who are enrolled in the College of Engineering may complete the alternative track to Integrative Studies in Biological and Physical Sciences that is described in item 1. under the heading Graduation Requirements for All Majors in the College statement. Certain courses referenced in requirement 3. below may be used to satisfy the alternative track.

2. The requirements of the College of Engineering for the Bachelor of Science degree.

The credits earned in certain courses referenced in requirement 3. below may be counted toward College requirements as appropriate.

3. The following requirements for the major:

- a. One of the following courses (1 credit):

CEM 161	Chemistry Laboratory I	1
PHY 191	Physics Laboratory for Scientists, I	1

- b. All of the following courses (43 credits)

CSE 232	Introduction to Programming II	4
CSE 260	Discrete Structures in Computer Science	4
CSE 331	Algorithms and Data Structures	3
ECE 201	Circuits and Systems I	3
ECE 202	Circuits and Systems II	3
ECE 203	Circuits and Systems Laboratory	1
ECE 230	Digital Logic Fundamentals	3
ECE 280	Electrical Engineering Analysis	3
ECE 302	Electronic Circuits	3
ECE 303	Electronics Laboratory	1
ECE 313	Control Systems	3
ECE 331	Microprocessors and Digital Systems	4
ECE 366	Introduction to Signal Processing	3
ECE 390	Ethics, Professionalism and Contemporary Issues	1
ECE 480	Senior Design	4

- c. Select a minimum of 21 credits from the major elective list below. Selected electives must include one course with a laboratory(L), one ECE course and one CSE course. The specific courses offered at the Dubai location can be expected to be a subset of this list during an individual student's degree pursuit.

ECE 305	Electromagnetic Fields and Waves I	4
ECE 320	Energy Conversion and Power Electronics	3
CSE 335	Object-oriented Software Design	3
ECE 402	Applications of Analog Integrated Circuits (L)	4
ECE 404	Radio Frequency Electronic Circuits (L)	4
ECE 410	VLSI Design (L)	4
CSE 410	Operating Systems	3
ECE 411	Electronic Design Automation (L)	4
ECE 412	Mixed-Signal Integrated Circuits (L)	4
ECE 416	Digital Control (L)	3
CSE 420	Computer Architecture	3
ECE 423	Power System Analysis	3
ECE 442	Intro to Communication Networks	3
CSE 450	Translation of Programming Languages	3
ECE 457	Communication Systems	3

ECE 458	Communication Systems Laboratory (L)	1
ECE 466	Digital Signal Processing and Filter Design	3
CSE 471	Media Processing and Multimedia Computing	3
ECE 474	Principles of Electronics Devices	3

d. **Experiential Education Substitution**

Students may use registered "out of classroom" experiences to substitute for credits in requirement 3a. For students who complete a total of 3 experiences documented by pre-approved EGR/ECE credits (EGR 393, ECE 490/499), the 21 credit requirement is reduced to 18.

**Total Credits Required for Degree** **128**

**16. Are there admissions requirements for this program?:**

Grade or grade-point average requirements and if so in which course(s), portfolio requirement, audition, essay, etc. If there are not admission requirements other than those required by the University policy indicate "none".

Yes, GPA

**DEPARTMENT LEVEL APPROVAL STATUS**

Approved: Department of Electrical and Computer Engineering  
9/4/2009 2:23:58 PM by Pauline VanDyke for Timothy Grotjohn, Chairperson

**COLLEGE LEVEL APPROVAL STATUS**

Approved: College of Engineering  
11/2/2009 8:46:02 AM by Thomas Wolff for Thomas F. Wolff, Associate Dean

Comments: Forwarding for University approval per conversation with Provost Wilcox and Associate Provost Youatt, 11/2/2009

## Speas, Joy

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**From:** John McCracken [mccracke@msu.edu]  
**Sent:** Wednesday, November 04, 2009 3:58 PM  
**To:** Speas, Joy  
**Subject:** dubai academic change

Dear Ms. Speas,

The Department of Chemistry is supportive of the requirement for a choice of CEM 141 or PHY 191 for the new Electrical and Computer Engineering Program.

Sincerely yours,

John McCracken  
Professor and Chair  
Department of Chemistry  
485B Chemistry Bldg.  
Michigan State University  
East Lansing, MI 48824  
517 355-9715 (ext. 269)  
fax: 517 353-1793

Supporting information for new degree program  
**Electrical and Computer Engineering**  
To be taught at the Dubai instructional site

**Program form item 15, Detailed Description**

a. Background information, including considerations which precipitated the development of the program, relationship to other programs at MSU....

Supply a copy of standards of accrediting agencies...

The proposal is to change the degree program offered in Dubai from *Computer Engineering* to *Electrical and Computer Engineering*, and move the students to the new program.

With two years experience in Dubai, it has become apparent to administrators in both the College of Engineering and the Dubai instructional site that including an electrical engineering component will enhance the marketability of the program and better serve regional demands. At the same time, adding the East Lansing Electrical Engineering as a separate, second major is not compatible with the present resources in Dubai. A program that offers components of both electrical and computer engineering will provide a more focused solution, both for students and future graduates in pursuit of their careers, and for faculty recruiting as the program further develops.

A copy of the ABET engineering (EAC) accreditation criteria, template for self-studies, and related information is available at <http://www.abet.org/forms.shtml>

b. Rationale for offering the program at MSU

Transition from program already offered. See (a).

c. Rationale for housing in ECE department.

See (a) and (b)

d. Educational objectives of the program and their relationship to those of the college and university.

New objectives will be published that bridge the following objectives, previously developed for ABET accreditation. Note that these only differ in the first objective.

## Computer Engineering

The computer engineering program provides its graduates with a solid foundation on which they can build successful and sustainable careers. Within the first several years following graduation, graduates of the computer engineering program will:

1. **have accrued an understanding of the discipline**, built on an exposure to a broad range of computer engineering topics including the latest and emerging techniques and technologies.
2. **have established expertise within the discipline** originating with in-depth study in selected curricular areas emphasizing the solution to engineering problems using proper tools, practical approaches, and creative problem solving.
3. **be engaged in lifelong learning** in computer engineering, based on a strong foundation in the core sciences and mathematics.
4. **have an appreciation for the global and societal impact of the discipline** through an exposure to contemporary issues, and a knowledge and respect for ethical standards and professional responsibilities.
5. **have successfully utilized essential professional skills** such as teamwork and communications, both oral and written, within the context of engineering problem solving and design.

## Electrical Engineering

The electrical engineering program provides its graduates with a solid foundation on which they can build successful and sustainable careers. Within the first several years following graduation, graduates of the electrical engineering program will:

1. **have accrued an understanding of the discipline**, built on an exposure to a broad range of electrical engineering topics including the latest and emerging techniques and technologies.
2. **have established expertise within the discipline** originating with in-depth study in selected curricular areas emphasizing the solution to engineering problems using proper tools, practical approaches, and creative problem solving.
3. **be engaged in lifelong learning** in electrical engineering, based on a strong foundation in the core sciences and mathematics.
4. **have an appreciation for the global and societal impact of the discipline** through an exposure to contemporary issues, and a knowledge and respect for ethical standards and professional responsibilities.
5. **have successfully utilized essential professional skills** such as teamwork and communications, both oral and written, within the context of engineering problem solving and design.



e. Faculty who were instrumental in developing the program and faculty who will be responsible for implementing the program...

For both development and implementation

- Timothy Grotjohn, Chairperson, Electrical and Computer Engineering
- Matthew Mutka, Chairperson, Computer Science and Engineering
- Boutheina Tlili Kzadri, Dubai instruction site

f. Plan for evaluating the program, assessing student outcomes....

Because of the engineering accreditation process, the college has a very robust system of program and student assessment procedures, which are well established in the ECE department and all engineering departments, and already in play in Dubai. Use of that system will continue.

g. Program description, including statement and specific requirements, as they will appear in the catalog.

Program requirements have been submitted with the program form. The program description will be developed from the existing two catalog descriptions, and forwarded by the ECE department in time for the first governance meetings on this program action.

h. If a different location than East Lansing, specify

Dubai, United Arab Emirates

i. Certificate programs,

Not applicable.

j. Other information that will assist the Provost and other University-level committees in evaluating the request.

See (a) for the rationale for switching from Computer Engineering to Electrical and Computer Engineering at the Dubai site. This approach was approved in concept by Provost Wilcox at a meeting with College leadership on November 2, 2009.

**Program form item 16 – Admission requirements**

For items a through g., there is no change from the current practices of the College of Engineering.

h. Will this change affect time to degree?

No. For the students presently in Dubai, the changes in the program occur at points in the curriculum they have not yet reached.

i. How many (and which) student will be affected by this change?

There are approximately 14 total freshmen and sophomores in Computer Engineering in Dubai.

j. How will the unit notify current students and how will they be accommodated.

Students will be informed by a letter from the Department and College, developed in consultation with the Dubai Executive Director, Dr. Mullan.

k. How will this change affect access for transfer students?

No affect.

l. How will the unit educate prospective students and feeder institutions about the change...?

The Dubai recruiting director will promote the new major and explain the additional opportunities with "Electrical" now in the title.

**Program form item 17 – Cooperating Departments / Schools / Colleges**

- Department of Electrical and Computer Engineering
- Department of Computer Science and Engineering
- College of Engineering

# DEPARTMENT of ELECTRICAL and COMPUTER ENGINEERING

*Timothy Grotjohn, Chairperson*

## UNDERGRADUATE PROGRAMS

### COMPUTER ENGINEERING

Computer engineering is concerned with the organization and design of computers and computer systems. The study of computer hardware and software, and their integration and application, is emphasized. The undergraduate program in computer engineering integrates studies in mathematics, basic sciences, engineering sciences, and engineering design. The program is structured to establish analytical and design skills in areas such as computer architecture, digital logic design, analog and mixed-signal circuits, computer communication networks, digital computer control, integrated circuit engineering, software engineering, operating systems, data structures and algorithms, computer-aided engineering, and electronic design automation. Complementing these fundamentals, the program also provides opportunities for specialization in individually selected areas of interest.

The Bachelor of Science Degree program in Computer Engineering is accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012; telephone 1-410-347-7700.

### Requirements for the Bachelor of Science Degree in Computer Engineering

1. The University requirements for bachelor's degrees as described in the *Undergraduate Education* section of this catalog; 128 credits, including general elective credits, are required for the Bachelor of Science degree in Computer Engineering.

The University's Tier II writing requirement for the Computer Engineering major is met by completing Electrical and Computer Engineering 480. That course is referenced in item 3. b. below.

Students who are enrolled in the College of Engineering may complete the alternative track to Integrative Studies in Biological and Physical Sciences that is described in item 1. under the heading **Graduation Requirements for All Majors** in the College statement. Certain courses referenced in requirement 3. below may be used to satisfy the alternative track.

2. The requirements of the College of Engineering for the Bachelor of Science degree. The credits earned in certain courses referenced in requirement 3. below may be counted toward College requirements as appropriate.
3. The following requirements for the major:

	CREDITS
a. One of the following courses: .....	1
CEM 161 Chemistry Laboratory I .....	1
PHY 191 Physics Laboratory for Scientists, I .....	1
b. All of the following courses: .....	56
CSE 231 Introduction to Programming I .....	4
CSE 232 Introduction to Programming II .....	4
CSE 260 Discrete Structures in Computer Science .....	4
CSE 331 Algorithms and Data Structures .....	3
CSE 410 Operating Systems .....	3
ECE 201 Circuits and Systems I .....	3
ECE 202 Circuits and Systems II .....	3
ECE 203 Electric Circuits and Systems Laboratory .....	1
ECE 230 Digital Logic Fundamentals .....	3
ECE 280 Electrical Engineering Analysis .....	3
ECE 302 Electronic Circuits .....	3
ECE 303 Electronics Laboratory .....	1
ECE 331 Microprocessors and Digital Systems .....	4
ECE 390 Ethics, Professionalism and Contemporary Issues .....	1
ECE 480 Senior Design .....	4
c. <b>Electives</b> Complete 24 credits of electives as specified below. At least 18 credits must be from core and focus track electives combined. Ad-	

ditional credits to meet the 24 credit requirement may be taken from other courses listed below, any 400-level Computer Science and Engineering (CSE) or Electrical and Computer Engineering (ECE) courses, or by completing an approved 3 or 4 credit experiential, out-of-classroom education experience obtained through engineering cooperative education or independent study.

**Core**

At least 6 credits from the following:

CSE 420	Computer Architecture	3
CSE 422	Computer Networks	3
ECE 410	VLSI Design	4

**Focus Track**

At least 12 credits from the following:

**Hardware**

ECE 402	Applications of Analog Integrated Circuits	4
ECE 411	Electronic Design Automation	4
ECE 412	Introduction to Mixed-Signal Circuit Design	4

**Software**

CSE 335	Object-oriented Software Design	3
CSE 450	Translation of Programming Languages	3
CSE 471	Media Processing and Multimedia Computing	3
ECE 366	Introduction to Signal Processing	3

**Recommended Electives**

ECE 305	Electromagnetic Fields and Waves I	4
ECE 313	Control Systems	3
ECE 404	Radio Frequency Electronic Circuits	4
ECE 415	Computer Aided Manufacturing	3
ECE 416	Digital Control	3
ECE 457	Communication Systems	3
ECE 458	Communication Systems Laboratory	1
ECE 466	Digital Signal Processing and Filter Design	3
ECE 474	Principles of Electronics Devices	3

*Insert 1*

**ELECTRICAL ENGINEERING**

The program provides both required and elective studies in communications, computers, control systems, electromagnetics, electronics, materials processing, power, signals, solid state, and biomedical engineering. It places emphasis on the fundamentals of science and mathematics and their application to the solution of contemporary problems that are within the purview of professional electrical engineers. The program is designed to establish a sound scientific basis for continuous growth in professional competence.

The Bachelor of Science Degree program in Electrical Engineering is accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012; telephone 1-410-347-7700.

**Requirements for the Bachelor of Science Degree in Electrical Engineering**

- The University requirements for bachelor's degrees as described in the *Undergraduate Education* section of this catalog; 128 credits, including general elective credits, are required for the Bachelor of Science degree in Electrical Engineering.

The University's Tier II writing requirement for the Electrical Engineering major is met by completing Electrical and Computer Engineering 480. That course is referenced in item 3. b. below.

Students who are enrolled in the College of Engineering may complete the alternative track to Integrative Studies in Biological and Physical Sciences that is described in item 1. under the heading **Graduation Requirements for All Majors** in the College statement. Certain courses referenced in requirement 3. below may be used to satisfy the alternative track.

- The requirements of the College of Engineering for the Bachelor of Science degree. The credits earned in certain courses referenced in requirement 3. below may be counted toward College requirements as appropriate.
- The following requirements for the major:

	CREDITS
a. One of the following courses:	1
CEM 161 Chemistry Laboratory I	1
PHY 191 Physics Laboratory for Scientists, I	1
b. All of the following courses:	42
CSE 251 Programming in C	1
ECE 201 Circuits and Systems I	3
ECE 202 Circuits and Systems II	3
ECE 203 Electric Circuits and Systems Laboratory	1
ECE 230 Digital Logic Fundamentals	3
ECE 280 Electrical Engineering Analysis	3
ECE 302 Electronic Circuits	3
ECE 303 Electronics Laboratory	1
ECE 305 Electromagnetic Fields and Waves I	4
ECE 313 Control Systems	3
ECE 320 Energy Conversion and Power Electronics	3
ECE 331 Microprocessors and Digital Systems	4
ECE 366 Introduction to Signal Processing	3

**ELECTRICAL AND COMPUTER ENGINEERING**

The Bachelor of Science degree in Electrical and Computer Engineering is offered only at the Dubai instructional site. The program is designed to provide students with an opportunity to study electrical engineering and computer engineering including exploration of both hardware and software.

**Requirements for the Bachelor of Science Degree in Electrical and Computer Engineering**

1. The University requirements for bachelor's degrees as described in the *Undergraduate Education* section of this catalog; 128 credits, including general elective credits, are required for the Bachelor of Science degree in Electrical and Computer Engineering.

The University's Tier II writing requirement for the Electrical and Computer Engineering major is met by completing Electrical and Computer Engineering 480. That course is referenced in item 3. b. below.

Students who are enrolled in the College of Engineering may complete the alternative track to Integrative Studies in Biological and Physical Sciences that is described in item 1. under the heading Graduation Requirements for All Majors in the College statement. Certain courses referenced in requirement 3. below may be used to satisfy the alternative track.

2. The requirements of the College of Engineering for the Bachelor of Science degree. The credits earned in certain courses referenced in requirement 3. below may be counted toward College requirements as appropriate.
3. The following requirements for the major:

			CREDITS
a.	One of the following courses (1 credit):		
	CEM 161	Chemistry Laboratory I	1
	PHY 191	Physics Laboratory for Scientists, I	1
b.	All of the following courses (43 credits):		
	CSE 232	Introduction to Programming II	4
	CSE 260	Discrete Structures in Computer Science	4
	CSE 331	Algorithms and Data Structures	3
	ECE 201	Circuits and Systems I	3
	ECE 202	Circuits and Systems II	3
	ECE 203	Circuits and Systems Laboratory	1
	ECE 230	Digital Logic Fundamentals	3
	ECE 280	Electrical Engineering Analysis	3
	ECE 302	Electronic Circuits	3
	ECE 303	Electronics Laboratory	1
	ECE 313	Control Systems	3
	ECE 331	Microprocessors and Digital Systems	4
	ECE 366	Introduction to Signal Processing	3
	ECE 390	Ethics, Professionalism and Contemporary Issues	1
	ECE 480	Senior Design	4
c.	Complete a minimum of 21 credits from the following courses. Specific courses offered at the Dubai instructional site can be expected to be a subset of this list during an individual student's degree pursuit.		

- (1) At least one of the following laboratory courses:
 

ECE 402	Applications of Analog Integrated Circuits	4
ECE 404	Radio Frequency Electronic Circuits	4
ECE 410	VLSI Design	4

	ECE	411	Electronic Design Automation	4
	ECE	412	Introduction to Mixed-Signal Integrated Circuits	4
	ECE	416	Digital Control	3
	ECE	458	Communication Systems Laboratory	1
(2)	At least one of the following courses:			
	CSE	335	Object-oriented Software Design	3
	CSE	410	Operating Systems	3
	CSE	420	Computer Architecture	3
	CSE	450	Translation of Programming Languages	3
	CSE	471	Media Processing and Multimedia Computing	3
(3)	At least one of the following courses:			
	ECE	305	Electromagnetic Fields and Waves I	4
	ECE	320	Energy Conversion and Power Electronics	3
	ECE	423	Power System Analysis	3
	ECE	442	Introduction to Communication Networks	3
	ECE	457	Communication Systems	3
	ECE	466	Digital Signal Processing and Filter Design	3
	ECE	474	Principles of Electronic Devices	3

Students may use registered 'out of classroom' experiences to substitute for credits in this requirement. Students who complete a total of three experiences documented by pre-approved Engineering 393 or Electrical and Computer Engineering 490 or 499 credits, may reduce this requirement to 18 credits. All substitutions must be approved by the student's academic advisor.

ECE 390	Ethics, Professionalism and Contemporary Issues	1	
ECE 480	Senior Design	4	
EGR 102	Introduction to Engineering Modeling	2	
c.	One of the following courses:		3
CE 221	Statics	3	
ME 201	Thermodynamics	3	
d.	A minimum of six courses totaling a minimum of 18 credits, of 3 or 4 credits each, selected from at least four different areas. A laboratory course must be included. Students may substitute, for one of the six required courses, a 3 or 4 credit experiential education experience obtained in a minimum of three out-of-classroom experiences through engineering cooperative education or independent study. Students interested in the experiential education experience must contact the department for approval.		
<b>Electromagnetics</b>			
ECE 405	Electromagnetic Fields and Waves II	4	
ECE 407	Electromagnetic Compatibility	4	
<b>Power</b>			
ECE 420	Machines and Power Laboratory	1	
ECE 423	Power System Analysis	3	
<b>Integrated Circuits/VLSI</b>			
ECE 402	Applications of Analog Integrated Circuits	4	
ECE 404	Radio Frequency Electronic Circuits	4	
ECE 410	VLSI Design	4	
ECE 411	Electronic Design Automation	4	
ECE 412	Introduction to Mixed-Signal Circuit Design	4	
<b>Solid-State Electronics/Electro-optics</b>			
ECE 474	Principles of Electronic Devices	3	
ECE 476	Electro-Optics	4	
ECE 477	Microelectronic Fabrication	3	
<b>Communications/Signal Processing</b>			
ECE 442	Introduction to Communication Networks	3	
ECE 457	Communication Systems	3	
ECE 458	Communication Systems Laboratory	1	
ECE 466	Digital Signal Processing and Filter Design	3	
<b>Control/Robotics</b>			
ECE 415	Computer Aided Manufacturing	3	
ECE 416	Digital Control	3	
<b>Biomedical Engineering</b>			
ECE 445	Biomedical Instrumentation	3	
ECE 446	Biomedical Signal Processing	3	
ECE 447	Introduction to Biomedical Imaging	3	
ECE 448	Modeling and Analysis of Bioelectrical Systems	3	

### Biomedical Engineering Concentration

The department offers a concentration for students who plan to pursue graduate work in biomedical areas or seek employment in selected medical-related areas. The concentration is available to, but not required of, any student enrolled in the Bachelor of Science degree program in Electrical Engineering. Courses completed to satisfy requirement 3. above may also be used to satisfy the requirements of the concentration. The concentration will be noted on the student's transcript.

### Biomedical Engineering

To earn a Bachelor of Science degree in Electrical Engineering with a biomedical engineering concentration, students must complete requirements 1., 2., and 3. above and the following:

			CREDITS
1.	Complete 6 credits from the following courses:		
	ANTR 350 Human Gross Anatomy and Structural Biology	3	
	BS 111 Cells and Molecules	3	
	PSL 250 Introductory Physiology	4	
	PSL 431 Human Physiology I	3	
	PSL 432 Human Physiology II	3	
2.	Complete 6 credits from the following courses:		
	ECE 445 Biomedical Instrumentation	3	
	ECE 446 Biomedical Signal Processing	3	
	ECE 447 Introduction to Biomedical Imaging	3	
	ECE 448 Modeling and Analysis of Bioelectrical Systems	3	
3.	Complete 3 credits from the following courses:		
	ME 494 Biofluid Mechanics and Heat Transfer	3	
	ME 495 Tissue Mechanics	3	
	MSE 425 Biomaterials and Biocompatibility	3	
	A 400-level listed above or other approved Electrical and Computer Engineering (ECE) courses with biomedical engineering content as approved by the student's advisor. The course used to fulfill this requirement may not be used to fulfill concentration requirement 1. or 2.		

**LINKED BACHELOR'S-MASTER'S DEGREE IN  
ELECTRICAL ENGINEERING**

*Bachelor of Science Degree in Electrical Engineering*  
*Master of Science Degree in Electrical Engineering*

The department welcomes applications from Michigan State University Electrical Engineering undergraduate students in their junior and senior year. Admission applications must be made during the prior spring semester for an anticipated spring graduation or the prior Fall semester for an anticipated Fall graduation to allow admission before the final semester as a Electrical Engineering undergraduate. Admission to the program requires a minimum undergraduate grade-point average of 3.50 and an approved program of study for the Master of Science degree in Electrical Engineering at the time of admission. Admission to the Linked Bachelor's-Master's program allows the application of up to 9 credits toward the master's program for qualifying 400-level and above course work taken at the undergraduate level at Michigan State University or an external accredited institution. The number of approved credits, not to exceed 9, are applied toward the credit requirement of the master's degree. Credits applied to the Linked Bachelor's-Master's program are not eligible to be applied to any other graduate degree program.

**GRADUATE STUDY**