Minnesota State University, Mankato  
Curriculum Proposal

Please type or select the requested information. Print completed forms, add appropriate paper attachments, and route through MSU's curricular process for recommendations and decisions.

<table>
<thead>
<tr>
<th>College: Science, Engineering and Technology</th>
<th>Proposal # 356</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department: Electrical and Computer Engineering and T</td>
<td>Effective Date of Change:</td>
</tr>
<tr>
<td>Program: Electrical Engineering</td>
<td>Academic Year 2006-07</td>
</tr>
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</table>

(Check all that apply):  
- Undergraduate  
- Graduate  

Type of Change: PROGRAM PROPOSALS  
Proposed: Redesign Change in Degree Award  

Title Current:  
Title Proposed:  
24-Char. Abbrev:  

Include a course or program description for the Bulletin (30-40 words maximum for courses, 100 for programs):  
Program description should remain as is currently found in the bulletin.

Rationale or Justification for change:  
We believe that the changes proposed are required to allow our program to remain current and to allow us to remain accredited.

***For General Education or Cultural Diversity Courses Only***

<table>
<thead>
<tr>
<th>GE Category #</th>
<th>GE Category Name (Maximum of 3 Categories)</th>
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</table>

* For Writing Intensive Courses, attach a description of the kind and quantity of writing.  
* For Upper Division Courses, include a description of the respects in which it is broad and general rather than narrow and specific, and so suitable as GE.

Attach paper copies of the following:  
a. Syllabus or course outline.  
b. Course's student learning outcomes associated with each GE competency or CD designation.  
c. List of strategies to be used to assess students' achievement of each GE competency or CD designation.

***For New Courses***

<table>
<thead>
<tr>
<th>Instructional Type: Lecture</th>
<th>Course will be offered:</th>
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<tr>
<td>Course is an elective.</td>
<td>Fall Semester</td>
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<tr>
<td>Course is required for program</td>
<td>Spring Semester</td>
</tr>
<tr>
<td>Pre- or Co-requisites:</td>
<td>Summer Session</td>
</tr>
</tbody>
</table>

Other courses are being changed or eliminated. (Explain.)  

Course content or title is similar to courses in other departments. (Attach copy of letter of agreement with other program(s) contacted. Indicate the nature of the discussions and/or resolution of differences or potential conflicts.)

Attach paper copies of the following:  
a. Syllabus or course outline.  
b. Course's student learning outcomes.  
c. A list of resources required to offer and support this course.  
d. A description of how teaching this course will affect department staffing.  
e. If 400/500 level course, an explanation of added expectations of graduate students.

Revised September 2002
Minnesota State University, Mankato
Curriculum Proposal

***Signature Page***

Department
- Recommended (Category/ies_______)  
  [Signature]  
  Date

Comments:

College Curriculum Committee
- Recommended (Category/ies_______)  
  [Signature]  
  Date

Comments:

College Dean
- Recommended (Category/ies_______)  
  [Signature]  
  Date

Comments:

General Education Subcommittee
- Recommended (Category/ies_______)  
  Date

Comments:

Undergraduate Curriculum and Academic Policy Committee
- Recommended (Category/ies_______)  
  [Signature]  
  Date

Comments:

Faculty Association Graduate Committee
- Recommended  
  Date

Comments:

Graduate Dean
- Recommended  
  Date

Comments:

Academic Affairs Council
- Recommended (Category/ies_______)  
  [Signature]  
  Date

Comments:

Senior Vice President and Vice President for Academic Affairs
- Approved (Category/ies_______)  
  [Signature]  
  Sr. Vice President / Vice Pres. Academic Affairs  
  Date

Comments:

Revised September 2002
Memorandum

To: Course and Curriculum Committees
CC: [Click here and type name]
From: William B Hudson, Chair ECET
Date: February 15, 2007 (Information previously provided – revised here for clarity)
Re: Electrical Engineering Curriculum Changes

Attached please find the revised curriculum for the Electrical Engineering degree program. Please be aware that many of the courses required for the Electrical Engineering degree are also required for the Computer Engineering degree so that changes in both Electrical and Computer Engineering degree programs need to be reviewed and considered jointly.

Specific points to note:

- Because of required sequencing of courses to meet prerequisites changes in the program are first shown on a modified student advising form to establish that course prerequisites are met and also that students would be able to complete the program in four years.

- Changes in this program do not change current engineering general education requirements.

- Course additions proposed as part of this proposal include, EE 106 and EE 107 to help in addressing student retention issues through integrated freshmen year departmental hands on courses.

- The addition of a of CS 220 course requirement to be offered by the new CS department to better meet the needs of transfer students.

- Addition of an additional semester of design through the creation of a new design course in the junior year EE336.

- Addition of two new courses EE 381 and EE 382 to address the current weaknesses in students exposure to digital design.

- Changes in credit hours for EE 332, EE 341, EE 333, EE 353, EE 350, EE 467, EE 250, and EE 477 to allow more consistent class scheduling to aid in student learning and faculty scheduling.

- The total credit hours required for the Electrical Engineering degree would not change with the proposed curriculum changes.
Provided in support of this proposal and identified as attachment 2 are the required program student learning outcomes as defined by our accreditation agency ABET. These outcomes listed as topics ask are supported by course outcomes which have been created for all courses and mapped to the provided learning outcomes.

Minutes of department meetings supporting these changes are provided and marked as attachment 3.

Our program accreditation requires both assessment and improvement. Accreditation Criteria 2 requires that we evaluate and determine that the Electrical Engineering program prepares students to meet career and professional requirements normally one to five years after graduation. It is required that we have in place a process by which we determine this and use the results to improve our Electrical Engineering program. Further Criteria 3 of our accreditation requires that we assess program outcomes (competencies at graduation) and use these results to improve the Electrical Engineering program. An overview of the assessment plan for the Electrical Engineering program is provided as attachment 4.

As can be seen the change in the Electrical Engineering program has implications for new course requirements in Computer Science. Correspondence related to this change can be found marked as attachment 5.

**Resources**

Resources required to support the changes will occur through departmental reallocation of existing resources and will change only as student numbers increase as would occur with the existing curriculum.

**Staffing**

Departmental staffing is adequate to address the program changes. Staffing needs will change only as student numbers change which would occur with the current program.

**Library Needs**

No changes would occur relative to necessary library holdings.

**Bulletin Copy**

Changes in bulletin copy should only reflect changed course offering and program requirements as provided in the supporting materials.
### Change in Credit Hours

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The changes are marked with +/- indicating an increase or decrease in credit hours.
Notes:

*H/SS:
   Humanities 6-7 credits
   Social Sciences 6-7 credits
   16 total credits one class following at the 300 or 400 level

** EE Electives
   Previous requirements 9 credits
   EE 334 and EE 344 are now allowed as possible electives in addition to the others listed

   So 7 credits of EE electives will be required to reach 128

*** Business Area Electives:
   Would have a total of 6 or 9 credits depending on how we view Econ credits
   EE 450 – 3 credits
   And one of BLAW 200, FINA 362, MGMT 330, MGMT 440, or MRKT 310
   Would also have macro or micro economics 3 credits

Total Credits = 128
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<th>Proposed Program</th>
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<tr>
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<td>EE 332 Electronics I</td>
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<tr>
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<tr>
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<td>EE 471 Advanced Control Systems</td>
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<tr>
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<td>EE 475 Integrated Circuit Engineering</td>
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<tr>
<td>EE 479 Antennas, Propagation, and Microwave Engineering</td>
<td>EE 479 Antennas, Propagation, and Microwave Engineering</td>
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</tr>
<tr>
<td>EE 487 RF Systems Engineering</td>
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<td>Total Credits</td>
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<td>128</td>
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</tr>
</tbody>
</table>
Attachment 2 - The Electrical Engineering Student Learning Outcomes

Students completing the Electrical Engineering degree program will be able to:
(a) to apply knowledge of mathematics, science, and engineering
(b) to design and conduct experiments, as well as to analyze and interpret data
(c) 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) to function on multi-disciplinary teams
(e) to identify, formulate, and solve engineering problems
(f) understand professional and ethical responsibility
(g) to communicate effectively
(h) have the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) understand the need for, and an ability to engage in life-long learning
(j) understand contemporary issues
(k) use the techniques, skills, and modern engineering tools necessary for engineering practice.
Minutes of the Meeting of part of the faculty of Department of Electrical and Computer Engineering and Technology
31 October 2006

Present: Han-way Huang, William Hudson, Julio Mandojana, Thomas Hendrickson, John Caven, Muhammad Khaliq, Vincent Winstead, Paul Lindfors

1. The minutes of the meeting of 3 October 2006 were approved.

2. Department Good News

2.1 IEEE speakers
2.2 IEEE tour of Winland Electronics on Monday, 30 October
2.3 Grants?
2.4 Grant applications

3. The personnel committee will be forthcoming in the near future regarding the request by Dr. Kapadia to be promoted to rank of Full Professor.

4. Faculty interested in teaching summer courses need to apply to Dr. Hudson soon. Those who have expressed interest thus far are: Khaliq, Kapadia, Mandojana and Winstead. The courses that will probably be offered are EE-230 and EE-231.

5. Some graduate courses have experienced a problem with insufficient enrollment. The department needs to develop a system of written commitment by graduate students so the department can plan the courses and teaching loads more effectively. Ideas were forwarded, but no action was taken.

6. Thanks to Mandojana and Allen for preparation of course and program materials and Mandojana and Hudson for steering the course and curriculum changes through the Course and Curriculum Committee of the college. The process was tedious but necessary. The faculty had reviewed and approved the Course and Curriculum materials previously but to provide a clean paper trail Hudson and Winstead will circulate a form that will preserve a written record of faculty approval of the course and curriculum changes by way of email.

7. Mandojana will tour Winstead and Zhang through Goodrich so possible courses for Spring Semester 2007 can be identified. Planning for this tour will be done by the 3 participants.

8. Hudson was surprised by the announcement regarding IEEE publications and a complete shift to electronic forms that arrived from the library. Several faculty noted the absence of journals they thought had once been present. The rushed schedule and extent of the changes will be investigated by Hudson.

9. Jeff Pribyl of Chemistry and Geology has been discussing with the engineering program heads the development of a new, 3-credit chemistry course for engineering students. This course would have no laboratory. Such a course would allow electrical, mechanical and computer engineering students greater program flexibility but the laboratory component may be needed by civil engineering students. It was agreed that students could still take Chemistry-201 in place of the new course when it is offered.

10. Other issues were tabled.
The ECET department has invested many meetings during the last two years to the refinement of all of the department programs. The department faculty have had many votes as we have worked to refine the curriculum to best serve our students and our constituent groups. The final affirmation of these changes has been accomplished by an email vote sent to faculty after changes recommended by the College Course and Curriculum were implemented - Email attached as well as program summaries.

The results of email vote are as follows:

- Electronic Engineering Technology: Approve 8, Disapprove 1
- Computer Engineering Technology: Approve 9, Disapprove 0
- Electrical Engineering: Approve 9, Disapprove 0
- Computer Engineering: Approve 9, Disapprove 0
Minutes of the Meeting of par. of the faculty of Department of Electrical and Computer Engineering and Technology
07 November 2006

Present: Gale Allen, Han-way Huang, William Hudson, Paul Lindfors, Julio Mandojana , R. A. Nair, Mahbubur Syed, Vincent Winstead, Vincent Zhang

1. Presentation by Diane Richards, Collection Development Librarian: Questions regarding change to electronic form of journals and possibility of "missing" journals were answered. Receiving the journals in electronic form will duplicate the printed journals now received plus add others. The apparently "missing" journals are still present in printed form.

2. The minutes of the meeting of 31 October 2006 were approved.

3. Curriculum issues dominated the meeting. Hudson reported that all program changes that were approved previously were not going to be approved by the Dean because of staffing issues. Working with David Haglin of CIS many changes were preserved while some changes were not included or a compromise with CIS was worked out. A list of the present and revised programs that are expected to be approved for EE, CompE, EET, and CompET are attached. No easy summary of the situation can be made. Motion made and seconded all present voted to move forward with the programs as defined in the attached forms.

4. Summer teaching remained as reported previously: 1) courses that would be offered would be EE-230 and 231 and 2) interested faculty are Kapadia, Khaliq, Mandojana, and Winstead.

5. Khaliq went home sick this afternoon so the procedure and timetable for review of materials and decision regarding the submission for promotion from Kapadia will be announced later.

6. Allen distributed a list of general education courses for engineering technology majors that cover multiple categories. This list should aid students to complete their degree programs in the minimum 128 credits and the list should be used during pre-registration reviews on Thursday and Friday. A copy is attached.

7. Upon suggestion by the Dean the department agreed to drop the courses listed below because they will not be included in the revised programs:

EE-101, 380, 462
EET_101, 225, 230, 400, 480, 488, 489
Electrical and Computer Engineering and Technology Department
Program and Course Assessment

**Educational Objective Assessment (1-5 years after graduation)**
Efforts are made to contact graduates of all department programs for at least five years following graduation. Surveys are used based on the major that ask graduates for their impressions on how their program of study prepared them for their career. Information from these surveys is fed back into the program to make improvements. Both students and faculty are involved in this effort.

**Constituent Input**
Input from Internship employers is gathered through internship reports to assist in program assessment and improvement. Further input is obtained by faculty through the use of company survey forms to determine specific company skill set needs. Information from these surveys and reports is used to refine curriculum to better meet the needs of employers as they use ever evolving technologies.

**Course Assessment**
Outcomes are established for each course that map to the required ABET a-k outcomes for each of the degree offerings. Each instructor in the ECET department is responsible for assessing student competency in each course outcome area. This information is gathered each semester and is reviewed by the department assessment committee which then makes recommendations to the ECET faculty regarding possible improvement areas. All department faculty scan examples of student work to create assessment portfolios to support our accreditation and assessment efforts.

**Student Input for Assessment**
Input from students in all department programs is solicited by a student advisory board meeting and through the use of online surveys supported through MSU assessment office. The surveys are offered students each semester and solicit and analyze responses by program of study and by year in the program. As with all of the other assessment tools this information is fed back into the assessment loop to support program improvement efforts.
Bill Hudson,

I am writing to acknowledge that your department has been keeping the CIS department informed of your intended curricular changes that include dropping several COMS courses from your CE and CET majors. I understand that these changes reflect the feedback you have received from your advisory board, and I have been happy to work with you on providing some replacement courses that make sense (CS 320 and CS 360) for your majors.

Sincerely,

David Haglin

Dr. David J. Haglin, Chair
Computer and Information Sciences Department
Minnesota State University, Mankato, MN 56001
http://theory.cs.mnsu.edu/haglin
Hudson, William B

From: Haglin, David
Sent: Tuesday, February 20, 2007 2:45 PM
To: Hudson, William B
Subject: EE Students in CS 220

Bill Hudson,

I understand you have proposed changes to your EE major whereby your students will be required to take our CS 220(3) and a 1-credit ECET lab course. Our CS majors will be taking the same CS 220(3) lecture course along with a CS 221(1) lab. I believe the blending of EE and CS students in the CS 220(3) will enhance and broaden the discussion without losing focus on material. We welcome this opportunity for our CS students to interact with your EE students in these courses. We anticipate proposing the change from CS 220(4) to CS 220(3) and CS 221(1) by March 1, 2007 to accommodate this blending of curricular experience for the students in our respective programs.

Sincerely,

David Haglin

----
Dr. David J. Haglin, Chair
Computer and Information Sciences Department
Minnesota State University, Mankato, MN 56001
http://theory.cs.mnsu.edu/haglin

2/21/2007
Minnesota State Colleges and Universities

PROGRAM REDESIGN APPLICATION

RELATED POLICY or STATUTE: MS 1996, Ch. 368, Sec. 33; MS 1995, Ch. 248, Article 11, Sec. 10; and MS 1996, Ch. 398, Sec. 38; Board Policy 3.14, 3.17, 3.19

[This form is designed for electronic use. You should have some familiarity with the Word table-making function. Enter your information in the correct box on the Tables below.] Please submit an individual form for each program you are redesigning. Multiple changes to the same program may be made on the same form. You may delete all the tables that do not apply to your redesign request.]

SECTION I: DESCRIPTION OF CURRENTLY APPROVED PROGRAM

<table>
<thead>
<tr>
<th>8-Digit/CIP#</th>
<th>Program Name</th>
<th>Electrical Engineering</th>
<th>Award</th>
<th>Bachelor</th>
<th>of Science</th>
<th>Cr Length</th>
<th>128</th>
<th>Location's MSU, Mankato</th>
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</tbody>
</table>

Name of affiliated educational institution that offers one or more credits in this program: None

Is this award jointly offered: Yes No - No

SECTION II: PROPOSED CHANGES TO PROGRAM

Effective start date(s): Fall 2007

Rationale for Proposed Change(s): Support update of Electrical Engineering curricula

Section IIA: NAME CHANGE

Current: Proposed:

Section IIB: CIP CHANGE*

Current: Proposed:

Current Program Outcomes: Proposed Program Outcomes:

*Contact staff to determine whether change is permitted as a redesign, or whether a new program proposal is required.

Section IIC: CHANGE CREDIT LENGTH WITHIN POLICY

Previous: Proposed:

Section IID: CHANGE CREDIT LENGTH TO EXCEED POLICY

Credit length beyond the policy limits will be approved only if one or more of the following conditions exist: a) the length is required by a state or national licensing body or other regulatory agency, accrediting association, or board; b) the program is employer-sponsored where the employer specifies the required credits as a condition for conferring the award; or c) a formal task analysis has been conducted within the last three years and the results endorsed by an advisory committee. Request for a program length in excess of policy from a professional association or advisory committee is not sufficient for approval.

Previous Length: Proposed Length:
State Rationale for Exceeding Policy Limits (Attach evidence as appropriate in an appendix):

### Section IIE: ADD CURRICULUM ALTERNATIVE/S*

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Option or Emphasis or certificate that is a subcredential of existing award (choose one):

Courses unique to this alternative:

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<th>COURSE TITLE/NUMBER</th>
<th>Number of Credits</th>
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</tbody>
</table>

*Change in Curriculum Alternative/s: If you are adding multiple alternatives to a single program, please identify each separately and list courses separately by copying and pasting this section as many times as necessary.

### Section IIIF: DELETE EXISTING CURRICULUM ALTERNATIVE/S*

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*Delete Curriculum Alternative/s: If you are deleting multiple alternatives, identify each separately. Add additional lines as necessary.

### Section IIG: AWARD CHANGE

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List courses for both current award and proposed award
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**Section IIH: CREATE NEW AWARD IN RELATED ACADEMIC AREA**

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Please list all courses for the new award below:

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<th>Number of Credits</th>
<th>EXISTING COURSE/S</th>
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</table>

*Creating new awards in related academic areas: Before completing this section, contact Academic Program staff to verify that you can make these proposed changes as redesigns. If you are adding awards in multiple related areas, identify each*
SECTION III: REDESIGNED PROGRAM SUMMARY

Program Requirements:

Complete this section if the number of credits in the award has increased from the previous design, or if it is a new award.

Use the following headings to provide information on each of the components in the program. List all credit totals required for the students to graduate, including prerequisites. If this application is for multiple awards (AAS and/or diplomas and/or certificates) duplicate this table and list requirements for each award separately.

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<th>Previous Credits</th>
<th>Proposed Credits</th>
</tr>
</thead>
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<td>29</td>
</tr>
<tr>
<td>Prerequisites Math, Chem, Physics, Coms</td>
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</tr>
<tr>
<td>Major-Core ME, EE</td>
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<td>58</td>
</tr>
<tr>
<td>Major-Alternative (see above)</td>
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</tr>
<tr>
<td>Major-Restricted Electives</td>
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<td>7</td>
</tr>
<tr>
<td>Required Minor (or est. 20 credits)</td>
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</tr>
<tr>
<td>Free Electives</td>
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</tr>
<tr>
<td>TOTAL PROGRAM CREDITS</td>
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<td>128</td>
</tr>
</tbody>
</table>

SECTION IV: APPROVAL VERIFICATION

Application Author: William B Hudson
Title: Professor and Chair Electrical and Computer Engineering and Technology
Campus: Minnesota State University, Mankato
Phone and E-Mail: 507-389-5639 william.hudson@mnsu.edu

Approval Chief Academic Officer: [Signature]
Approval of President: [Signature] 4/19/03
Present:  Harry Petersen (AMET), Gregg Marg (Biology for Beth Lavoie), Jim Rife (Chemistry/Geology), Gregg Asher (CIS), Julio Mandojana (ECET), Dan Singer (Math/Statistics), Karen Chou (ME/CivE), Youwen Xu (Physics/Astronomy), Mahbubur Syed (UCAP Representative for CSET).

1. The meeting was called to order at 5:05 PM.
2. The minutes of 10-31-2006 meeting were approved as written.
3. Karen Chou reported that the proposals which were approved by the Committee and have all required documents have been moved forward to UCAP. However, although proposals 734 and 717 were approved by the Committee, when they reached UCAP the signature pages were missing. Karen will sign the proposals and return them back to UCAP.
4. Karen Chou summarized the proposals that will be reviewed in this meeting.
5. The Committee reviewed and approved 28 proposals.
6. Proposals 711, 712, 748, 749 have been resubmitted and renumbered to 7269, 7270, 7271 and 7272, and the Committee approved the later ones.

Meeting adjourned at 5:55 PM.

Respectfully submitted,

Youwen Xu, Secretary
Electrical Engineering
College of Science, Engineering and Technology
Department of Electrical & Computer Engineering and Technology
137 Trafton Science Center S • 507-392-5747
Web site: www.cset.mnsu.edu/ecet

Chair: Bill Hudson, Ph.D.
Program Coordinator: Julio Mandojana, Ph.D.

Gale Allen, Ph.D.; Mark Dvorak, Ph.D.; Tom Hendrickson, Ph.D.; Han-Way Huang, Ph.D.; Bill Hudson, Ph.D.; Rajiv Kapadia, Ph.D.; Muhammad Khaliq, Ph.D.; Paul Lindfors, Ph.D.; Julio Mandojana, Ph.D.; Ramakrishna Nair, Ph.D.; Vincent Winstead, P.E., Ph.D.; Qun Zhang, Ph.D.

Electrical Engineering (EE) encompasses research, development, design and operation of electrical and electronic systems and their components. This program leads to a Bachelor of Science in Electrical Engineering (BSEE). The primary objective of the Electrical Engineering program is to educate engineering professionals who possess a sound design and analytical background coupled with a strong laboratory experience. This means that the department prepares its Electrical Engineering graduates for:

1. Entry into the engineering work environment with well developed design and laboratory skills.
2. Further study toward advanced degrees in engineering and other related disciplines.
3. Advancement into managerial ranks and/or entrepreneurial endeavors.

The educational objectives for our Bachelor of Science in Electrical Engineering degree are to prepare our graduates to:

1. Function as responsible members of society with an awareness of the social, ethical, and economic ramifications of their work.
2. Become successful practitioners in engineering and other diverse careers.
3. Succeed in full-time graduate and professional studies.
4. Pursue continuing and lifelong learning opportunities.
5. Pursue professional registration.
6. Provide foundational education that allows for personal growth and flexibility through their career.

Our metrics for determining success in meeting these objectives will include:

1. Assessment of societal, economic awareness, and ethical performance of our graduates by the graduate and employer.
2. Monitoring of the success of our graduates in the work force.
3. Monitoring of the success of our graduates in graduate and professional programs.
4. Assessment of continuing and life-long learning by the graduate (and their employer as applicable).
5. Reviewing the number and success of our students completing professional registration to advance their careers.

The Electrical Engineering degree curriculum includes the following components:

1. A strong background in the physical sciences, mathematics, and the engineering sciences including extensive hands-on laboratory instruction.
2. An integrated design component including instruction in basic practices and procedures, creativity, control, economics, and synthesis. The process begins with basic instruction during the freshman year and concludes with a capstone design project.
3. A choice of several sub-disciplines in their senior level elective offerings (digital, controls, communications, microelectronics design and fabrication).
4. Opportunities for students to develop sensitivity to the social and humanistic implications of technology and motivate them to make worthwhile contributions to the profession and society, while upholding the highest standards of professional ethics.
5. Courses in business and economics to promote awareness of management and the economic aspects of engineering.
6. Preparation for continuing study and professional development.

The curriculum offers students the opportunity to emphasize a number of specialized areas including digital systems, communications, controls, and microelectronic design and fabrication.

During the senior year, students must take the first step toward registration as a professional engineer by taking the Fundamentals of Engineering (FE) examination.

The Electrical Engineering program is accredited by the Engineering Accreditation Board for Engineering and Technology (ABET).

Minnesota State Mankato offers a 3/2 program with regional Liberal Arts colleges. Contact the department for more information.

Recommended high school preparation is two years of algebra, one year of geometry, one-half year of trigonometry, one-half year of college algebra, and a year each of physics and chemistry. Without this background it may take longer than four years to earn the degree. The first two years students take science and mathematics courses common to all branches of engineering (pre-engineering), as well as supporting work in English, humanities and social sciences. Second-year electrical engineering students complete physics, mathematics and 200-level engineering science courses. Some specialization for a particular engineering major occurs in the second year.
Admission to Major. Admission to the college is necessary before enrolling in 300- and 400-level courses. Minimum college admission requirements are:
- a minimum of 32 earned semester credit hours.
- a minimum cumulative GPA of 2.00 (C).
Contact the department for application procedures.

During the sophomore year, students should submit an application form for admission to the electrical engineering program. Admission to the program is selective and, following application to the department, subject to approval of the faculty. The department makes a special effort to accommodate transfer students. Only students admitted to the program are permitted to enroll in upper-division EE courses. No transfer credits are allowed for upper-division EE courses except by faculty review followed by special written permission.

Before being accepted into the program and admitted to 300-level electrical engineering courses (typically in the fall semester), a student must complete a minimum of 48 semester credits including the following:
- General Physics (calculus-based) (10 credits)
- Calculus and Differential Equations (16 credits)
- Electrical Engineering Circuit Analysis I and II (including laboratory) (7 credits)
- Chemistry (5 credits)
- English Composition (4 credits)
- Computer Sciences (C, or C++) (2 credits)
- Statics (3 credits)
A cumulative grade-point average of 2.5 for all science, math and engineering courses must have been maintained. Grades must be "C" or better for courses to be accepted. Minnesota State Mankato students should complete the pre-engineering courses listed under the major.

GPA Policy: Students graduating with a degree in Electrical Engineering must have 1) completed a minimum of 20 semester credit hours of upper division EE course work; 2) have a cumulative GPA of 2.25 or higher in all upper division Minnesota State Mankato EE coursework; 3) have completed their senior design sequence at Minnesota State Mankato; and 4) have taken the FE exam and achieved the competency level set by the department.

Petition to evaluate transfer credits must occur no later than the first semester the student is enrolled at Minnesota State Mankato.

All international students wishing to have transfer credits granted from non-U.S. schools will be required to use the ECE evaluation service.

P/N Grading Policy: A student who majors in EE must elect the grade option for all courses even if offered by another department.

ELECTRICAL ENGINEERING BSEE

Required for Major (Prerequisites, 45 credits):
CHEM 201 General Chemistry I (5)
CS 171 Introduction to C++ Programming (3)
EE 230 Circuit Analysis I (3)
EE 231 Circuit Analysis II (3)
EE 240 Evaluation of Circuits (1)
ENG 101 Composition (4)
MATH 121 Calculus I (4)
MATH 122 Calculus II (4)
MATH 223 Calculus III (4)
MATH 321 Ordinary Differential Equations (4)
ME 212 Statistics (3)
PHYS 221 General Physics I (5)
PHYS 222 General Physics II (5)

Required for Major (General Studies, 13 credits):
ENG 271 Technical Communication (4) or
SPEE 233 Public Speaking for Technical Professionals (3)
* SPEE 102 Public Speaking (3) may be substituted.
Choose a minimum of 13 credits from Humanities and Social Sciences courses:

Humanities (6-7 credits)
HUM xxx HUM xxx HUM xxx
In general, graduation credit toward the humanities requirement is not allowed for any course in subject areas such as speech communication, writing, art, music, or theatre that involve performance or practice of basic skills.
Courses acceptable by department or program include:
ART 160 ART 260 ART 261 ART 413 ART 416 ART 419 ART 460
ART 462 ART 463 ART 466 ART 469 ENG 112W ENG 113W ENG 114
ENG 320 ENG 321 ENG 325 ENG 327 ENG 328 ENG 331 ENG 332
ENG 400 ENG 401 ENG 402 ENG 403 ENG 405 ENG 406 ENG 416
FOREIGN LANGUAGE 200 level or above;
HIST all except HIST 490 and higher;
HUM 150  HUM 155  HUM 250W*  HUM 280W HUM 281W  HUM 282  MASS 110
MASS 411  MASS 412  MUS 120  MUS 125  MUS 126  MUS 220  MUS 221
MUS 222  MUS 422  MUS 423  MUS 424  MUS 425  MUS 426  MUS 429
MUS 432
PHIL all except PHIL 490 and higher;
SPEE 203  SPEE 300  SPEE 315  SPEE 403  SPEE 412  SPEE 413  THEA 100
THEA 252  THEA 285W  THEA 481

For other acceptable courses, please consult with your advisor.
*Note: EET 125 may be substituted for HUM 250W

Social Sciences (6-7 credits)
SS  xxx  SS  xxx  SS  xxx
Courses acceptable by department or program include:
ANTH all courses except ANTH 480 and above;
GEOG 100  GEOG 101  GEOG 103  GEOG 340  GEOG 341  GEOG 425  GEOG 430
GEOG 435  GEOG 437  GEOG 445  GEOG 446  GEOG 450  GEOG 454  GEOG 456
POL all except:
POL  420  POL  421  POL  422  POL  490  and above;
PSYC all except:
PSYC 201  PSYC 202  PSYC 291  PSYC 303  PSYC 390  PSYC 391  PSYC 473  and above;
SOC all except:
SOC 201  SOC 202  SOC 466  SOC 469  SOC 470  SOC 485  and above;
URBS all except:
URBS 301  URBS 302  URBS 481  and above;
WOST all except:
WOST 260  WOST 277  WOST 290  WOST 320  WOST 430  WOST 460 and above. For other acceptable coursework, please consult your advisor.

At least 3 credits of the courses selected to complete the above requirements must be 300 level or above. At least one 300 level course must follow a lower level course in the same subject area.

Choose one course from the following:
ECON201  Principles of Macroeconomics (3)
ECON202  Principles of Microeconomics (3)

Required Core for Major (Engineering, 51 credits):
EE 101  Introduction to Engineering I (4)
ME 103  Computer Graphics Communication (4)
EE 244  Introduction to Digital Systems (3)
EE 264  Digital and Circuits Lab (4)
EE 106  Introduction to EE and CE I (3)
EE 107  Introduction to EE and CE II (3)
EE 235  Microprocessor Engineering Lab I (1)
EE 303  Introduction to Solid State Devices (3)
EE 304  Lab: Introduction to Solid State Devices (1)
EE 332  Electronics I (3)  -- credit change
EE 333  Electronics II (3)  -- credit change
EE 344  Microprocessor Engineering (3)
EE 335  Principles of Engineering Design I (1)
EE 337  Principles of Engineering Design II (1)
EE 341  Signals and Systems (3)
EE 342  Electronics Laboratory (1)
EE 344  Design and Evaluation of Microprocessors (4)
EE 350  Engineering Electromagnetics (3)  -- credit change
EE 353  Communication Systems Engineering (3)  -- credit change
EE 358  Control Systems (3)
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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>EE 363</td>
<td>Communication Systems Laboratory (1)</td>
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<tr>
<td>EE 366</td>
<td>Control Systems Laboratory (1)</td>
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<tr>
<td>EE 381</td>
<td>Digital Systems Design with Testability (3)</td>
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<tr>
<td>EE 382</td>
<td>Digital System Design with Testability Lab (1)</td>
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<tr>
<td>EE 457</td>
<td>Principles of Engineering Design III (1)</td>
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<td>EE 477</td>
<td>Principles of Engineering Design IV (1)</td>
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<tr>
<td>EE 482</td>
<td>Electromechanics (3)</td>
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<tr>
<td>EE 488</td>
<td>Thermal Systems Engineering (2) OR</td>
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<tr>
<td>ME 299</td>
<td>Thermal Analysis (2)</td>
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<tr>
<td>ME 291</td>
<td>Engineering Analysis (3) OR</td>
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<tr>
<td>MATH 354</td>
<td>Concepts of Probability and Statistics (3)</td>
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<tr>
<td>CS 220</td>
<td>Machine Structures and Programming (3)</td>
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**Required for Major (Business, 6 credits):**

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<th>Course Code</th>
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<tr>
<td>EE 450</td>
<td>Engineering Economics (3)</td>
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</tbody>
</table>

Choose one course from the following list:

BLAW 200, FINA 362, MGMT 330 or MGMT 440, MRKT 310

**Required Electives for Major (7 credits):**

Choose a minimum of 7 credits from the following courses. Two courses must be in sequence (same subject area):

<table>
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<th>Course Code</th>
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<tbody>
<tr>
<td>EE 453</td>
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<td>EE 487</td>
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**Required Minor: None.**

No minor or other major accepted toward degree.

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**COURSE DESCRIPTIONS**

**EE 101: (1) Introduction to Engineering I**
Discussion of historical, educational, and professional aspects of engineering. Problem-solving, study approaches and techniques, and the motivation behind modern engineering education and practices. Lab sessions cover the basics of word-processing, spreadsheets, databases, drawing, and graphing programs as well as preparation of plan-to-graduation and study techniques.

Fall

EE 106 (3) Introduction to EE and CE I

(Add course description.)

EE 107 (3) Introduction to EE and CE I

(Add course description.)

**EE 230 (3) Circuit Analysis I**

This course is meant to develop Electrical Engineering Circuit Analysis skills in DC and AC circuits. It includes circuit laws and theorems, mesh and node analysis, Natural and step response of RL, RC, and RLC circuits.

Pre: PHYS 222 or concurrent, MATH 321 or concurrent

Fall

EE 231 (3) Circuit Analysis II

Continuation of Circuit Analysis I to include special topics in circuit analysis.

Pre: EE 230 and EE 240, MATH 321, PHYS 222

Spring

EE 235 (1) Microprocessor Engineering Lab I

(Add course description.)

**EE 240 (1) Evaluation of Circuits**


Prerequisites: Must be taken concurrently with EE 230.
EE 244 (2) Introduction to Digital Systems
Simple coding schemes, Boolean algebra fundamentals, elements of digital building blocks such as gates, flip-flops, shift registers, memories, etc.; basic engineering aspects of computer architecture.

EE 250 (3-2) Engineering-Economics
Overview of accounting and finance and their interactions with engineering, manufacturing, marketing, R&D, and sales. Lectures include the development and analysis of financial statements, time-value of money, decision-making tools, ratio analysis, cost of capital, depreciation, taxes, cash flow, rate of return, and forecasting.

EE 253 (1) Logic Circuits Lab
Laboratory support to complement EE 244. Use of laboratory instrumentation to measure characteristics of various logic circuits and digital subsystems. Experimental evaluation of digital logic devices and circuits including logic gates, flip-flops, and sequential machines. Prerequisite: EE 230 and concurrent with EE 244.

EE 254 (1) Digital and Circuits Lab
Laboratory support for EE 231 and EE 244. Experimental evaluation of AC and transient circuits, digital logic devices including logic gates, flip flops, and sequential machines. Pre: EE 230, EE 240 and concurrently with EE 231 and EE 244

EE 298 (1-4) Topics
Varied topics in Electrical and Computer Engineering. May be repeated as topics change. Prerequisite: to be determined by course topic.

EE 303 (3) Introduction to Solid State Devices
Introduction to crystal structure, energy band theory, conduction and optical phenomenon in semiconductors, metals and insulators. Study of equilibrium and non-equilibrium charge distribution, generation, injection, and recombination. Analysis and design of PN-junctions, (bipolar transistor, junction) and MOS field-effect transistors. Introduction to transferred electron devices and semiconductor diode laser. Pre: PHYS 222, and MATH 321

EE 304 (1) Lab: Introduction to Solid State Devices
Laboratory support for EE 303. Experiments include resistivity and sheet resistance measurements of semiconductor material, probing material, probing of IC chips, PN-junction IV and CV measurements, BJT testing to extract its parameters, MOSFET testing and evaluating its parameters, cv-measurements of MOS structure, and familiarization with surface analysis tools.

EE 332 (3) Electronics I
Electronic amplifier concepts and real operational amplifier networks. Semiconductor device characteristics include diodes, BJT’s, JFET’s, MOSFET’s. Also discuss DC bias circuits along with small signal, large signal, and SPICE device modeling and analysis. Small-signal (single and multi-stage), power amplifiers, differential amplifiers, and feedback amplifier concepts and design will be discussed.

EE 333 (3) Electronics II
This is the second course of the electronics sequence. Design and analysis skills will be developed by examining the 741 and related devices. Additional course topics include filters, tamed circuits, signal generators, and wave-shaping. Digital circuits including the basics of various forms of MOS and bipolar digital logic and memory will be studied.
Pre: EE 332

EE 334 (3) Microprocessor Engineering
Use of microprocessors and microcontrollers in engineering applications. Topics include assembly language programming, smart and programmable controllers, memory design including dynamic memory and direct memory access, bus standards and protocol, serial and parallel I/O, interfacing with other programmable systems, maskable and non-maskable interrupts.
Pre: EE 244

EE 336 (1) Principles of Engineering Design I

(Add course description.)

EE 337 (1) Principles of Engineering Design II
--title change
Application of the design techniques in the engineering profession. Electrical engineering project and program management and evaluation including computer assisted tools for planning and reporting, design-to-specification techniques and economic constraints.  
Pre: Admission to EE program  
Spring

EE 341 (3) Signals & Systems  
Analysis of linear systems and signals in the time and frequency domain. Laplace and Fourier transforms. Z-transform and discrete Fourier transforms.  
Pre: MATH 321  
Fall

EE 342 (1) Electronics Laboratory  
This lab is designed to accompany EE 332. The lab covers the experimental measurement and evaluation of diode, BJT, and MOS characteristics; various feedback topologies; oscillator and op-amp circuits; and rectifiers and filter circuitry.  
Pre: EE 231 and EE 332 taken concurrently.  
Fall

EE 344 (1) Design & Evaluation of Microprocessors  
Laboratory support for EE 334. Study of various single board computers through assembly language programming. Basic input/output, ports, memory, addressing, timers, A/D converters, seria and parallel communication protocol, and interrupt processing.  
Pre: Concurrent with EE 334  
Fall

EE 350 (3) Engineering Electromagnetics  
Pre: MATH 223 and PHYS 222  
Spring

EE 353 (3) Communication Systems Engineering  
Pre: EE 332  
Spring

EE 358 (3) Control Systems  
Pre: EE 341  
Spring

EE 363 (1) Communication Systems Laboratory  
Pre: Concurrent with EE 353  
Spring

EE 368 (1) Control Systems Laboratory  
Laboratory support for EE 358. Experimental evaluation of basic control system concepts including transient response and steady state performance. Analog and digital computers.  
Pre: EE 341 and concurrent with EE 358  
Spring

EE 390 (2) Logic Synthesis and Simulation using HDLs  
Design of combinational and sequential systems and peripheral interfaces. Emphasis is placed on hardware description languages, computer-aided tools, simulations and implementation.

EE 381 (3) Digital System Design with Testability  
(Add course description)

EE 382 (1) Digital System Design with Testability Lab  
(Add course description)
EE 439 (3) Electronics for Non-Electrical Engineering Majors
Topics covered include power supplies, operational amplifiers and feedback circuits, linear and nonlinear circuits and applications, analog switches, digital logic gates and devices, A/D and D/A converters, microprocessors, and basic control systems.
Pre: PHYS 221 and PHYS 222
Variable

EE 460 (3) Engineering Economics

(Add course description.)

EE 453 (3) Advanced Communications Systems Engineering
Behavior of analog systems and digital systems in the presence of noise, principles of digital data transmission, baseband digital modulation, baseband demodulation/detection, bandpass modulation and demodulation of digital signals. Channel coding, modulation and coding trade-offs, spread spectrum techniques, probability and information theory.
Pre: EE 353 and EE 363
Fall

EE 462 (3)-Computer Architecture
A study of various computer architectures including concepts of instruction, execution, instruction pipeline, superscalar design, multiprocessor systems, memory system design, and I/O system design.

EE 463 (3) Advanced Digital System Design
Design of combinational and sequential systems and peripheral interfaces. Design techniques using MSI and LSI components in an algorithmic state machine; implementation will be stressed. Rigorous timing analysis transmission-line effects and metastability of digital systems will be studied.
Prerequisite: EE 244

EE 467 (1) Principles of Engineering Design III -- credit & title changes
The design and organization of engineering projects. Project proposals, reporting, feasibility studies, and interpretation. Specification preparation, interpretation, and control. Issues involving creativity, project planning and control, and intellectual property rights. Students enrolled in this course must initiate and complete a design project in a small team format.
Pre: EE 337 and senior standing
Fall

EE 471 (3) Advanced Control Systems
This course is a continuation of EE 358. Techniques for the analysis of continuous and discrete systems are developed. These techniques include pole placement, state estimation, and optimal control.
Pre: EE 358 and EE 368
Fall

EE 472 (3) Digital Signal Processing
Develop design and analysis techniques for discrete signals and systems via Z-transforms, Discrete Fourier Transforms, implementation of FIR and IIR filters. The various concepts will be introduced by the use of general and special purpose hardware and software for digital signal processing.
Pre: EE 341
Spring

EE 475 (3) Integrated Circuit Engineering
Introduction to theory and techniques of integrated circuit fabrication processes, oxidation, photolithography, etching, diffusion of impurities, ion implantation, epitaxy, metallization, material characterization techniques, and VLSI process integration, their design and simulation by SUPREM.
Pre: EE 303 and EE 332
Fall

EE 476 (3) Antennas, Propagation, & Microwave Engineering
Principles of electromagnetic radiation, antenna parameters, dipoles, antenna arrays, long wire antennas, microwave antennas, mechanisms of radiowave propagation, scattering by rain, sea water propagation, guided wave propagation, periodic structures, transmission lines, microwave/millimeter wave amplifiers and oscillators, MIC & MMIC technology.
Pre: EE 350
Variable

EE 477 (1) Principles of Engineering Design IV -- credit & title changes
Completion of design projects and reports. Lectures on ethics, issues in contracting and liability, concurrent engineering, ergonomics and environmental issues, economics and manufacturability, reliability and product lifetimes. Lectures by faculty and practicing engineers.
Pre: EE 467
Spring
EE 479 (3) Superconductive Devices
Pre: EE 303
Variable

EE 480 (1) Integrated Circuit Fabrication Lab
Introduction to integrated circuit fabrication processes, device layout, mask design, and experiments related to wafer cleaning, etching, thermal oxidation, thermal diffusion, photolithography, and metallization. Fabrication of basic integrated circuit elements pn junction, resistors, MOS capacitors, BJT and MOSFET in integrated form. Use of analytic tools for in process characterization and simulation of the fabrication process by SUPREM.
Pre: Concurrent with EE 475
Fall

EE 481 (1) VLSI Design Laboratory
This laboratory accompanies EE 484. The laboratory covers the basics of layout rules, chip floor planning, the structure of standard cells and hierarchical design, parasitic elements, routing, and loading. Students will learn to design and layout standard cells as well as how to use these cells to produce complex circuits. The laboratory culminates with the individual design and layout of a circuit.
Pre: Concurrent with EE 484
Spring

EE 482 (3) Electromechanics
Electrical power and magnetic circuit concepts, switch-mode converters, mechanical electromechanical energy conversion, DC motor drives, feedback controllers, AC machines and space vectors, permanent magnet AC machines and drives, induction motors and speed control of induction motors, stepper motors.
Pre: EE 230
Fall

EE 484 (3) VLSI Design
Pre: EE 333
Spring

EE 487 (3) RF Systems Engineering
Pre: EE 353 and EE 363
Spring

EE 488 (2) Thermal Systems Engineering
Pre: PHYS 222 and EE 333
Variable

EE 491 (1-4) In-Service

EE 497 (1-6) Internship

EE 498 (1-4) Topics
Varied topics in Electrical and Computer Engineering. May be repeated as topics change. Prerequisite: to be determined by course topic

EE 499 (1-6) Individual Study